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The Remington-Lee Magazine Gun

Sectional View of Magazine

FARROW'S

MILITARY ENCYCLOPEDIA

A DICTIONARY OF MILITARY KNOWLEDGE

ILLUSTRATED

WITH MAPS AND ABOUT THREE THOUSAND WOOD ENGRAVINGS

BY

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"What is obvious is not always known, and what is known is not always present."—JOHNSON.

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DEDICATED

TO THE

NATIONAL GUARDS OF AMERICA

In Appreciation of their Enterprise and Valor

AND AS A TRIBUTE OF HOMAGE

TO

GALLANT SOLDIERS.

PREFATORY NOTICE.

The design of this work is that of a Library of Military Knowledge for the People—not a mere collection of elaborate treatises in alphabetical order, but a work to be readily consulted as a Dictionary on every military subject on which people generally require some distinct information—no article being longer than is absolutely necessary. The several topics are not handled with a view to the technical instruction of those who have to make a special study of particular branches of military knowledge or art. The information given may be characterized in many instances as *non-professional*, embracing those points of the several subjects which every intelligent man or woman may have occasion to speak or think about. At the same time every effort is made that the statements, so far as they go, shall be precise and scientifically accurate.

Although about 30,000 subjects have been compiled from the various publications and records of the War Department, Foreign War Offices, and Military Works of reference, more than 5000 original articles have been prepared by specialists in America and abroad. While the Tactics, Ordnance, Gun Machinery, Implements, and Equipments of all ages and of all military powers have been fully described and illustrated under appropriate headings, a complete system of cross-references enables the military student to quickly locate several hundred articles pertaining to the general subject under investigation. Thus, under the article Magazine Gun will be found the following references: *Boch*, *Buffington*, *Bullard*, *Burgess*, *Burton*, *Chaffee-Reece*, *Clemmons*, *Colt*, *Dean*, *Elliott*, *Franklin*, *Hunt*, *Lee*, *Lewis-Rice*, *Miller*, *Remington*, *Russell*, *Spencer-Lee*, *Springfield-Jones*, *Tiesing*, *Trabue*, *Whitney*, and *Winchester Magazine Guns*. Under each of these articles are references to articles describing and illustrating all other arms of the respective classes. The Compiler has made special effort to set forth in detail the numerous decisions, rendered by the War Department and Tactical Department at West Point, on the tactical points raised and submitted from time to time by the Officers of the Army and National Guard. The descriptions and illustrations of more than 500 varieties of Gun Machinery, Steam Hammers, Cranes, etc., constitute a novel feature of the work to be appreciated by those wishing to investigate the subjects of construction, testing, etc.

The original plan has been strictly adhered to throughout; and if, as the work proceeded, there has been any change in the method or quality of the execution, it may at least be affirmed that the change has not been for the worse. After some experience, it became easier to find the person specially qualified to write a particular kind of article, and thus the circle of contributors became widened, and the distribution of the work more special ized. It was also seen to be desirable, in regard to certain classes of subjects, to admit a rather ampler selection of heads. This has been effected without increasing the scale of the work, not so much by less full treatment of the subjects, as by increased care in condensing the statements and omitting everything superfluous. A great quantity of matter pertaining to Foreign Armies has been introduced in this work, so as to enable the military student to compare the organization, arms, etc., of all armies with those of his own service. The Encyclopedia contains also descriptions of ancient armor, and of arms, lately in use, which have become obsolete, as it may be of some interest to follow the changes which have taken place in the mode and means of fighting from the earliest period down to the present time. The insertion of veterinary terms and of remedies for the common complaints of horses will be found useful under conditions where a Veterinary Surgeon is not available, as is often the case in detached parties of Cavalry. A description of all tools and machines found commonly in workshops may prove acceptable to Departmental Officers on their first joining Government Manufacturing Establishments.

Of the Sciences, the least adapted to encyclopedic treatment is Mathematics. All terms of common occurrence in Gunnery, Reconnoissance, etc., however, have been introduced, and a brief exposition of the subjects given, as far as could be done in an elementary way. Natural Philosophy has received ample attention, and all the leading doctrines and facts of general interest will be found under their appropriate heads, treated in a popular way, and divested as far as possible of the technicalities of mathematics. Chemistry, some knowledge of which is becoming daily more indispensable in all departments of military life, receives a comparatively large space. Prominence has been given to those points of the subject that have either a direct practical military bearing or a special scientific interest. During the progress of the work, several changes in the nomenclature and notation of the Science have come into general use; these have been duly noted under the appropriate headings. The new and far-reaching doctrines of the Correlation of Forces and the Conservation of Energy have produced vast changes in the nomenclature and classification of the various sections of Military Physics; while the more complete investigations into the phenomena and laws of light, heat, motion, and electricity have created virtually new sections, which must find a place in any adequate survey of scientific progress. Mechanical invention has, indeed, so kept pace with the progress of Military Science and the Art of War, that in almost every department of Physics improved machines and processes have to be described, as well as new discoveries and altered points of view. The manufacture of gunpowder and high explosives is a signal instance of the extent to which in our day scientific discovery is indebted to appropriate machinery and instruments of observation and analysis. These extensive changes in Physics involve corresponding changes in the method of their exposition. The scientific department of the work is consequently treated in all its branches in the most effulgent manner, and over 1000 very fine engravings are used for the purpose of illustration.

True to its projected plan as a LIBRARY OF MILITARY KNOWLEDGE FOR THE PEOPLE, this Encyclopedia will be found to be especially rich in notices of miscellaneous military matters. Some of the subjects introduced might perhaps be considered beneath the dignity of a book aspiring to a more severely scientific character; but all of them are, if not instructive, at least curious or entertaining, and likely to occur in the course of reading or conversation. During the progress of the work, the Compiler has received numerous assurances from parents as to how highly it was prized, even though only partly issued, by their sons at Military Schools, as a repertory of the kind of things they are constantly in search of and often puzzling their elders about. This use of the Encyclopedia has been steadily kept in view; and it is gratifying to learn that it is found efficiently to serve the purpose intended.

In conclusion, the Compiler asks the indulgence of Military Critics wherever errors or discrepancies have crept into this work, and begs to acknowledge the valuable help obtained from the works of many authors, both military and scientific, through the courtesy of Messrs. John Wiley & Sons and Mr. D. Van Nostrand, publishers, and the assistance he has received from various friends. To General Stephen V. Benét, Chief of Ordnance, United States Army, he is especially indebted for courteous assistance in the preparation of the work. To economize in space and to avoid crowding up the text, the name of the author from whom information has been derived has not been inserted after each quotation; but a list of all works which have been consulted, and from which extractions have been made, will be found at the commencement of each volume.

It is intended, with the view of meeting the changes which are constantly taking place in the *matériel* of armies, new processes, military inventions, etc., to issue a Supplement at suitable intervals, containing all alterations and additions.

UNITED STATES MILITARY ACADEMY,
West Point, New York, 1885

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ABBREVIATIONS OF MODERN TERMS, PHRASES AND TITLES EMPLOYED IN FARROW'S MILITARY ENCYCLOPEDIA.

A.A.S. (*Academiæ Americanæ Socius.*) Member of the American Academy.
A.B. (*Artium Baccalaureus.*) Bachelor of Arts.
A.B.C.F.M. American Board of Commissioners for Foreign Missions.
Abp. Archbishop.
A.C. (*Ante Christum.*) Before Christ.
A. D. (*Anno Domini.*) In the year of our Lord.
Æt. (*Ætotis.*) Of age; aged.
Al. Alabama.
A.M. (*Artium Magister.*) Master of Arts; (*Ante Meridiem*) Before noon; (*Anno Mundi*) In the year of the world.
An. (*Anno.*) In the year.
Apr. April.
A.R. (*Anno Regni.*) In the year of the reign.
Ark. Arkansas.
A.U.C. (*Anno Urbis Conditæ.*) In the year from the foundation of the city.
Aug. August.
Avoir. Avoirdupois.
B. Book; (*b.*) Born.
B.A. Bachelor of Arts.
Bal. Balance.
Bart. Baronet.
Bbl. Barrel.
B.C. Before Christ.
B.C.L. Bachelor of Civil Law.
B.D. Bachelor of Divinity.
Bd. Bound.
Bds. Bound in boards.
Benj. Benjamin.
Bk. Book.
B.L. Bachelor of Laws; Breech-loading.
B.L.R. Breech-loading rifled.
Bp. Bishop.
Brig.-Gen. Brigadier-General.
C., or *Cap.* (*Caput.*) Chapter.
Cal. California.
Cam., or *Camb.* Cambridge.
Caps. Capitals.
Capt. Captain.
C.B. Companion of the Bath
C.C.P. Court of Common Pleas.
C.E. Civil Engineer.
Cent. (*Centum.*) A hundred.
C.J. Chief Justice.
C.O. Commanding officer.
Co. Company.
Col. Colonel; Colorado.
Com. Commodore.
Conn., or *Ct.* Connecticut.
Cor. Corinthian.
Cor. Sec. Corresponding Secretary.
Crim. Con. Criminal Conversation; Adultery.
Ct. Cent.
Cts. Cents.
Cwt. Hundredweight.
D., or *d.* Penny, *or* pence.
Dan. Daniel.
D.A.Q M.G. Deputy Assistant Quarter-master-General.
D C. District of Columbia.
D.C.L. Doctor of Civil Law.
D D. (*Divinitatis Doctor.*) Doctor of Divinity.
Dea. Deacon.
Dec. December.
Del. Delaware.
Dep. Deputy.
Dept. Department.
Deut. Deuteronomy.
Deft., or *dft.* Defendant.
Dist. District.
Dist. Atty. District Attorney.
ditto, or *do.* The same.
D.M. Doctor of Music.
Dols. ($) Dollars.
Doz. Dozen.
Dr. Doctor; Debtor; Dram.
D.V. (*Deo Volente.*) God willing.
Dwt. Pennyweight.
E. East.
Ed. Edition; Editor.
Edw. Edward.
E.g., or *e.g.* (*exempli gratia.*) For example.
Eliz. Elizabeth.
E.N.E. East-North-East.
Eph. Ephesians.
Esq. Esquire.
et. al. (*et alii.*) And others.
etc., or *&c.* (*et cætera.*) And so forth.
et seq. (*et sequentia.*) And what follows.
Exod. Exodus.
Expl. Explanation.
Ez. Ezra.
Ezek. Ezekiel.
Fahr. Fahrenheit.
Feb. February.
F.G. Fine grain; Field-gun.
Fl., or *Flor.* Florida.
Fred. Frederic.
F.R.S. Fellow of the Royal Society.
F.S. Field-service.
Ft. Foot, *or* feet.
Fur. Furlong.
Ga. Georgia.
G.B. Great Britain.
G.C. Good conduct.
G.C.B. Grand Cross of the Bath.
Gen. General; Genesis.
Geo. George; Georgia.
Gov. Governor.
Gov.-Gen. Governor-General.
G.S. General service.
G.S.W. General service wagon.
H., or *h.* Hour.
Hab. Habakkuk.
H.B.M. His, *or* Her, Britannic Majesty.
H.C. House of Commons.
Heb. Hebrews.
Hhd. Hogshead.
H.L. House of Lords.
H.M. His, *or* Her, Majesty.
H.M.S. His, *or* Her, Majesty's Ship, or Service.
Hon. Honorable.
Hos. Hosea.
H.R. House of Representatives.
H.R.H. His, *or* Her, Royal Highness.
Hund. Hundred.
I., or *Isl.* Island.
Ib., *Ibid.* (*Ibidem.*) In the same place.
Id. (*Idem.*) The same.
i.e. (*id est.*) That is.
I.H.S. (*Jesus Hominum Salvator.*) Jesus the Saviour of men.
Ill. Illinois.
In. Inches.
Incog. (*Incognito.*) Unknown.
Ind. Indiana.
I.N.R.I (*Jesus Nazarenus, Rex Iudæorum.*) Jesus of Nazareth, King of the Jews.
Inst. Instant (the current month).
Io. Iowa.
i.q. (*idem quod.*) The same as.
Is. Isaiah.
It. Italics.
J. Justice; Judge.
Jan. January.
Jas. James.
Jer. Jeremiah.
Jno. John.
Jono. Jonathan.
Jos. Joseph.
Josh. Joshua.
J.P. Justice of the Peace.
Jr., or *Jun.* Junior.
Judg. Judges.
Jul. July.
Kan. Kansas.
K.B. Knight of the Bath; King's Bench.
K.C.B. Knight Commander of the Bath.
Ken., or *Ky.* Kentucky
K.G. Knight of the Garter.
K.G.C. Knight of the Grand Cross.
Ki. Kings.
Knt., or *Kt.* Knight.
L. or *lb.* Pound (weight).
L., *l.*, or *£.* Pound sterling.
La. Louisiana.
Lat. Latitude.
L.G. Large grain.
L.I. Long Island.
Lieut. Lieutenant.
LL.B. Bachelor of Laws.
LL.D. Doctor of Laws
L.L.R. Line of least resistance.
L.S. Land-service.
M., or *m.* Masculine.
M.A. Master of Arts; Military Academy.
Maj. Major.
Mar. March.
Mass. Massachusetts.
Matt. Matthew.
M C. Member of Congress.
M.D. Doctor of Medicine.
Md. Maryland.
Mdlle., or *Mlle.* Mademoiselle.
M.E. Mechanical Engineer.
Me. Maine.
Mem. Memorandum.
Messrs. Gentlemen.
Meth. Methodist.
Mich. Michigan.
Min., or *min.* Minute, *or* minutes.
Minn. Minnesota.
Miss. Mississippi.
M.L. Muzzle-loading.
M L.R. Muzzle-loading rifled.
MM. Messieurs.
Mme. Madame.
Mo. Missouri; Month.
Mons. Monsieur.
Mos., or *mos.* Months.
M.P. Member of Parliament.
M.P.P. Member of Provincial Parliament.
Mr. Master, *or* Mister.
Mrs. Mistress, *or* Missis.
M.S. Sacred to the Memory.
MSS. Manuscripts.
Mt. Mount, *or* Mountain.
M.T. Mountain train.
Mus D. Doctor of Music.
N., or *n.* North; Noun; Neuter.
N.A. North America.
Nath. Nathaniel
N.B. New Brunswick; (*Nota bene*) Note well, *or* take notice.
N.C. North Carolina; Non-commissioned.
N.C.O. Non-commissioned Officer.
N.E. North-East; New England.
Neb. Nebraska
N.F Newfoundland.
N.H. New Hampshire.
N.J. New Jersey.
N.L. North Latitude.
N.N.E. North North-East.
N.N.W. North-North-West.
No. (*Numero.*) Number.
Non seq. (*Non sequitur.*) It does not follow.
Nos. Numbers.
Nov. November.
N.P. Notary Public; New pattern.
N.S. Nova Scotia; The New Style (since 1752).
N.T. New Testament.
N.W. North-West.
N.Y. New York.
O. Ohio.
Ob. (*Obiit*) Died.
Ob., or *Obdt.* Obedient.
Oct. October.
O.P. Old Pattern.
Or. Oregon.
O.S. Old Style.
O.T. Old Testament.
Oxf., or *Oxon.* (*Oxonia.*) Oxford.
Oz. Ounce, *or* ounces.
P., or *p.* Page; Pebble.

Pa., or *Penn.* Pennsylvania.

Parl. Parliament.

Pd. Paid.

P.E.I. Prince Edward Island.

Per cent. (*Per centum.*) By the hundred.

Ph.D. (*Philosophiæ Doctor.*) Doctor of Philosophy.

Phil. Philippians.

Phila. Philadelphia.

Pinx., or *Pxt.* (*Pinxit.*) Placed after the painter's name on pictures: as, "Turner *pxt.*"

Pk. Peck.

Pl. Plural.

Pltf. Plaintiff.

P.M. Postmaster; Past Master; (*Post Meridiem*) Afternoon.

P.M.G. Postmaster-General.

P.O. Post-Office.

pp. Pages.

P.P.C. (*Pour Prendre Congé.*) To take leave.

Pr., or P. (*Per.*) By the.

Pres. President.

Prof. Professor.

Pro tem. (*Pro tempore.*) For the time being.

Prov. Proverbs; Province.

Prox. (*Proximo.*) Next (the next month).

P.S. (*Post Scriptum.*) Postscript.

Ps. Psalm, or Psalms.

Pt. Pint.

Pub Doc. Public Documents.

Pwt. Pennyweight.

Q., or *Qu.* Query; Question; Queen.

Q.B. Queen's Bench.

Q.C. Queen's Council.

Q.E.D. (*Quod Erat Demonstrandum.*) Which was to be demonstrated.

Q.M. Quartermaster.

Q.M.G. Quartermaster-General.

Qr. Quarter (28 pounds); Farthing; Quire.

Qt. Quart; Quantity.

Qv. (*Quod vide.*) Which see.

R. (*Rex*) King; (*Regina*) Queen.

R.A. Royal Academy, or Academician; Rear-Admiral; Right Ascension; Royal Artillery.

R.C.D. Royal Carriage Department.

R.E. Royal Engineers.

Rec. Sec. Recording Secretary.

Rev. Revelation; Reverend.

R.F.G. Rifle fine grain.

R.G.F. Royal gun factory.

R.I. Rhode Island.

R.L. Royal Laboratory.

R.L.G. Rifle large grain.

R.M.A. Royal Military Academy.

R.N. Royal Navy.

Rom. Roman; Romans.

Rom. Cath. Roman Catholic.

R.R. Railroad.

Rt. Hon. Right Honorable.

Rt. Rev. Right Reverend.

S. South; Signor; Shilling.

S.A. South America; Small arms.

S.A.A. Small-arm ammunition.

S. Afr. South Africa.

Sat. Saturday.

S.B. Smooth-bore.

S.C. South Carolina; Scrap-carriage.

Sc., or *Sculp.* (*Sculpsit.*) Placed after the engraver's name on a picture.

Sch., or *Schr.* Schooner.

Scil., or *Sc.* (*Scilicet.*) To wit; namely.

Script. Scripture.

S.E. South-East.

Sec. Secretary; Section.

Sen. Senate; Senator; Senior.

Sep., or *Sept.* September.

Serg. Sergeant.

Serv., or *Servt.* Servant.

S.J. Society of Jesus.

S.J.C. Supreme Judicial Court.

S. Lat. South Latitude.

Sld. Sailed.

Sm. Samuel.

S.M.I. (*Sa Majesté Impériale.*) His, or Her, Imperial Majesty.

S.O. Staff Officer.

Soc. Society.

Sq. Square.

Sq. ft. Square feet.

Sq. in. Square inches.

Sq. m. Square miles.

Sr. Sir, or Senior.

SS., or *ss.* (*Scilicet.*) Namely.

S.S. Sea-service; Sunday-school.

S.S.E. South-South-East.

S.S.W. South-South-West.

St. Saint; Street.

Stat. Statute.

S.T.D. (*Sacræ Theologiæ Doctor.*) Doctor of Divinity.

Sun., or *Sund.* Sunday.

Supt. Superintendent.

S.W. South-West.

Ten., or *Tenn.* Tennessee.

Tex. Texas.

Th., or *Thurs.* Thursday.

Theo. Theodore.

Tr. Translation; Transpose; Treasurer; Trustee.

Tu., or *Tues.* Tuesday.

Ult. (*Ultimo.*) Last, or Pertaining to the last month.

U.S. United States.

U.S.A. United States of America; United States Army.

U.S.M. United States Mail; United States Marine.

U.S.M.A. United States Military Academy.

U.S.N. United States Navy.

U.S.V. United States Volunteers.

U.T. Utah Territory.

Va. Virginia.

V.C. Victoria Cross.

Vice-Pres. Vice-President.

Vid. (*Vide.*) See.

Vis., or *Visc.* Viscount.

Viz. (*Videlicet.*) Namely; to wit.

V.n. Verb neuter.

Voc. Vocative.

Vol. Volume.

V.P. Vice-President.

V.R. (*Victoria Regina.*) Queen Victoria.

Vs. (*Versus.*) Against.

Vt. Vermont.

W. Week; West.

Wash. Washington.

Wed. Wednesday.

W.I. West India; West Indies.

W. Lon. West Longitude.

Wm. William.

W.M. Worshipful Master.

W.N.W. West-North-West.

W.S.W. West-South-West.

Wt. Weight.

Xmas. Christmas.

Y. Year.

Yd. Yard.

Yr. Your.

Zach. Zachary.

Zech. Zechariah.

Zeph. Zephaniah.

FOREIGN WORDS AND PHRASES EMPLOYED IN FARROW'S MILITARY ENCYCLOPEDIA.

Ab ante. (L.) Before; previously.

A bas. (Fr.) Down.

Ab extra. (L.) From the outside.

Ab initio. (L.) From the beginning.

Ab origine. (L.) From the origin.

Ab ovo usque ad mala. (L.) From the egg to the apples; from first to last. Roman banquets began with eggs, and ended with apples.

Ab urbe conditâ. (L.) From the foundation of the city.

A compte. (Fr.) On account.

Ad infinitum. (L.) To infinity.

Ad interim. (L.) In the mean while.

Ad libitum. (L.) At one's pleasure.

Ad nauseam. (L.) To disgust; till disgust is excited.

Ad patres. (L.) To his fathers; *i.e.*, dead.

Ad referendum. (L.) Till further consideration.

Ad valorem. (L.) According to; upon the value.

Affaire d'amour. (Fr.) An intrigue; a love-affair.

Affaire d'honneur. (Fr.) An affair of honor; *i.e.*, a duel.

A fortiori. (L.) With stronger reason.

A gusto. (Ital.) To one's heart's content.

A la bonne heure. (Fr.) In happy time; at a good hour.

A la Française. (Fr.) In the French manner.

A la mode. (Fr.) In fashion; fashionable.

A l'Anglaise. (Fr.) In the English manner.

Al fresco. (Ital.) In the open air.

Alias. (L.) Otherwise; *e.g.*, Jones, *alias* the Count Johannes.

Alibi. (L.) Elsewhere. A legal defense by which the defendant attempts to show that he was absent at the time and from the place of the commission of the crime.

Allons. (Fr.) Come on; let us go.

Alma mater. (L.) A nourishing mother. A name frequently applied by students to their college.

A l'outrance. (Fr.) To the uttermost; the last extremity.

Alter ego. (L.) A second self.

Alumnus. (L.) A foster-child; a pupil. The graduates of American colleges are often called *alumni*.

Amende honorable. (Fr.) To make the *amende honorable* is to make a suitable apology for and confession of one's offense.

Amor patriæ. (L.) Love of country; patriotism.

Amour propre. (Fr.) Self-esteem.

Ancien régime. (Fr.) The old government; the French monarchy before the Revolution.

Anno Domini. (L.) In the year of our Lord.

Anno mundi. (L.) In the year of the world.

Annus mirabilis. (L.) The wonderful year.

Ante bellum. (L.) Before the war.

Ante meridiem. (L.) Before noon.

A posteriori. (L.) From the latter; the cause from the effect.

A priori. (L.) From the former; the effect from the cause.

A propos. (Fr.) Appositely; seasonably; in regard to.

Argumentum ad hominem. (L.) An argument to the man; *i.e.*, personal.

Audi alteram partem. (L.) Hear the other part; both sides.

Au fait. (Fr.) Skilled; accomplished; competent.

Au fond. (Fr.) To the bottom; thoroughly.

Au revoir. (Fr.) Good-by, till we meet again.

Auto da fé. (Sp.) An act of faith; *i.e.*, burning heretics.

Aux armes. (Fr.) To arms.

A votre santé. (Fr.) To your health.

Bas bleu. (Fr.) A bluestocking; a literary woman.

Beau idéal. (Fr.) Ideal beauty. The absolute beauty which exists only in the mind.

Beau monde. (Fr.) The gay world; the world of fashion.

Bel esprit. (Fr.) A fine mind; wit.
Ben trovata. (Ital.) Well found; "a happy thought."
Bête noir. (Fr.) A scarecrow; a bugbear.
Billet-doux. (Fr.) A love-letter; a "sweet" note.
Bizarre. (Fr.) Strange; eccentric; fanciful.
Blasé. (Fr.) One who has seen and enjoyed everything, and upon whom pleasure palls, is called *blasé*.
Bonâ fide. (L.) In good faith; genuine; actual.
Bon-gré, mal-gré. (Fr.) With a good or ill grace; willy-nilly.
Bonhomie. (Fr.) Simple, unaffected good-nature.
Bon-jour. (Fr.) Good-day; good-morning.
Bon-mot. Fr.) A good word, *i.e.*, a witty saying.
Cœteris paribus. (L.) Other things being equal.
Canaille. (Fr.) The rabble; the common multitude
Carte blanche. (Fr.) Blank sheet of paper. To give a person *carte blanche* is to give him an unconditional discretion.
Casus belli. (L.) A case of war; an act which justifies war.
Cedant arma togæ. (L.) Let arms yield to the gown; *i.e.*, military to civil power.
Cela va sans dire. (Fr.) That goes without saying: follows as a matter of course and necessarily.
Chacun à son goût. (Fr.) Every man to his taste.
Châteaux en Espagne. (Fr.) Castles in Spain: air castles.
Chef d'œuvre. (Fr.) A masterpiece; an unequaled work.
Che sarà, sarà. (Ital.) What is to be, will be.
Chevalier d'industrie. (Fr.) An adventurer; one who lives by his wits.
Chronique scandaleuse. (Fr.) A record of scandals.
Cicerone. (Ital.) A person who acts as guide to sight-seers.
Comme il faut. (Fr.) Neatly; properly; rightly; in "good form."
Compagnon de voyage. (Fr.) Companion of one's travels.
Compos mentis. (L.) Sane; of sound mind.
Con amore. (Ital.) Earnestly; zealously.
Con spirito. (Ital.) In a spirited manner.
Corps Diplomatique. (Fr.) The foreign ambassadors.
Corpus delicti. (L.) The body of the offense.
Coup d'état. (Fr.) A bold stroke in politics.
Coup de grâce. (Fr.) A stroke of mercy; a final blow.
Coup de main. (Fr.) A bold, swift understanding.
Coup d'œil. (Fr.) A swift glance of the eye.
Coûte qu'il coûte. (Fr.) Let it cost what it may.
Cui bono. (L.) To what (for whose) good.
Cum grano salis. (L.) With a grain of salt; not unqualifiedly.
Currente calamo. (L.) Rapidly and fluently.
Da capo. (Ital.) From the beginning.
De bonne grâce. (Fr.) Readily; with good will.
Début. (Fr.) One's first appearance in society, or on the stage.
De facto. (L.) Actual; in fact.
De gustibus non est disputandum. (L.) There is no disputing about tastes.
De jure. (L.) Rightfully; lawfully; lawful.
De mortuis nil nisi bonum. (L.) Say nothing but good of the dead.
Dénouement. (Fr.) The catastrophe of a plot.
De novo. (L.) Anew; over again; afresh.
Deo volente. (L.) If it please God.
Dernier ressort. (Fr.) The last resource.
De trop. (Fr.) In the way; too much.
Dieu et mon droit. (Fr.) God and my right.
Distingué. (Fr.) Distinguished in manner.
Distrait. (Fr.) Preoccupied; absent-minded.
Divide et impera. (L.) Divide and govern.
Dolce far niente. (Ital.) Sweet do-nothing; luxurious idleness.
Double entente. (Fr.) Double meaning; obscenity in disguise. (Often erroneously written *double entendre*.)
Douceur (Fr.) Sweetness; compensation; a gratuity.
Dramatis personæ. (L.) The characters of a drama.
Dulce domum. (L.) Sweet home.
Dum vivimus, vivamus. (L.) While we live, let us live; enjoy life to the full.
Éclat. (Fr.) Splendor; distinction; brilliancy.
Élan. (Fr.) A spring; fire; dash; impetuosity.
Embarras de richesses. (Fr.) Embarrassment of riches; excess of anything.
Embonpoint. (Fr.) Plumpness of figure.
Empressement. (Fr.) Enthusiasm; eagerness.
En famille. (Fr.) In family; by themselves.
Enfant gâté. (Fr.) A spoiled child.
Enfant terrible. (Fr.) A terrible child; making ill-timed remarks.
En grande toilette. (Fr.) In full dress; toilet.
En masse. (Fr.) In a body.
En rapport. (Fr.) In communication.
En règle. (Fr.) As it should be; in rule.
En revanche. (Fr.) To make up for it.
En route. (Fr.) On one's way.
En suite. (Fr.) In company together.
Entente cordiale. (Fr.) A cordial understanding.
Entourage. (Fr.) Surroundings; adjuncts.
Entre nous. (Fr.) Between ourselves.
E pluribus unum. (L.) One of many. Motto of the United States.
Ergo. (L.) Therefore.
Esprit de corps. (Fr.) The spirit of the body; a feeling for the honor and interest of an organization.
Esprit fort. (Fr.) A skeptic; a freethinker
Et cætera. (L.) And the rest; etc.
Ex cathedrâ. (L.) From the chair; with authority.
Excelsior. (L.) Higher.
Exeunt omnes. (L.) They all go out.
Ex nihilo nihil fit. (L.) From nothing, nothing comes.
Ex officio. (L.) By virtue of his office.
Ex parte. (L.) From a part; one-sided.
Ex post facto. (L) After the deed is done.
Ex tempore. (L.) Off-hand.
Facile princeps (L.) Easily the chief.
Facilis est descensus Averni. (L.) The descent into hell is easy.
Fait accompli. (Fr.) An accomplished fact.
Faux pas. (Fr.) A false step; a mistake.
Fecit. (L.) He, *or* she, made. This word is put after an artist's name on a picture.
Felo de se. (L.) A felon of himself; a suicide.
Femme de chambre. (Fr.) A chambermaid.
Femme sole. (Fr.) An unmarried woman.
Festina lentè. (L.) Make haste slowly.
Fête champêtre. (Fr.) A rural party; a party in the open air.
Feuilleton. (Fr.) A small leaf. The bottoms of the pages in French newspapers are so called, being given up to light literature.
Fiat justitia, ruat cœlum. (L.) Let justice be done, though the heavens fall.
Finis coronat opus. (L.) The end crowns the work.
Flagrante delicto. (L.) In the act.
Fugit hora. (L.) The hour flies.
Gamin. (Fr.) A street-urchin.
Garçon. (Fr.) A waiter.
Garde du corps. (Fr.) A body-guard.
Garde mobile. (Fr.) Troops liable for general service.
Gasconnade. (Fr.) Boasting; bragging.
Gaucherie. (Fr.) Awkwardness; clumsiness.
Gendarme. (Fr.) An armed policeman.
Genius loci. (L.) The genius of the place.
Gentilhomme. (Fr.) A gentleman; nobleman.
Genus homo. (L.) The human race.
Gloria in excelsis. (L.) Glory to God in the highest.
Gloria Patri. (L.) Glory to the Father.
Grand siècle. (Fr.) A great century.
Grossièreté. (Fr.) Grossness; rudeness.
Habeas corpus. (L.) You may have the body.
Hauteur. (Fr.) Haughtiness; loftiness.
Hic et ubique. (L.) Here and everywhere.
Hic jacet. (L.) Here lies.
Homme d'état. (Fr.) A statesman.
Honi soit qui mal y pense. (Fr.) Shame to him who evil thinks.
Horribile dictu. (L.) Horrible to say.
Hors de combat. (Fr.) Out of condition to fight.
Hôtel de ville. (Fr.) A town-hall.
Ibidem. (L.) In the same place.
Ich dien. (Ger.) I serve. (Motto of the Prince of Wales.)
Ici on parle Français. (Fr.) French spoken here.
Idem sonans. (L.) Sounding the same.
Id est. (L.) That is; i.e.
Ignis fatuus. (L.) A foolish fire; a delusion.
Ignobile vulgus. (L.) The ignoble crowd.
Ignotum per ignotius. (L.) The unknown by something more unknown.
Imprimis. (L.) In the first place.
In articulo mortis. (L.) At the point of death.
Index expurgatorius. (L.) A purging index; a list of works prohibited to be read.
In embryo. (L.) In the rudiments.
In esse. (L.) Actual; in existence.
In extremis. (L.) At the point of death.
In flagrante delicto. (L.) In the very act.
Infra dignitatem. (L.) Beneath one's dignity.
In futuro. (L.) In the future.
In hoc signo vinces. (L.) In this sign thou shalt conquer.
In loco (L.) In place; on the spot.
In medias res. (L.) In the middle of a subject.
In pace. (L.) In peace.
In perpetuum. (L.) Forever.
In propriâ personâ. (L.) In one's own person.
In re. (L.) In the thing: in the matter of.
In rem. (L.) Against the thing.
In sæculâ sæculorum. (L.) For ages of ages.
Instanter. (L.) Instantly.
In statu quo. (L.) In the state in which it was.
Inter alia. (L.) Among other things.
Inter nos. (L.) Between ourselves.
Inter se. (L.) Among themselves.
In toto. (L.) Entirely; wholly.
In transitu. (L.) In the passage; on the way.
In vino veritas. (L.) In wine there is truth.
Ipse dixit. (L.) He said it himself.
Ipso facto. (L.) By the fact itself.
Je ne sais quoi. (Fr.) I know not what.
Jeu de mots. (Fr.) A play upon words.
Jour de fête. (Fr.) A saint's day; a festival.
Jubilante Deo. (L.) Be joyful to God.
Jupiter tonans. (L.) Jupiter the thunderer.
Jure divino. (L.) By divine law.
Jure humano. (L.) By human law.
Jus civile. (L.) The civil law.
Jus gentium. (L.) The law of nations.
Juste milieu. (Fr.) The golden mean.
Labor omnia vincit. (L.) Labor conquers all things.
Laissez faire. (Fr.) Let things alone.
Lapsus linguæ. (L.) A slip of the tongue.
Lares et penates. (L.) The household gods.
Laus Deo. (L.) Praise be to God.
L'avenir. (Fr.) The future.
Le beau monde. (Fr.) The world of fashion.
Lèse majesté. (Fr.) High treason.
Lex loci. (L.) The law of the place.
Lex scripta. (L.) The written law.
Lex talionis. (L.) The law of retaliation.
Literatim. (L.) Letter for letter.
Littérateur. (Fr.) A literary man.
Locus sigilli. (L.) The place of the seal.
Ma chère. (Fr.) My dear.
Ma foi. (Fr.) My faith; upon my faith.
Magnum bonum. (L.) A great good.
Maison de ville. (Fr.) The town-house.
Maître d'hôtel. (Fr.) A house-steward.
Major domo. (Ital.) A chief steward.
Maladie du pays. (Fr.) Home-sickness.
Matériel. (F.) Opposed to personnel.
Mater familias. (L.) The mother of a family.

Mauvaise honte. (Fr.) Bashfulness.
Maximum. (L.) The greatest possible.
Me judice. (L.) In my judgment
Memento mori (L.) Remember death.
Memorabilia. (L.) Things deserving to be remembered.
Mens sana in corpore sano. (L.) A sound mind in a sound body.
Meum et tuum. (L.) Mine and thine.
Mirabile dictu. (L.) Wonderful to tell.
Mise en scène. (Fr.) Putting on the stage.
Modus operandi. (L.) The method of operating
Mon ami. (Fr.) My friend.
Mot d'ordre. (Fr.) The password; countersign.
Multum in parvo. (L.) Much in little.
Nemine contradicente. (L.) No one contradicting.
Ne plus ultra. (L.) Nothing more beyond; the utmost.
Nil admirari. (L.) To wonder at nothing.
Nil desperandum. (L.) We must not despair.
Ni l'un ni l'autre. (Fr.) Neither the one nor the other.
N'importe. (Fr.) It does not matter.
Nisi prius. (L.) Unless before.
Noblesse oblige. (Fr.) Nobility obliges; noble must act nobly.
Nolens volens. (L.) Willy-nilly.
Noli me tangere. (L.) Don't touch me; hands off.
Nolle prosequi. (L.) To abandon prosecution.
Nom de guerre. (Fr.) A war-name.
Nom de plume. (Fr.) Pen-name; name assumed by an author.
Non compos mentis. (L.) Not in one's right mind.
Non est inventus. (L.) He has not been found.
Non multa, sed multum. (L.) Not many things, but much.
Nota bene. (L.) Mark well.
Nous avons changé tout cela. (Fr.) We have changed all that.
Nous verrons. (Fr.) We shall see.
Odium theologicum. (L.) Theological hatred.
Olla podrida. (Sp) A mixture.
Omnia vincit amor. (L.) Love conquers all things.
On dit. (Fr.) They say; people say.
Onus probandi. (L.) The burden of proof.
Oro pro nobis. (L.) Pray for us.
O tempora! O mores! (L.) Oh, the times! Oh, the manners!
Otium cum dignitate. (L.) Ease with dignity.
Outré. (Fr.) Extravagant; extreme.
Par excellence. (Fr.) By way of eminence; in the highest degree.
Par hasard (Fr.) By chance.
Pari passu. (L.) With equal step.
Parvenu. (Fr.) An upstart; a rich snob.
Pater familias. (L.) The father of a family.
Pater patriæ. (L.) The father of his country.
Pax vobiscum. (L.) Peace be with you.
Peccavi. (L.) I have sinned.
Pendente lite. (L.) While the suit is pending.
Per annum. (L.) By the year.
Per capita. (L.) By the head; on each person.
Per contra. (L.) On the other hand.
Per diem. (L.) By the day; every day.
Per se. (L.) By itself.
Personnel. (Fr.) The staff; persons in any service.
Petitio principii. (L.) Begging the question.
Petite. (Fr.) Small; little.
Pièce de résistance. (Fr.) A joint of meat.
Pinxit. (L.) He, *or* she, painted it.
Pis aller. (Fr.) A last expedient.
Plebs. (L.) The common people.
Poeta nascitur, non fit. (L.) A poet is born, not made.
Point d'appui. (Fr.) Point of support.
Posse comitatus. (L.) The power of the country; the force that may be summoned by the Sheriff.
Poste restante. (Fr.) To be left till called for.
Post meridiem. (L.) Afternoon.
Post mortem. (L.) After death.
Post obitum. (L.) After death.
Pourparler. (Fr.) A consultation.
Pour prendre congé. (Fr.) To take leave.
Précieuse. (Fr.) A bluestocking; a conceited woman.
Preux chevalier. (Fr.) A gallant gentleman.
Prima donna. (Ital.) The first lady; the principal female singer in an Italian opera.
Primâ facie. (L.) On the first face; at first sight.
Primus inter pares. (L.) First among his peers.
Pro bono publico. (L.) For the public good.
Procès verbal. (Fr.) Verbal process; the taking of testimony in writing.
Pro et con. (L.) For and against.
Pro formâ. (L.) For the sake of form.
Pro patriâ. (L.) For one's country.
Pro tempore. (L.) For the time.
Punica fides. (L.) Punic faith; *i.e.*, treachery.
Quantum sufficit. (L.) As much as is sufficient.
Quelque chose. (Fr.) As if.
Quid nunc? (L.) What now? A gossip.
Quid pro quo. (L.) An equivalent.
Qui vive. (Fr.) Who goes there?
Quod erat demonstrandum. (L.) Which was to be demonstrated.
Quondam. (L.) At one time; once.
Rara avis. (L.) A rare bird.
Rechauffé. (Fr.) Warmed over; stale.
Recherché. (Fr.) Choice; elegant.
Reducteur. (Fr.) An editor.
Redivivus. (L.) Restored to life.
Reductio ad absurdum. (L.) Reduction to an absurdity.
Rentes. (Fr.) Public funds; national securities.
Requiescat in pace. (L.) May he, or she, rest in peace.
Res gestæ. (L.) Things done.
Resurgam. (L.) I shall rise again.
Revenons à nos moutons. (Fr.) Let us return to our sheep; come back to the subject.
Robe de chambre. (Fr.) A dressing-gown.
Roué. (Fr.) A rake.
Rouge et noir. (Fr.) Red and black (a game).
Sanctum sanctorum. (L.) The holy of holies.
Sang froid. (Fr.) Cold blood; self-possession.
Sans culottes. (Fr.) Without breeches; red republicans.
Sartor resartus (L.) The tailor patched.
Sauve qui peut. (Fr.) Save himself who can.
Savoir-faire. (Fr.) Knowing how to do things.
Savoir-vivre. (Fr.) Knowledge of the world.
Semper idem. (L.) Always the same.
Semper paratus. (L.) Always prepared.
Sequitur. (L.) It follows.
Seriatim. (L.) In order.
Sic itur ad astra. (L.) Thus men go to the stars.
Sic semper tyrannis. (L.) Thus always with tyrants. The motto of Virginia.
Sic transit gloria mundi. (L.) So passes the glory of the world.
Similia similibus curantur. (L.) Like is cured by like.
Sine die. (L.) Without a day.
Sine qua non. (L.) Without which, not; an indispensable condition.
Soi disant. (Fr.) Self-styled.
Spirituel. (Fr.) Witty.
Status quo. (L.) The state in which; the former state.
Stet. (L.) Let it stand.
Suaviter in modo, fortiter in re. (L.) Gently in manner, bravely in action.
Sub rosâ. (L.) Under the rose; secretly.
Sui generis. (L.) Of its own kind.
Summum bonum. (L.) The supreme good.
Tableau vivant. (Fr.) A living picture.
Table d'hôte. (Fr.) A public ordinary; dinner at a fixed price.
Tabula rasa. (L.) A smooth tablet; a blank.
Tant mieux. (Fr.) So much the better.
Tant pis. (Fr.) So much the worse.
Te Deum laudamus. (L.) Thee, God, we praise.
Tempora mutantur, et nos mutamur in illis. (L.) Times change, and we change with them.
Tempus fugit. (L.) Time flies.
Terra firma. (L.) Solid earth.
Terra incognita. (L.) An unknown country.
Tête-à-tête. (Fr.) Head to head; in private conversation.
Tiers état. (Fr.) The third estate; *i.e.*, the commons.
Totidem verbis. (L.) In just so many words.
Tour de force. (Fr.) A turn of strength.
Tout ensemble. (Fr.) The whole taken together.
Tout le monde. (Fr.) Everybody.
Trottoir. (Fr.) The pavement.
Tu quoque, Brute! (L.) Thou, too, Brutus.
Ubi libertas, ibi patria. (L.) Where liberty is, there is my country.
Ubi supra. (L.) As mentioned above.
Ultima Thule. (L.) Uttermost Thule; the end of the earth.
Usque ad nauseam. (L.) Till it was, *or* is, absolutely sickening.
Utile dulci. (L.) The useful with the sweet.
Ut infra. (L.) As below.
Ut supra. (L.) As above.
Vade mecum. (L.) Go with me; a companion.
Væ victis. (L.) Woe to the vanquished.
Vale. (L.) Farewell.
Valet de chambre. (Fr.) A servant.
Veni, vidi, vici. (L.) I came, I saw, I conquered.
Verbatim et literatim. (L.) Word for word; letter for letter.
Verbum sat sapienti. (L.) A word to the wise is sufficient.
Viâ. (L.) By way of.
Vide. (L.) See.
Videlicet. (L.) Namely.
Vinculum matrimonii. (L.) The bond of matrimony.
Vis à vis. (Fr.) Face to face.
Vis inertiæ. (L.) The force of inactivity.
Vis viva. (L.) Living force.
Vivâ voce. (L.) By the living voice.
Vive la bagatelle. (Fr.) Success to trifles.
Vive la Reine. (Fr.) Long live the Queen.
Vive l'Empereur. (Fr.) Long live the Emperor.
Vive le Roi. (Fr.) Long live the King.
Voilà. (Fr.) See there; behold.
Vox, et præterea nihil. (L.) A voice, and nothing more.
Vox populi, vox Dei. (L.) The voice of the people is the voice of God.

INDEX OF MATTERS NOT HAVING SPECIAL ARTICLES.

At the close of Volume III. will be found an Index of Subjects not having Special Articles. It has not been thought necessary to repeat in this Index the titles of the many thousand articles composing the body of the work. A person consulting the Encyclopedia is supposed, in the first instance, to look for the subject he is in quest of in its proper alphabetical place. If it is not to be found there, or by a *cross-reference*, by turning to the Index he is likely to get a reference to it under another name, or as coming in for notice in connection with some other subject. It frequently happens that subjects, having articles of their own, are further noticed under other heads; and where it seemed of importance, a reference is given in the Index to this additional information. The title of the article referred to is printed in *italics;* and when the article is of considerable length, the page is given in which the information is to be found.

CONTINUED REVISION.

The process of revising Farrow's Military Encyclopedia is constantly carried on, thus keeping up the information to the latest possible date. These revisions and additions will be supplied every few years in the shape of Supplements. A few blank pages are inserted at the close of each volume for the purpose of noting the reference to the various articles in the Supplements, which would naturally find alphabetical arrangement in the respective volumes.

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HABEAS CORPUS.—A writ of *Habeas Corpus* is an order in writing, signed by the Judge who grants the same, sealed with the seal of the Court of which he is Judge, and issued in the name of a Sovereign Power where it is granted, by such a Court or a Judge thereof having lawful authority to issue the same, directed to any one having a person in his custody or under his restraint, commanding him to produce such person at a certain time and place, and to state the reason why he is held in custody or under restraint. A State Judge has no jurisdiction to issue a writ of *Habeas Corpus*, or to continue proceedings under the writ when issued, for the discharge of a person held under the authority, or claim and color of the authority, of the United States, by an officer of that Government. If upon the application for the writ it appears that the party alleged to be illegally restrained of liberty is held under the authority, or claim and color of the authority, of the United States, by an officer of that Government, the writ should be refused. If this fact do not thus appear the State Judge has a right to inquire into the cause of imprisonment, and ascertain by what authority the person is held within the limits of the State; and it is the duty of the Marshal, or other officer having the custody of the prisoner, to give, by a proper return, information in this respect. But after he is fully apprised by the return that the party is held by an officer of the United States, under the authority, or claim and color of the authority, of the United States, he can proceed no further. These principles applied to a case where a *Habeas Corpus* was issued by a Court Commissioner of one of the Counties of Wisconsin to a recruiting officer of the United States, to bring before him a person who had enlisted as a soldier in the Army of the United States, and whose discharge was sought on the alleged ground that he was a minor under the age of eighteen years at the time of his enlistment, and that he enlisted without the consent of his father. The petition for the writ alleging that the prisoner had enlisted as a soldier and been mustered into military service of the National Government, and was detained by the officer as such soldier—this Court held that the Court Commissioner had no jurisdiction to issue the writ for the discharge of the prisoner, as it thus appeared that upon the petition that the prisoner was detained under claim and color of authority of the United States by an officer of that Government; and that if he was illegally detained, it was for the courts or judicial officers alone, to grant him release. Should a writ of *Habeas Corpus* be served upon an Army Officer by a Civil Magistrate or Court of any State, commanding him to produce an enlisted man, or show cause for his detention, the officer makes respectful return that the man is a duly enlisted soldier of the United States, and that the Supreme Court of the United States has decided in such case, that a Magistrate of a Court of a State has not jurisdiction.

HABERGEON.—A short coat of mail, consisting of a jacket without sleeves. In early times, the habergeon was composed of chain mail; but in the fourteenth century, a habergeon of plate-armor was worn over the hauberk. See *Hauberk*.

HABILIMENTS OF WAR.—In ancient statutes, armor, harness, utensils, etc., without which it was supposed there could be no ability to maintain a war.

HACHE D'ARME.—A battle-axe with a narrow handle armed with a sharp blade in the form of a crescent, very much curved, terminating in two points approaching the handle on one side; the other side terminating in a point or hammer; when both sides were armed with a blade it was called *Besagne*.

HACHEE.—The ignominious punishment of carrying a saddle or dog, to which soldiers were formerly subjected in France.

HACKAMORE.—A halter used by packers. It consists of a long leather or rope strap and head-stall. It is used when leading the pack-animal, also to make the animal fast, usually to the aparejo, while preparing to pack. On the march, the strap is wrapped around the animal's neck and made fast to the head-stall.

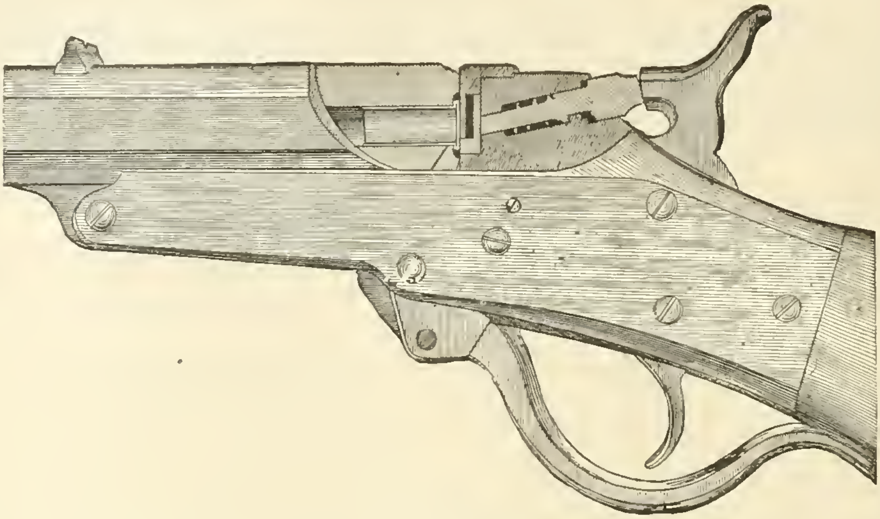
HACK-BUSH—HACK-BUSS.—A heavy hand cannon, with butt and serpentine lock. It belongs to the second half of the fifteenth century. The match is no longer loose, but fixed to the serpentine, which springs back by means of a trigger. This sort of cannon is about 40 inches in length, and it is usually provided with a hook, so that when it is placed on a wall, it cannot slip back. Without the hook it is sometimes called *Arquebuse with Matchlock*. See *Hake*.

HACQUETON.—A stuffed coat or cloak, generally of leather, mounted with metal, formerly worn in France by certain Knights of the King's Guards called *Gardes de la Manche*. It came into use during the reign of Charles V., and was discarded during the Revolution of 1789.

HACQUET-WAGON.—A four-wheeled wagon used in the Prussian service to carry pontons. The underframe of this carriage is built like that of a chariot, by which means it can turn without difficulty.

HADDAN RIFLING.—This plan of centering against the bore consists of 3 large and shallow elliptical grooves, which in the earlier forms were about 1-6 in. deep and took away nearly two-thirds of the surface of the bore. The projectile is rotated by 3 wings formed on the front of the shot, straight with its axis. In the earlier projectiles, the rear tapered, and had a shoulder for a ring-wad to stop the windage. The later projectiles have merely a wooden sabot. As the wings are on the front part of the projectile, the rifling is carried only to within one caliber of the powder-chamber, and hence is not a source of weakness at that point.

HADLEY FIRING-PIN.—A simple device for using rim-fire cartridges in rifles adapted for central-fire ammunition. It was invented for and specially applied to the Maynard rifle. This rifle is confined to central-fire ammunition in each and all of the calibers, excepting the 22; but by this device rim-fire cartridges from 22 to 38 caliber may be used. The drawing shows the nature and simplicity of the invention. It consists of a cap attached to the breech-piece by two small screws, in which is a disk with a firing-pin projecting through the cap at such a point from the center as to strike the rim of the cartridge. This disk plays freely in the cap, and is driven forward by the firing-pin in the breech-piece. To use the central-fire cartridges it is only necessary to remove the cap, change firing-pins, and insert the latter.



Hadley Firing-pin.

HAGBUT.—An arquebuse, of which the butt was bent or hooked, in order that it might be held more readily. Also written *Hagg* and *Haguebut*. See *Hack-bush*.

HAGNER MAGAZINE.—General Hagner proposed that a projection be formed on the under side of the stock, between the lower band and the guard, in which three cartridges might be placed, with their heads to the rear. This magazine differs from the *Benton fixed Magazine*, merely in its location, and holding three cartridges instead of five.

HAIDUCKS.—Originally a designation of cattle-herds in Hungary. Afterwards, the word came to signify a class of mercenary foot-soldiers ready to accept pay from any one who would employ their services, but displaying great gallantry on the field of battle. The remarkable constancy with which they stood by Bocskai throughout the War of the Revolution, was rewarded by that Prince with a grant of a district as their own possession, and at the same time with the privileges of nobility. This grant was made by a public decree of Dec. 12, 1605, and confirmed by the Diet in 1613. Except the privilege of exemption from taxes, which Charles III. took away, the Haiducks enjoy all the rights of Nobles to the present day. Their residence, the Haiduck district, remains independent of the country authorities, and is under the direct administration of the National Government. The Haiduck district lies within the country of North Bihar, between the Theiss and Transylvania, has an area of about 594 square miles and six principal Haiduck towns. The capital of the district used to be Böszörmény. The total population is about 63,000, all Magyars, and for the most part belonging to the Reformed Church. In 1876 this district was incorporated with portions of two adjoining districts into a new administrative division (called *Haidekencomitat*) with Debreczin for its capital. In course of the present century, the name Haiducks has begun to be applied to the Macers of Hungarian Courts and the Halberdiers of the Hungarian Magnates; also to the Lackeys and other Attendants in German Courts. Also written *Hajduks*, *Haiduks*, and *Hayduks*.

HAIL.—A term in military parlance, meaning to challenge, accost, or salute. A sentinel hails any one approaching his post between taps and reveille with, "Who goes (or comes) there?"

HAIR.—A spring or other contrivance in a rifle or pistol-lock, which, being unlocked by a slight pressure on the trigger, strikes the tumbler-catch, and unlocks the tumbler.

HAIR-CLOTH.—A species of cloth made of horse-hair, laid upon the floors of magazines and laboratories to prevent accidents. It is usually made up in pieces 14 feet long and 11 feet wide, each weighing 36 pounds.

HAIR-TRIGGER.—A trigger so constructed as to discharge a fire-arm by a very slight pressure, as by the touch of a hair. It is connected with the tumbler-catch by a device called the *Hair*. One of the latest improvements in sporting-arms is the addition of a set, or hair-trigger. This differs from the ordinary hair-trigger, in that it can be used precisely as if this trigger was not on the gun, if, as in hunting, it is not wanted. For fine shooting, as in target practice, it is made available thus: After setting the hammer at full-cock, the trigger should be pressed forward slightly, and it is thus set. If it is found too delicate, or not delicate enough, it can be adjusted to suit the wishes, by turning a set screw in or out. This screw will be found by the side of the trigger.

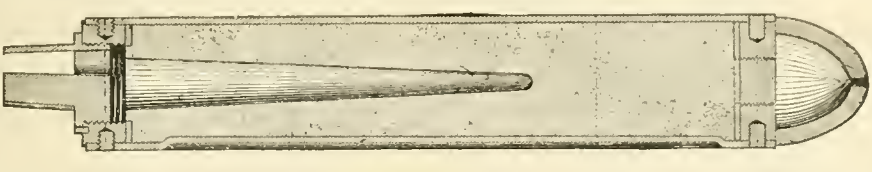
HAKE.—An old term for a hand-gun, used in ancient times, and usually fired on a rest by the manual application of a match. When the weight of these instruments was reduced, and a lock appended, so that they might be fired without a rest, they were called *calivers*. Hand-guns of this description are mentioned as having been first used at the Siege of Arras, in 1414. An inquisition taken at Huntercombe, in Yorkshire, in 1375, the record being in the Chapter-house, Westminster, mentions the attack on Manor-house of Huntercombe by 40 men armed, among other weapons, with "gonnes"—supposed to be *hand-guns*.

HALBERD—HALBERT.—A weapon borne, up to the close of the eighteenth century, by all sergeants of foot, artillery, and marines, and by companies of halberdiers in the various regiments. It consisted of a strong wooden shaft about 6 feet in length, surmounted by an instrument much resembling a bill-hook, constructed alike for cutting and thrusting, with a cross-piece of steel, less sharp, for the purpose of pushing; one end of this cross-piece was turned down as a hook, for use in tearing down works against which an attack is made. The honor of inventing the halberd is contested by the Swiss and Danes, but probably each produced something resembling it. Its name appears to be derived from the Teutonic *hild*, battle, and *bard*, axe. The halberd appears first in England about the time of Henry VII., and maintained its position for upwards of two centuries. Now it is rarely seen except on certain ceremonial occasions.

Old Halberd is a familiar term formerly used in the British Army, to signify a person who had gone through the different gradations, and risen to the rank of a commissioned officer.

HALBERDE. A term frequently given to the *guisarme*, or to one of its modifications, in the middle ages.

HALE WAR ROCKETS.—The general construction of the 12 and 24-pounders are the same, differing only in general dimensions and the number of vents and curved shields or walls, the 12-pounder having 3 and the 24-pounder 5. The rocket consists of four pieces. A head, conoidal in shape, of cast-iron, hollow for bursting, having a cylindrical hole in the base about $\frac{15}{16}$ inch diameter, with screw-thread for fuse; there is also a small hole in front, used for filling shell with combustible material, closed by a screw, but into which can, if desirable, be fitted a nipple and cap for ignition by percussion; the head is turned down at the rear $\frac{3}{4}$ inch so as to enter the body of the case about $\frac{13}{16}$ inch, and to which it is secured by six pins or screws. A *cylindrical body* of sheet-iron about $\frac{1}{8}$ inch thick, with edges lapped, riveted, and brazed at the longitudinal joints. A *thick iron disk* or annular ring fitted in and fixed by screws or pins closes the base. A *tail-piece* of cast-iron containing the vents and shields or walls is screwed into the disk which closes the base. The vents themselves are conical, the apex pressing against the curved shields, each placed in the same relative position to one of the vents, keeps the rocket point foremost in its flight, and gives the rotary motion on the turbine principle. The composition which is separated from contact with the iron by pasteboard to prevent oxidation, consists of saltpeter, sulphur, and charcoal, in the proportions of 70, 16, and 23, and is introduced into the case in successive pellets and pressed by hydraulic power; it is afterward bored out in a cone for about two-thirds of its length. The war-rockets are fired from a trough mounted on a stand, either singly or in groups of seven, by means of an ordinary friction-tube and lanyard.



Hale War-rocket.

The Hale Life-Saving Rocket differs from the above only in that the head, instead of being of cast-iron, is of wood, and in the addition of a piece of chain about 3 feet long which is connected to the center of the bottom of the tail-piece by a double swivel; to the chain is attached the life-line. This rocket is fired from an ordinary V-shaped trough, which may be given any desired elevation. As the chain is hardly long enough to prevent the burning off of the rope by the gas escaping from the vents, it is safest to wet about two fathoms of the rope next to the chain. See *Rockets*.

HALF-BASTION.—A demi-bastion. In fortification that half of a bastion cut off by the capital, consisting of one base and one front.

HALF BATTA.—An extra allowance which was granted to the whole of the officers belonging to the British East Indian Army, except Bengal, when out of the Company's district in Province of Oude. In the upper Provinces *double-batta* was allowed. All above full was paid by the native Princes, as the troops stationed in that quarter are considered as Auxiliaries. See *Batta*.

HALF-BLOCKS.—These are of the same dimensions as *blocks*, except that the cross-section is usually 4 × 8 inches, in place of 8 inches square. They are used for the same purposes as whole blocks; but, when the distance through which the piece is to be raised is only half of what it is when the whole block is used.

HALF-CAPONNIERE. In fortification, a communication in a dry ditch with one side prepared for defense, having but one parapet and glacis.

HALF-CHESS.—A short *chess* or platform board of a military bridge. See *Ponton*.

HALF COCK.—The position of the cock of a gun when retained by the first notch. See *Lock*.

HALF-DISTANCE.—Half the regular interval or space between troops drawn up in the ranks or standing column.

HALF DOUBLE SAP.—This is an ordinary line of sap pushed forward in a position where it is necessary to give temporary cover on the reverse of the trench, from a slant fire by gabions filled with sand-bags. The distance between the two rows of gabions in this case, is only 5 feet 6 inches, the single sap-roller covering in front this interval from enfilading fire. See *Sap*, and *Wing Traverses*.

HALF-FACE.—A movement, in the School of the Soldier, in order to take half the usual distance between the right or left face and front, to give an oblique direction to the line, or to fill up a gap at the corner of a square.

HALF FILE LEADER.—The foremost of a rank entire. The *Chef de Demi file* in France.

HALF-FILES.—Half the given number of any body of men drawn up two deep. They are so called in cavalry, when the men rank off singly.

HALF FULL SAP.—In siege operations, when the sappers have only a flank fire (coming in a direction nearly perpendicular to that of the sap) to fear, the sap-roller may be dispensed with. The first sapper then covers himself with the last-filled gabion whilst placing and filling the new one. This species of sap is called the half-full sap.

HALF-HITCH.—A form of hitch much used in mechanical maneuvers. It is made by passing the end of a rope round its standing part, and bringing it up through the bight. See *Cordage* and *Knots*.

HALF-MERLON.—That solid portion of a parapet which is at the right or left extremity of a battery.

HALF-MOON.—In fortification, an outwork that has two faces which form a salient angle, the gorge of which resembles a crescent. It owes its original invention to the Dutch, who used it to cover the points of their bastions. This kind of fortification is, however, defective, because it is weak on its flanks. Half-moons are now called ravelins, which species of work is constructed in front of the curtain.

HALF-PAY.—An allowance given in the British Army and Navy to Commissioned Officers not actively employed in the rank to which half-pay has reference. It corresponds to the French *demi-solde*, or pay of *non-activité*. It has long been a disputed point whether half-pay is given to officers as a retaining fee, to keep them at hand for the time when their services may be again required, or an award on account of services already rendered: but whatever the terms of the original grant, there can be little doubt that, under the present regulations, half-pay, except when distinctly named *retired* half-pay, is in the nature of a retaining fee. This allowance is on quite a different footing in the Navy and Army. In the Royal Navy of Great Britain, officers are merely appointed to serve during the period a certain ship is in commission; when this expires, their employment ceases and they revert to a state of non-activity. As there are always many more Naval Officers than appointments for them to fill, a considerable number are at all times on the non-effective list. These are placed on half-pay until again called upon to serve; the amount of such half-pay being usually about 60 per cent. of the full pay of each grade. Half-pay is thus in the Navy a recognized condition for all officers not immediately wanted afloat. In the British Army, the case is different; there, an officer on joining, is posted to a particular regiment, with which, in theory, he is supposed to serve until removed from it on attaining the rank of General. Consequently, no fund like the naval half-pay list is in any degree admitted. Army half-pay is of two natures—*temporary* and (so-called) *permanent* half-pay. The former is limited to officers incapacitated by casual sickness, to those who are without occupation, in consequence of any reduction of the corps in which they were serving, and to those serving in certain staff appointments. *Permanent* half-pay can be demanded by any officer who has served 25 years; it is also given to Majors and Lieutenant-colonels who, after serving for 5 years with a regiment in those ranks, are not re-employed. Since the abolition of purchase and sale of commissions, this last class may be expected, for the sake of promotion in the lower ranks, to increase considerably. The cost of half-pay is already very great; in 1877-78, it was £315,500 for the Army. Till lately, a large proportion of the recipients were officers placed on the list at the great reduction after the peace of 1815. There is a slightly different system or practice in the United States. There is sometimes a distinction between officers on active duty and those awaiting orders. Officers on leave, beyond the time allowed by law, are put on half-pay; and officers retired from active service receive three-fourths of their full pay. The salaries, at present, from Major-general downwards are graded as in the above tables. See *Pay*.

Officers.	Yearly Pay of Officers in Active Service.				
	1st 5 yrs.	After 5 yrs.	After 10 yrs.	After 15 yrs.	After 20 yrs.
Major-general	$7,500	....	....	....	....
Brigadier-general	5,500	....	....	....	....
Colonel	3,500	$3,850	$4,200	$4,500	$4,500
Lieutenant-colonel	3,000	3,300	3,600	3,900	4,000
Major	2,500	2,750	3,000	3,250	3,500
Captain (mounted)	2,000	2,200	2,400	2,600	2,800
" (not mounted)	1,800	1,980	2,160	2,340	2,520
1st Lieut. (mounted)	1,600	1,760	1,920	2,080	2,240
" (not mounted)	1,500	1,650	1,800	1,950	2,100
2d Lieut. (mounted)	1,500	1,650	1,800	1,950	2,100
" (not mounted)	1,400	1,540	1,680	1,820	1,960
Chaplain	1,500	1,650	1,800	1,950	2,100

Officers.	Pay of Retired Officers				
	1st 5 yrs.	After 5 yrs.	After 10 yrs.	After 15 yrs.	After 20 yrs.
Major-general	$5,625	....	....	....	....
Brigadier-general	4,125	....	....	....	....
Colonel	2,625	$2,887	$3,150	$3,375	$3,375
Lieutenant-colonel	2,250	2,475	2,700	2,925	3,000
Major	1,875	2,062	2,250	2,437	2,625
Captain (mounted)	1,500	1,650	1,800	1,950	2,100
" (not mounted)	1,350	1,485	1,620	1,755	1,890
1st Lieut (mounted)	1,200	1,320	1,440	1,560	1,680
" (not mounted)	1,125	1,237	1,350	1,462	1,575
2d Lieut. (mounted)	1,125	1,237	1,250	1,462	1,575
" (not mounted)	1,050	1,155	1,260	1,365	1,470
Chaplain	1,350	1,485	1,620	1,755	1,890

HALF-PIKE.—A short pike, formerly carried by infantry officers. See *Spontoon*.

HALF-ROLLER.—This roller has the same dimensions as the *long roller*, but is round only on one side, square on the opposite side, and has no groove. It is used resting on the square side, when, instead of rolling the gun, the object is to have a firm support on which the gun can have its ends alternately raised, as in mounting a gun on its carriage by means of blocks.

HALF-SUNKEN BATTERY.—A battery having its interior space or terre-plein sunk some inches below the natural surface, and its parapet composed of the earth thus obtained and that taken from a narrow ditch in front. This description of battery admits of being more quickly constructed than any other, as the diggers can work both in front and rear at the same time.

HALF-SWORD.—A figure within half the length of a sword; a close fight.

HALF-WROUGHT MATERIALS.—In artillery, the several parts of gun-carriages in the rough, or partly shaped to the form required. Supplies of these materials are kept in every Arsenal, and are issued to batteries on indent. Each battery in the field in England, is allowed the following half-wroughts:—

Beam..............................1
Cheeks............................2
Perch wagon.......................1
Splinter-bar......................2
Shafts, spare.....................2, complete.
Felloes...........................12
Spokes............................24

But as a spare carriage is allowed, there is no necessity to carry such ponderous articles as beams, etc.; the officer commanding a troop or battery will, therefore, use his discretion, according to the nature of the service on which he may be going, as to half-wrought materials he will carry, any in excess of the number allowed being provided at his own expense. On leaving a station where there may be an Arsenal, he can, if he thinks fit, return into store such half-wroughts as he may not wish to carry on the march, receiving from the Ordnance Officer a receipt, which will be his voucher for obtaining others free of charge at the next Arsenal. The above instructions have reference to the artillery in India, wherever the carriages are of the old pattern, viz., of wood. The new field-carriages being made of iron, the supply of half-wroughts as shown in the above list is not required, except for the wheels and other wooden parts of the carriage.

HALLECRET.—Light armor much used in the sixteenth century by the Swiss. It consisted of breastplate and gussets, often reaching to the middle of the thigh, and sometimes below the knees.

HALOXYLIN.—The name of a new kind of explosive material or blasting-powder which has been invented in Styria by two brothers, and is described as incapable of spontaneous ignition, and as quite free from smoke and noxious gases. It is composed of non-resinous sawdust, charcoal, niter, and ferrocyanide of potassium, and is twice the bulk of gunpowder, but one-half more powerful. For blasting and mining purposes it is considered as preferable to gunpowder.

HALT.—Literally, to stop; a term well known to soldiers. It is the word of command given to a body of men, or to a regiment or an army, on the move, to discontinue its march. In the march of a body of soldiers halts are very necessary for the comfort of the men, to enable them to rest themselves. On the usual daily march of a regiment in India, halts are made half-way, and coffee is served out to the men. This is a very desirable arrangement, seeing how early a regiment commences its march in that country.

HALTER.—A head-stall and strap by which an animal is hitched to a stanchion or manger. The halter was anciently used, and is shown in the sculptures of Nimroud. The army is represented in the act of crossing a river, and the horses are haltered behind the sterns of the boats, swimming in the wake.

HALTING DAYS.—The days in the week usually allotted for repose, when troops are upon the march, and there is not any particular necessity for exertion or dispatch.

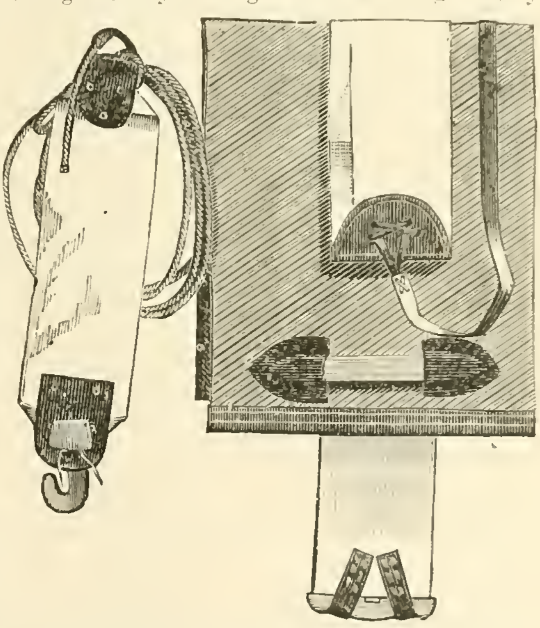
HALYARDS.—The ropes used in hoisting and lowering flags. Signal halyards are running cords of the best white hemp, passing through a pulley at the top of the flag-staff; the flags when attached to them are rolled up, and then hoisted and expanded to the wind by a jerk when the proper moment arrives.

HAMATA. A flexible cuiras composed of metal chains, and first worn by cavalry soldiers in the time of Polybius. See *Cuiras* and *Mail*.

HAMES.—Two pieces of iron encircling a horse's collar, connected at the bottom by an iron loop, and at the top by a strap and buckle. Attached to the hames are iron lugs to which the traces are linked.

HAMMER.—1. That part of a gun-lock which strikes the percussion-cap or firing-pin. It works on a spring called the *hammer-spring*. 2. The term is also applied to instruments in very general use for driving and drawing nails, beating out metals, etc. For many purposes, hammers are required of greater weight than man could wield; and a great variety of power-hammers are used. These, for the most part, are masses of iron raised by steam or other power, and then allowed to fall by their own gravity upon the work. The *helve* or *shingling hammer*, used for compressing the mass of iron drawn from the puddling furnace, and the *tilt-hammer*, used in the manufacturing of shear-steel, are important examples of such hammers. The first is a heavy bar of cast-iron about 10 feet long, weighing 3 or 4 tons and upwards, to which is attached a head of wrought-iron faced with steel, weighing nearly half a ton more. It works upon an axis at the end of the bar furthest from the head, and is raised by cams attached to a heavy wheel set in motion by steam or water-power; these cams strike or "lick" a projection extending beyond the head, and thus raise it about 18 or 20 inches at the rate of 70 to 100 times per minute. The tilt-hammer is similar, but much lighter, and is adapted for striking above 300 blows per minute. In order to obtain this velocity a short "tail" extends with a downward inclination beyond the axis, and the cams strike this downwards, and thus lift the longer arm of the lever to which the head is attached. These, when worked by steam, as they usually are in this country, are, of course, steam-hammers; but when the term steam-hammer is used without qualification, it applies to another and more elaborate machine of very different construction, invented by Mr. James Nasmyth in 1842, and subsequently modified and improved in some of its minor details. In this, the hammer is attached to the bottom of a heavy mass of iron, the "hammer-block," capable of rising and falling between upright bars or "guides"; this, again, is fixed to the rod of a piston, which works in a cylinder placed perpendicularly over the hammer-block, hammer, and anvil. As the piston rises in the cylinder, it lifts the attached mass, which is then allowed to fall from varying heights, according to an adjustment which can be made by an attendant simply touching a handle. The adjustments are so perfect that it may be made to crush a mass of iron, and at the next blow to crack a nut held in the fingers without damaging either kernel or fingers, or to crack the top of an egg in an egg-cup, as might be done with the bowl of a spoon. The mechanism by which this is effected is too elaborate to be described here in detail. One novel contrivance, viz., the "latch," which reverses the action of the steam valves at the precise moment required, is of remarkable ingenuity. See *Steam-hammer*.

HAMMER CLOTH.—When the aparejo is placed on the back of a pack-animal, it is covered with a piece of canvas or matting, made to fit it, called the *Hammer-cloth*. Two pieces of hard wood, about 1 inch thick, 2 inches wide, 20 inches long, round on the outside and beveled to an edge at the ends, are placed about 6 inches from the end of the cloth. Leather caps are stitched over the ends of the wood. To secure the hammer-cloth, aparejo and the blankets beneath it to the animal, a wide girth, called a cincha or cinch, is used. It is made of hide or strong canvas, about 6 feet long (a little too short to go around the mule's body over the aparejo), from 15 to 20 inches wide, and so folded as to bring the edges and stitching in the center. A semi-circular piece of leather, provided with holes or a ring, is stitched on one end, and two loops of strong leather and a slider of hard wood on the other. The cinch is tightened by drawing the two ends together, by



means of what is known as the latigo-strap—made of strong bridle-leather about 6 feet long, an inch and one-half wide at one end and tapering to one-half inch at the other. When the strap is sufficiently drawn, a loop is formed in the free end and the bow is pulled under the front and back lashings of the strap. To relax the cinch and set all free, it is only necessary to pull on the free end of the strap. For very small animals a short cinch (one end furnished with a ring and the other with a stick, bent into the shape of a hook), attached to a rope at the ring may be used. See *Aparejo* and *Packing*.

HAMMER-NAIL.—The pin securing the cock to the plate of the gun-lock. It is frequently called the *lock-nail.*

HAMMER PIKE.—A long-shafted weapon, like the *war-hammer*. It was carried by the subalterns in charge of the flag under the First Empire (1804-1814).

HAMMER SPRING.—The spring of a hammer in a gun-lock. Its parts are the *play-side*, the *stud-side*, the *turn*, the *flower*, the *stud*, and the *eye*; through the latter passes the rod of the spring-pin.

HAMMOCK.—A kind of bed suspended on land, between trees or posts; on board ship, between hooks. Each soldier proceeding to sea on board a troop or transport-ship is entitled to have a hammock told off to him as a resting-place of a night. The hammock suspended forms a sort of bag capable of containing the soldier's mattress, his blankets, and himself, as soon as he has acquired the far from easy knack of climbing into it. The hammocks are taken below at sunset, and hung in rows about 2 feet apart, in the men's portion of the ship. When done with in the morning, the bedding is carefully tied up within each, and the whole stowed in the hammock-netting, which is generally in the bulwarks of the waist. If the weather be not sufficiently dry, however, to allow of this, the hammocks are left below. Stowed thus in the netting, the hammocks form a strong barrier against small shot.

HANAPIER.—The front part of a cuirass, or iron breast-plate worn by light-armed soldiers. Also written *Hanepier*.

HAND.—1. The small of a gun-stock. 2. A measure four inches in length. The height of a horse is computed by so many hands and inches.

HAND ARBALEST.—A portable balista used in ancient Greece, very much like the cross-bow of the Middle Ages.

HAND ARMS.—Hand-arms are usually divided into three classes, depending on their mode of operation. 1st. *Thrusting*-arms, which act by the point. 2d. *Cutting*-arms, which act by the edge. 3d. *Thrusting and Cutting*-arms, which act either way. The object of all hand-weapons is to penetrate, directly, the person of an enemy. They may be divided into three distinct parts, viz.: 1st. The point, or edge, which attains the object; 2d. The body, or blade, which constitutes the mass of the weapon, and transmits the force of the hand to the object; and, 3d. The handle, or point of application of the motive force. The mechanical principles to which they may be referred, are lever and wedge. With a given force of the hand, acting against a given object, the penetration of a thrusting-weapon depends upon the power of the wedge formed at its point. The effect will be modified, however, by the position of the axis of the wedge, for if it do not coincide with the direction of the impelling force, there will be a component force which acts to turn the point to one side. The blade of a thrusting-weapon should, therefore, be straight, and should taper to a point. To guide it easily, the center of gravity should be found in or near the handle; this may be accomplished by grooving the blade, by making the handle heavy, or by adding a counterpoise to it.

The principal thrusting-weapons are the *straight sword*, *lance*, and *bayonet*. The straight swords as well as other swords, are composed of the *blade*, the *hilt*, and the *guard*. The blade is divided into the *point*, the *middle*, the *reinforce*, the *shoulder*, the *tang*, or portion which is inserted into the handle, and the *grooves*, the number of which is equal to the number of faces, or, from two to four. The length of blade varies from 30 to 33 inches, the width is from ½ to ¾ of an inch, and the weight 1 to 1½ lbs. The hilt is divided into the *knob*, and the *gripe*; the gripe is generally made of wood, covered with leather or sheet-brass, and wrapped with wire to give it roughness, and prevent it from slipping in the hand. The guard is composed of the *curved branch* and *cross-piece*, and the *plate*, all joined in one piece. The object of the guard is to protect the hand, the plate to ward off the point, and the branch, the edge of the enemy's sword. The *wounds* made by thrusting-swords, particularly those with three or four concave sides, are very dangerous, as they close up externally and suppurate internally. In experienced hands the straight sword is well adapted to encounter one of its kind, but it is too weak to parry the blows of a saber. It is now but little used in this country, except for ornamental purposes; the saber being preferred as a service weapon, even for infantry officers.

The lance, or pike, is composed of a sharp steel blade, fixed to the end of a long and slender handle of wood. The *blade* is generally from 8 to 10 inches long, and, in order that it may combine stiffness with lightness, is grooved after the manner of the common bayonet, leaving three or four ridges. The base of the blade has a socket, and two iron straps, for securing it to the handle. Three small staples are sometimes fastened to the handle, below the blade, for the purpose of attaching a *pennon*, which serves as an ornament, and to frighten the enemy's horses. The *handle* is made of strong, light, well-seasoned wood. The lower end is protected with a tip of iron, and a leather *loop* is attached opposite the center of gravity, to enable the arm to carry and guide the lance. The total length of a lance varies from 8½ to 11 feet, and the weight is about 4½ lbs. On horseback, and when not in use, the lance may be carried in two ways: 1st. By placing the lower end in a leather boot attached to the stirrup, and passing the right arm through the leather loop. 2d. By placing the lower end in the boot and strapping the handle to the pommel of the saddle. The first mode enables the horseman to take his lance with him when he dismounts, and is well suited to light lances. The second mode is necessary to heavy lances. In the first shock of a cavalry charge, and in the pursuit of a flying enemy, the lance is a superior weapon to the saber, as it has a greater penetration, and attains its object at a greater distance; but in the hand-to-hand conflict following a charge, the latter is superior to the former. Hence, it has been customary in certain services to arm a portion of both light and heavy cavalry with the lance. In the Russian service, the front rank of the cuirassiers, a species of heavy cavalry, is armed with the lance, and the rear rank with the long two-edged saber; and in nearly every European service, the lancers constitute an important part of the cavalry organization. It is also a favorite weapon with the mounted Indians of this country.

The bayonet is a pointed blade, attached to the end of the fire-arm, to convert it into a pike. The mode of attachment should be such that the bayonet will not interfere with the loading, aiming, and firing of the piece; and it should be so secure as not to be disengaged in conflict. The *musket-bayonet* is composed of a *blade*, a *socket*, and a *clasp*. The blade of this bayonet is made of steel, 18 inches long, and, to give it lightness and stiffness, its three faces are grooved in the direction of the length. The grooves are technically called *flutes*. The blade is joined to the socket by the *neck*, which should be strong, and free from all defects of workmanship. The *socket* is made of wrought-iron, carefully bored out to fit the barrel of the piece easily, and at the same time closely. It is secured by a stud (brazed on the barrel), which fits into a crooked channel, or *groove*, cut in the socket, and by a movable ring called the *clasp*. Short arms such as carbines and musketoons are sometimes furnished with bayonets of sufficient length to enable these arms to resist a charge of infantry or cavalry. Such bayonets are generally made in the form of a sword. The back of the handle has a groove which fits upon a stud on the barrel, and the cross-piece of the handle is perforated so as to encircle the muzzle-end of the barrel. The bayonet is prevented from slipping off by a spring catch. The handle is made of a solid piece of brass, with a hole running through it for the tang of the blade, which is secured by riveting down the point. The back of the blade is turned toward the barrel, and the body is bent outward, fixed, may be used as a poignard, for the personal defense of the soldier. The bayonet contributes very much to the efficiency of a military fire-arm, particularly as it enables infantry to resist cavalry. Too much attention cannot be paid in teaching troops the use of this arm, and inspiring them with

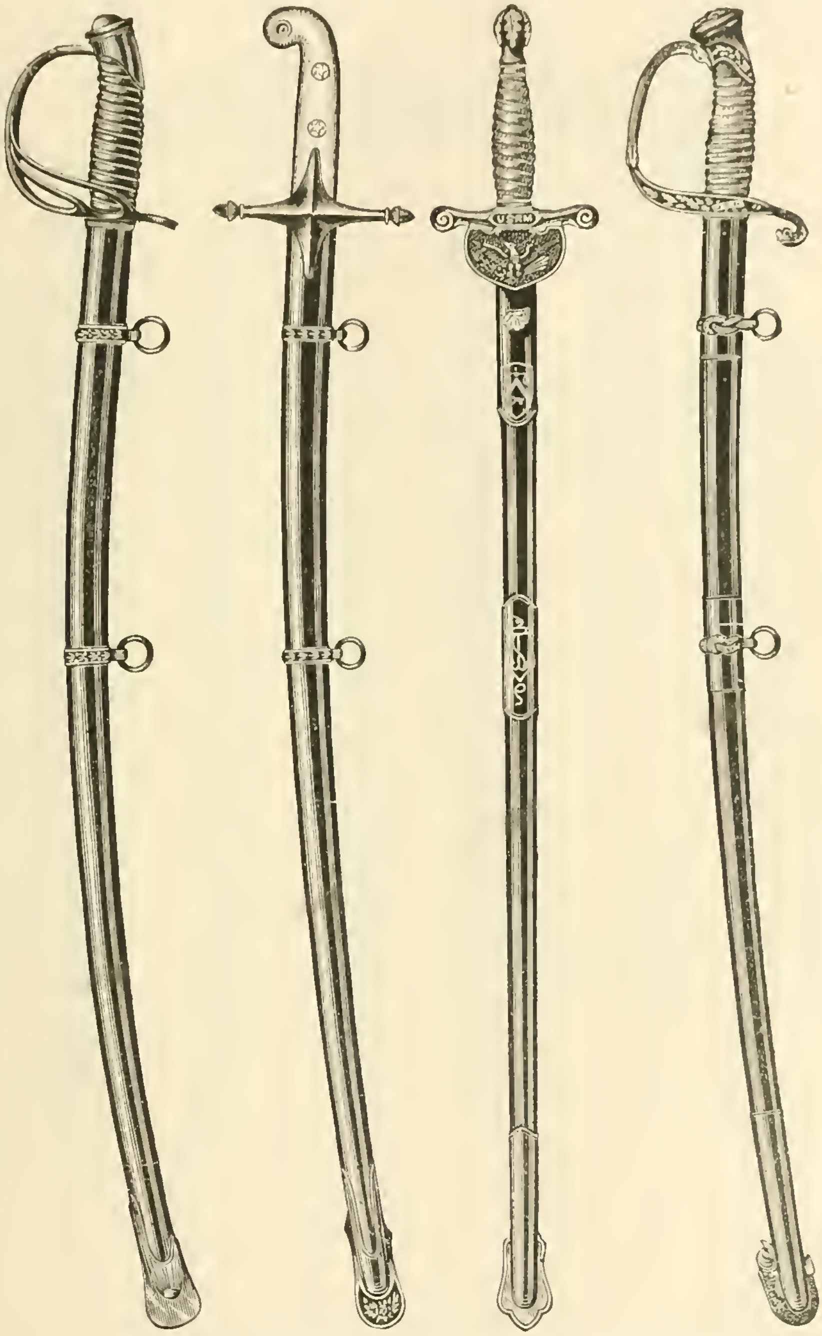


Fig. 1.

that neither may interfere with the hand in loading. Its length is about 23 inches, and its breadth $1\frac{1}{4}$ inches. The *sword-bayonet* is too heavy to be carried habitually fixed to the barrel; ordinarily it is carried as a side-arm, for which purpose it is well adapted, as it has a curved cutting-edge, as well as a sharp point. The regulation bayonet, when not confidence in it, for it very often decides the fate of a battle.

That edge of a cutting-arm will have the greatest penetration which opposes the fewest points to its object; a blade with a convex edge, will, therefore, have greater penetration than a straight one. The effect of a cutting-blade will be modified by the manner it is applied to the surface of the object; an oblique stroke, for instance, will make a deeper cut than a direct one. If the edge of the sharpest blade be submitted to a microscope, it will present to the eye numerous asperities, which give it the appearance of the cutting-edge of a saw; it is evident, therefore, that the motive force should act obliquely to the cutting-edge of the blade, as that enables it to rupture the layers of flesh upon which it acts, in de-

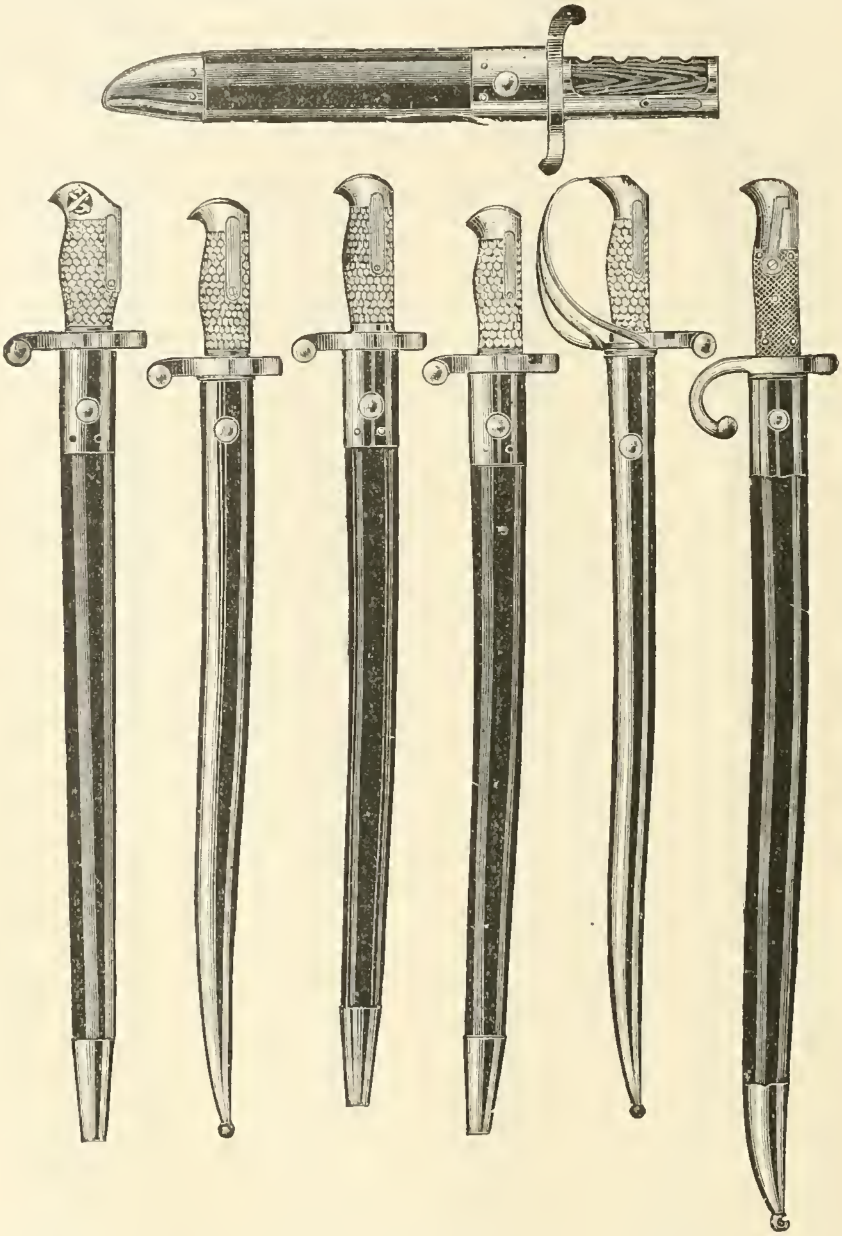


Fig. 2.

tail, and without expending its force upon the elasticity of several layers at once, which would be the case were it to act directly upon the object. When the curvature of a blade is convex on the cutting-side, the part near the point makes a deeper cut when it is pushed from the hand that moves it, as will be the case with the blows delivered in a charge of cavalry. On the contrary, a *concave* cutting-edge, like that of a sickle, acts most favorably when it is drawn toward the person using it; such is the *yataghan* of the Arabs, the shape of which is that of an elongated letter S. The facility of handling a saber, and the effect of its blow, depend upon the relative positions of the *handle*, the *center of gravity*, the *point of contact*, and the *center of percussion*. The nearer the center of gravity is to the point of contact, the more powerful will be the blow; but the difficulty of handling increases with the distance of the center of gravity from the handle. As the force of the blow is the important consideration in a saber, and the facility of handling in a thrusting-sword, it is customary to make the point of the blade heavier, and the handle lighter, in the former than in the latter. In certain light cavalry sabers, the center of gravity is placed about three or four inches from the handle. In order that no part of the force be lost, the point of contact should coincide with the center of percussion; the position of the latter point, however, depends upon the weight of the soldier's arm.

if motion takes place around the shoulder, and it therefore varies in particular cases. The principal cutting-weapon is the saber. The cutting-edge is generally convex; and the degree of its curvature is the characteristic feature of the weapon. The nomenclature of the saber is nearly the same as for the sword, the principal difference being in the structure of the guard, which is made lighter or heavier, as the saber approximates the character of a cutting or thrusting-weapon. There are two kinds of sabers used in the United States service, viz.: the *cavalry saber*, and the *light-artillery saber*. The *cavalry saber* being used, to a certain extent, for pointing as well as cutting, has only a moderate degree of curvature, a long blade (36 inches), and a "basket-hilt" to protect the hand from the point of the enemy's sword, and to carry the center of gravity toward the handle. The guard is composed of the *front*, *middle*, and *back* branches. The gripe is covered with calfskin, and bound with wire. The *light-artillery saber* being used more particularly for hand-to-hand conflicts, has a shorter (32 inches) and more curved blade, and a lighter handle than the cavalry saber. The guard is composed of a single piece of brass, terminating in a scroll. The blades of all sabres are grooved, to give them lightness. In certain services it is customary to arm the heaviest cavalry, or cuirassiers, with swords which are capable of coping with the bayonet or lance. The blades are long (from 36 to 40 inches), light, and straight, and they have a sharp point, and a single cutting-edge. The hilt is heavy, and of the basket form. The only weapon of the thrusting and cutting class used in the United States service is the foot-artillery sword, which resembles the short Roman sword in its character. The blade has two cutting-edges, is lightened toward the handle, and is 19 inches long. The guard is a simple cross-piece, formed of the same piece as the handle, which is made of brass. Figures 1 and 2 represent a variety of hand-arms, as manufactured in the United States. See *Small-arms*.

HAND BARROW.—A wooden frame which is carried around by two men, instead of being rolled forward, like a wheel-barrow. Those employed in the Ordnance Department are very useful in the erection of fortifications, as well as carrying shells and shot along the trenches. The ends of the side-rails are rounded and form the handles. Rope netting passes through holes in the side-rails and joins them. The weight of this barrow is about 20 pounds.

HAND BOARD.—A board used in the laboratory in rolling port-fire cases and similar work.

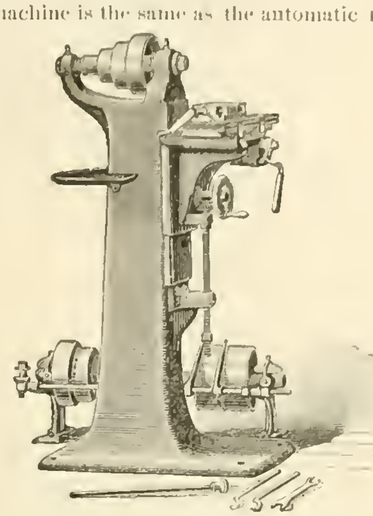
HAND CANNON.—A rudely made weapon of the fourteenth century. It was made of wrought-iron, and fastened to a piece of rough wood, so that it could not be brought to the shoulder. At first, the touch-hole was on top of the cannon, and had a covering plate on hinges to preserve it from damp. A little later the touch-hole was placed to the right of the cannon. See *Hackbush*.

HAND CART.—A light hand-truck used for the transportation of light stores from one part of a work to another. That for carrying powder, fuses, and such like articles has an arched lid-cover to keep off rain and prevent accidents from fire. The form mostly used in the United States service consists of a light body with shafts, mounted on two wheels. The shafts are joined together at the ends, and supported immediately in front of the body by iron legs. It weighs 180 pounds, and is very handy for the transportation of light stores in siege and garrison service. The drawing shows a very convenient cart, having two main fixed wheels and two heavy castors. This form is much used in transporting the heavier stores about the Armory and Arsenal.

HANDCUFF.—A fetter to secure the hands together. Handcuffs are made of iron, ring-shaped, with a lock attached, and just large enough to keep on the wrists without hurting them. Men who have deserted the service are usually manacled in this manner when being removed from one place to another.

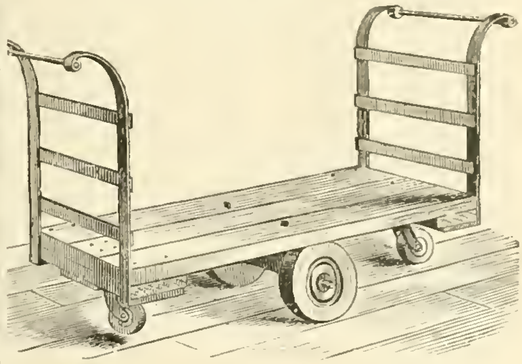
HAND CULVERIN. A small well-made cannon of the fifteenth century. The match was fastened to the weapon itself, and was held by the *Serpentin*, a sort of small linstock.

HAND FEED MILLING-MACHINE. A machine much used in the Armory for the rapid manipulation of small work, in the fabrication of fire-arms, etc. The machine is the same as the automatic machine,



Hand-feed Milling-machine.

with the exception of the automatic-feed being replaced by the hand-feed, which is operated by a lever fastened to the pinion-shaft, giving a very direct motion and quick return. Adjustable stops are placed on the table for regulating the motion. The machine



Hand-cart.

is usually furnished with a vise and a dividing-head, and is arranged for cutting gears and pinions either on centers or in a spring-chuck. The counter-shaft hangers are generally adjustable and self-oiling. See *Milling*.

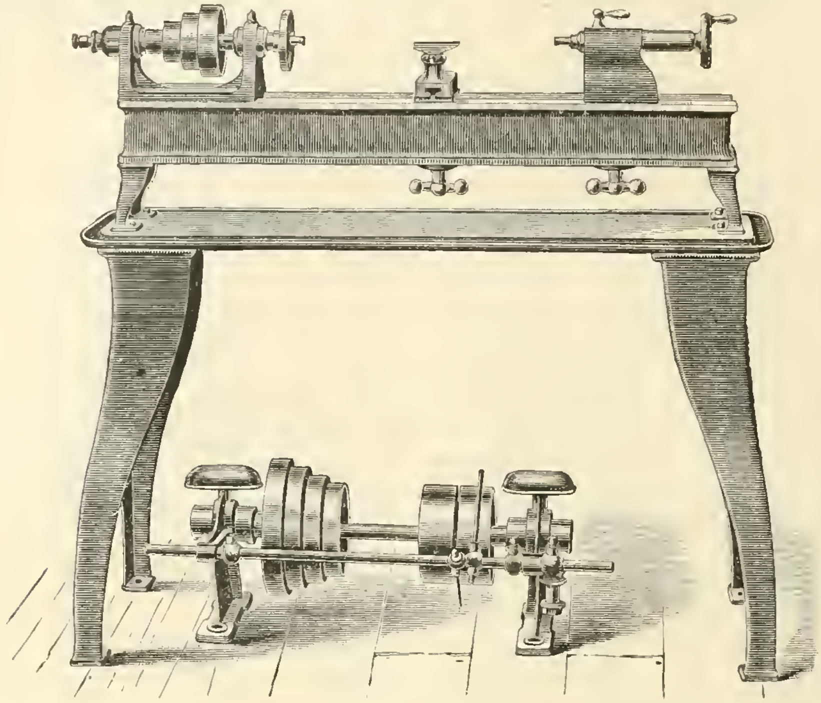
HANDFUL.—A term used figuratively, in a military sense, to denote a comparatively small number; as, "A handful of men."

HAND GALLOP.—A very slow and easy Gallop, in which the hand presses the bridle to hinder increase of speed.

HAND GRENADE. -Hand-grenades consist of small cylindrical-shaped shells, with conical ends, fitted with a plunger at the striking-end, and a directing-feather at the other. The plunger fits loosely into the cavity in the forward part of the shell, and is made to project two or three inches beyond its face, being retained in place by a light spring; it has attached to its outer end a circular piece of sheet-iron several inches in diameter. At the bottom of the cavity in which the plunger is placed a nipple is fixed, communicating with the bursting-charge, on which is placed an ordinary percussion-cap, which is exploded when the plunger is driven in violently, thereby igniting the charge. There are three sizes of grenades, 1, 3, and 5 pounds, and are intended to be thrown by the hand, and may be very effectively used in repelling attacks by boats or by persons well sheltered against others completely exposed.

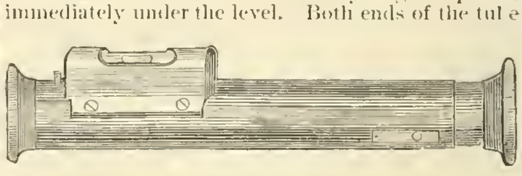
Ketchum's hand-grenade, which has lately been introduced into the American service, is a small, oblong percussion shell, which explodes on striking a slightly resisting object. To prevent accidents, the "plunger," or piece of metal which communicates the shock to the percussion cap, is not inserted in its place until the moment before the grenade is to be thrown. See *Grenade*, *Projectiles*, and *Rampart-grenade*.

HAND-LATHE.—A small lathe mounted on a bench or table and turned by a hand-crank or by a bow. It is usually portable, and may be secured by a clamp to the bench. It is extensively used in the Armory in making the small parts of small-arms. The drawing shows the Pratt and Whitney 8-inch hand-lathe, as employed in most gun-factories in the United States. The cone has four grades, for 1½-inch belt; the spindle has extra large bearings, in gun-metal boxes, and has a hole through its center ⅜-inch in diameter. The boxes are seated in tapering recesses, and are split, so that any possible wear may be taken up by means of cap-nuts. The cap-nuts contain felt linings, to prevent the introduction of dust, or of emery, when the lathe is used for polishing. A hand lever for actuating the foot-stock spindle is furnished, in addition to the hand-wheel and screw, or without hand-wheel and screw. The lathe with 30-inch bed, receives 12 inches between centers, and weighs, with the countershaft, 340 lbs. Speed of countershaft, with 7 by 2¼-inch tight and loose pulleys, 320 revolutions per minute. Larger lathes of this pattern are also used on the larger parts of small-arms. A 15-inch hand-lathe has a cone carrying a 2¼-inch belt. The head-spindle has large bearings, in cast-iron boxes lined with Babbit-metal of the best quality. The face-plate and centers interchange with those of the 13-inch engine-lathe. Hand-lathes swinging 12 inches, are of similar construction, with the exception that the boxes are of the same material and style as those of the 8-inch. The holes through the centers of the spindles are for 12-inch lathes, $\frac{7}{16}$-inch diameter; 15-inch lathe, $\frac{9}{16}$-inch. Countershafts should have speed as follows: For 12-inch lathe, tight and loose pulleys 6 or 8 by 2¼ inches, 200 to 250 revolutions per minute; for 15-inch lathe, tight and loose pulleys 8 or 12 by three inches, 175 to 250 revolutions per minute. See *Lathe*.



Hand-lathe.

HAND-LEVEL.—A small and portable instrument for indicating a horizontal line, or determining the position as to horizontality of an object or surface to which it is applied. The drawing represents Locke's hand-level, a very accurate and suitable instrument for general reconnaissance-work. It consists of a brass tube about six inches long, having a small level on top and near the object end, there being also an opening in the tube beneath, through which the bubble can be seen, as reflected by a glass prism, immediately under the level. Both ends of the tube are closed by plain glass settings to exclude the dust, and there is in the inner end of the sliding or eye-tube a semicircular convex lens, which serves to magnify the level-bubble, and cross-wire underneath, while it allows the object to be clearly seen through the open half of the tube. The cross-wire is fastened to a little frame moving under the level-tube and adjusted to its place by the small screw, shown on the edge of the level case. The level of any object in line with the eye of the observer is determined by sighting upon it through the tube and bringing the air-bubble of the level into a position where it is bisected by the cross-wire. A short telescope is some



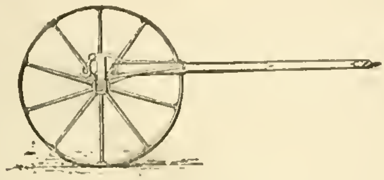
Hand-level

times applied in place of the plain glass ends, thus enabling levels to be taken at greater distance and with increased accuracy. See *Clinometer*, and *Y Level*.

HAND MALLET.—A wooden hammer with a handle, to drive fuses, or pickets, etc., in making fascines or gabion batteries.

HAND RUBBING.—The manipulation which a horse's legs undergo on the march and elsewhere, chiefly at feeding time, and which should be continued for about 20 minutes at each meal.

HAND SLING CART.—A two-wheeled carriage made entirely of iron, except the pole, which is of oak. The axle-tree is arched to make it stronger,



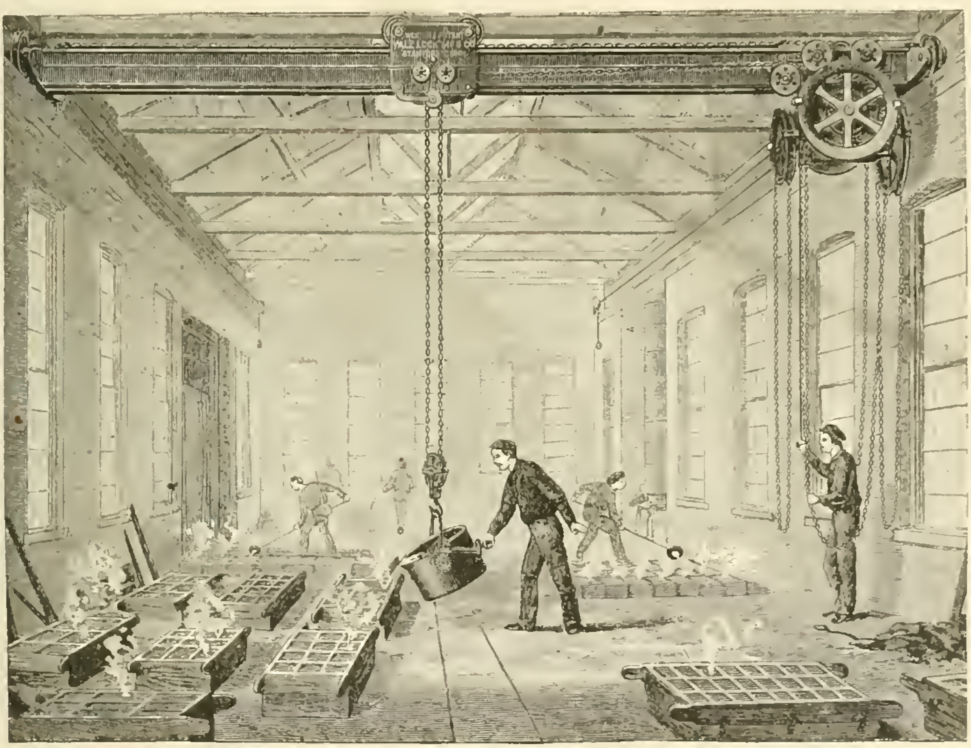
Hand Sling-cart.

and connected with the pole by strong wrought-iron straps and braces. In the rear of the axle a projection is welded to receive the end of a strong hook. The end of the pole terminates in a ferrule and an eye. The eye serves the purpose of attaching to the cart, when necessary, a limber or a horse. The diameter of the wheel is six feet. The hand sling-cart is designed for moving light weights and siege-pieces in the trenches by hand. The weight is raised by first attaching to it a sling, and then applying to the sling the hook upon the rear of the axle, by raising the pole of the cart. The pole is used as a lever, the axle and wheels being the fulcrum. It may be used for any weights not exceeding 6,000 pounds. See *Garrison Sling-cart* and *Sling-cart*.

HANDSPIKE.—A wooden or iron lever, flattened at one end and tapering towards the other, used in raising heavy weights and in moving guns into position for loading and firing. The *trail* handspike for field carriages is 53 inches in length; the *maneuvering* handspike for garrison and sea-coast carriages and for gins is 66 inches; for siege and other heavy work it is made 84 inches long and 12 lbs. weight; the *shod* handspike is particularly useful in the service of mortars and casemate and barbette carriages; the *truck* handspike for casemate carriages, of wrought-iron; the *roller* handspike, for casemate carriages. It is made of iron, 1 inch round, the point conical, whole length 34 inches.

HANDSPIKE RINGS.—The thimbles on the trail transoms of guns, for the handspike, by which they are maneuvered.

HAND TRAVELING-CRANE.—The most satisfactory construction of this crane, as exhibited in the engraving, has the mechanism attached to one end of the bridge so that the operator is somewhat removed from the load, thus adapting it especially to foundry use. The bridge is arranged to travel lengthwise upon the longitudinal tracks, and the trolley to move transversely upon the bridge, so that the entire rectangular space between the tracks is covered by the crane. Cranes of this design are built of any desired capacity up to 10 tons, and of any span. The crab containing the operating mechanism is permanently secured to the under side of the bridge at one end, and is located entirely below it, so that the bridge can be placed close to the under side of roof or ceiling. The trolley travels upon tracks on top of the bridge, and its sides extend downward close to the bridge, with the chain sheaves contained between them, thus giving the maximum amount of hoist. The Weston fixed-cable system is employed to effect the squaring of the bridge and its longitudinal motion upon the overhead tracks. The travel of the trolley upon the bridge is effected by an independent mechanism, operated by an endless hand-chain from the floor below, in a manner similar to that employed in the



Hand Traveling-crane.

jib cranes. Motion of the bridge is also effected by an endless hand-chain or rope passing over another rope-wheel. Pulling one side of this chain causes the bridge to move in one direction, and pulling the other causes it to move in the opposite direction. At each end of the crab, or housing containing the operating mechanism, are similar rope-wheels, over each of which passes an endless rope or chain. Pulling either of these in one direction causes hoisting, and in the other, lowering. One is larger than the other, thus giving two speeds; while, by pulling both simultaneously, an additional speed is obtained. The several motions of hoisting or lowering, and of moving the bridge or trolley, may each be effected independently or simultaneously.

The hoisting-gear consists of cut steel worms engaging with cut worm-wheels, with provision for thorough lubrication. The main hoisting-chain is endless and passes over pocketed chain-wheels, by which it is driven, the arrangment of parts being such as to distribute the wear equally throughout the entire length of this chain. A safety device, consisting of automatic friction-ratchets in combination with the worm-shafts, is employed, so that the load is always self-sustained in any position and cannot run down. Lowering is effected by reversing the motion of the hoisting-chains. The location of the mechanism at one end of the bridge removes the operator from proximity to the load, which is, of course, desirable in handling ladles of hot metal, and in lifting large flasks, etc. While particularly designed for foundry use, this type of crane is equally suitable for use in forges and for many of the same purposes as other cranes. See *Cranes, Power Traveling-crane*, and *Traveling-crane*.

HANDLE.—The portion of a tool, or implement, by which it is grasped. As—*helve* of a hammer or axe; the *haft* of a knife; the *hilt* of a sword; the *stock* of a drill, bit, or gun; the *shaft* of a spear, lance, or harpoon; the *crank* of a winch or crab; the *pommel* of a saddle; the *trigger* of a gun-lock; and the *dolphin* of a gun. In bronze guns of the old construction handles were usually cast over the center of gravity of the piece, for convenience of handling and slinging. These were made in the shape of a fish, and hence were called *dolphins*.

HANDLE ARMS.—In the earlier tactics, a word of command (when the men were at *ordered arms*), by which the soldier was directed to bring his right hand briskly to the muzzle of his fire-lock.

HANGED, DRAWN, AND QUARTERED.—The description of the capital sentence on a traitor, which consisted of drawing him on a hurdle to the place of execution, and after hanging him dividing the body into quarters. This punishment was substituted, for the ancient more barbarous sentence of disemboweling alive, but the Crown has power to reduce the sentence to simple beheading.

HANGER.—A term applied to a short broadsword, incurvated towards the point. The *hanger* was a Turkish sword formerly worn by the Janissaries.

HANG FIRE.—The term is applied when a gun is slow in discharging itself, from the flame being checked in its passage to the charge, either from the vent being fouled or the charge being damp. The former can scarcely happen now, as the friction tube conveys the flame to the charge with great certainty.

HANTE. The French name for an ornamental pike, having a banner attached.

HAQUETON.—A padded or quilted tunic worn by armed warriors in the Middle Ages. It was worn beneath the mail and was slightly longer than the *hauberk*.

HAR.—A syllable used in composition usually as a prefix, and signifying *army*: occurring in various forms, as *hare*, *her*, and *here*; as harisvalt, leader of an army.

HARANES. The French designation of the Hungarian Militia.

HARASS.—In the military, the act of annoying and incessantly pursuing or hanging on to the rear and flanks of a retreating force, so as, if possible, to prevent its attaining its object, and perhaps overcoming the enemy altogether. Notwithstanding the disadvantage which a retreating army has under these circumstances, history affords us examples that if the retreat be conducted by an able Commander, he has it in his power, by his ingenuity and other military qualities, to avoid the enemy, by getting into inaccessible places, or by so disposing of his troops as to make it hazardous for a pursuing army to follow him up, or any longer to endeavor to harass him.

HARBOR DEFENSES.—The entrance to a harbor may be considered, and is in fact, a defile, the defense of which follows the rules applicable to defiles generally. The means usually employed to prevent the passage of hostile ships are divided into three classes, viz.: 1st. Forts and land-batteries; 2d. Submarine mines; 3d. Floating defenses. Whenever practicable, batteries should be well strung out in groups, the strength of which should increase as they are approached from the outside. This arrangement has a peculiarly discouraging effect on an enemy. The first batteries will at least damage him and cause confusion, thus weakening his attack on the stronger, and when his discomfiture finally takes place, the batteries already passed will prevent his return and insure his total destruction. The islands, headlands, and narrows usually found at the entrances of harbors will generally, to a greater or less degree, enable this arrangement to be carried out. Experience teaches that where the channel is unobstructed steam-vessels can run past shore batteries, however well the latter may be served. But, on the other hand, where obstructions to their rapid transit exist, they have not the endurance and aggressive power to effect much damage to land defenses. In the smoke of battle and tideway of the channel they become unmanageable, get aground, or collide with each other.

It is a well-settled fact that a hostile fleet, by concentrating its fire on an open work, may temporarily silence its guns. For this reason the accumulation of guns in works exposed to such concentration should be avoided by distributing them in batteries, each containing but few pieces, due regard being had to their security from assault and capture by any force that may be landed for that purpose. The best arrangement is to place them in detached batteries of, say, 2, 4, or 6 pieces each, well secured from the enemy's fire by earthen epaulments and traverses. This arrangement makes it difficult for the enemy to discover the exact position of the guns, and every peculiarity of ground should be taken advantage of to increase this difficulty. Whatever tends to make batteries difficult to see, and consequently to hit, is as much a protection as that which makes them capable of resisting a hit when made. Guns thus dispersed have greater freedom of lateral range of fire, and do not interfere so much with each other by reason of their smoke as when concentrated—a matter of no little importance with heavy artillery, which emits such volumes as, in certain conditions of the atmosphere, to greatly interfere with accuracy of aim. When batteries are extended, a larger area will be swept by their converging fire than when the guns are assembled *en masse*. An additional advantage conferred by distributing the guns is, that while obtaining concentrated fire on an important or decisive point, a similar fire cannot be directed in return. This arrangement would, furthermore, tend to neutralize the power which a fleet might have of forming on a wide arc of a circle, and moving slowly under steam, so as to render the task of hitting the individual ships more difficult, throw a converging fire upon the works on shore.

In the design of such works, it is of primary importance that conjoint action of the various parts should be maintained; and to prevent the individual batteries from being captured by *coup de main*, small inclosed earth-works, heavily stockaded to resist escalade, and each armed with field, siege, and machine guns, and siege mortars, should be constructed so as to have complete command over all land approaches. These earth-works should contain the infantry supports. In this manner most of the existing sea-coast forts may be utilized, making of them protecting works for exterior earthen batteries. The defenses of a harbor should, in every instance, be capable of repulsing all attacks that the enemy is likely to make on them. The power and persistency of these attacks will depend upon the importance to him of the object to be gained. Large and opulent cities, naval establishments, and ship-yards are among the first prizes sought for. The aggressive power of modern navies is such as to make it quite impracticable to effectually guard every harbor on an extended coast. It is, therefore, better to entirely abandon those that are unimportant to the enemy, for whatever use he may make of them, than by feebly guarding them to invite his attacks and thus afford him the moral effect and consolation of cheap victories, and to the country the mortification and disadvantage of defeat and loss of prestige.

The number of troops required for the manning of a work erected for harbor defense depends chiefly upon the nature and amount of armament contained therein. Works of this nature are armed principally with pieces of the heaviest caliber, but, for reasons hereafter given, all kinds should generally find place. The amount of armament depends upon the extent of the work and the part it is to play in the scheme of defense. Three full detachments are necessary for each piece. Knowing the number of pieces in the work and the number of men required for the service of each, the entire strength required is obtained. Three relief detachments are necessary, for the reasons that the labor of manipulating and serving heavy artillery is very great, and when a rapid and continuous fire is to be maintained, strong fatigue parties are required in carrying ammunition from the service magazines to the pieces; damages done to the works during the day have to be repaired at night, and casualties occurring, whether from the fire of the enemy or from accidents, must be provided against, so that at any moment an efficient detachment may be at every piece. As a general rule, batteries should not be encumbered by an attempt to include musketry defense within their limits. The place for this arm is on the flanks of the batteries, and in strength sufficient to prevent an enterprising enemy from landing and assaulting the work, and from approaching to keep down the fire of the guns while his vessels run by it. However well it may have answered with the old style of artillery to have the troops serving batteries charged, in addition, with musketry duty, it certainly is not advisable with the artillery of the present. Steam-propelled iron-clads, carrying guns of enormous power, range, and accuracy, demand the undivided attention in action of those using the only weapons effective against such adversaries. The labor of handling and caring for the kind of artillery, ammunition, material, and machines now used, altogether with the construction, preservation, and repair of batteries, will require all the time and the whole attention of the troops serving guns in war. The care of infantry arms and equipments, together with the drills and parades incident thereto, have a tendency to draw away the attention of officers and men and prevent them from keeping in an efficient state of readiness, the only safeguard that stands between an enemy and the object for which he may desire to enter a harbor. When a work containing batteries for harbor defense is inclosed, the amount of musketry necessary for it is determined by allowing two muskets for each lineal yard of parapet not occupied by the batteries. Artillery being the main feature in such works, the command should be vested in an Artillery Officer. Where there are several forts and batteries guarding the entrance to a harbor or constituting a line of works, they should, for the purpose of administration and command, be united in groups, each group being under an Artillery Officer of appropriate rank, and the whole combined and commanded by the Senior Officer of Artillery present. By this means thorough co-operation is secured throughout the entire system. In order to avoid the weakening effect of divided responsibility, submarine mines, when employed in conjunction with a fort for the defense of a channel, should be under the control of the Commandant of the fort, who should select from his command the proper number of officers and men to be instructed in the method of working this branch of defense. No more troops than are necessary to carry out the foregoing rules should be crowded into a work; otherwise, unnecessary casualties from the fire of the enemy will be added, stores consumed, and unhealthiness engendered; and, besides, in time of war, when troops are not required in any one place, their services are generally needed elsewhere. The high standard of practical gunnery required of artillery demands a proportional degree of intelligence and capacity for instruction in the individual soldier. Artillerymen should be selected with a special view to this, artisans and mechanics forming a large proportion. Steam-power and the application of labor and time-saving machinery should, wherever practicable, be introduced to assist in making the defensive abilily of fortified places more perfect. In conducting the defense of a work, too much importance should not be attached to the battering of it by an enemy; for experience teaches that a place is formidable, if resolutely defended, long after it has lost all semblance of the form and symmetry possessed by it when it came from the hands of the constructing engineer. See *Defense*.

HARBORING AN ENEMY.—A crime prohibited in military law and severely punished under all circumstances. The Articles of War provide that whosoever relieves the enemy with money, victuals, or ammunition, or knowingly harbors or protects an enemy, shall suffer death, or such other punishment as a Court-Martial may direct.

HARCARRAH.—In India, a messenger employed to carry letters, and otherwise intrusted with matters of consequence that require secrecy and punctuality. They are very often Brahmins, who are well acquainted with the neighboring countries; they are sent to gain intelligence, and are used as guides in the field.

HARD-BREAD.—A component of the army ration, generally issued, instead of flour, to troops while campaigning. When hard-bread is put in boxes, (the best packages for *field* transportation), they should be made of fully seasoned wood, of a kind to impart no taste or odor to the bread, and as far as practicable of *single* pieces. When two pieces are used in making the same surface, they should be tongued and grooved together. A box, 26×17×11 inches, exterior measure, is an average box for hard-bread, under the usual circumstances of land transportation. The ends of a box of this size should be made of inch, and the remainder of five-eighths stuff, the package well strapped with green hickory or other suitable wood. Hard-bread, after *thorough* cooling and drying, should be pressed closely in its packages, each package containing a uniform weight *of bread*, for the convenience of calculation. It can be re-dried in boxes without removal therefrom, by being exposed for about forty hours to a temperature of 140 degrees Fahrenheit. *Hard-tack*, *Pilot-bread*, and *Sea-bread* are common names of the article. See *Ration*.

HARD-LABOR.—A military punishment frequently awarded by Courts-Martial. This punishment is now firmly established in the United Kingdom; and by express statute, the power of adding hard-labor to the punishment of imprisonment, has been given in most cases, both as to indictable offenses and the more disgraceful offenses which are punishable summarily. The kind of labor is prescribed by the rules of the jail or prison, where provision must be made of the proper materials for the purpose. Picking oakum, working the tread-mill, etc., form part of this labor; and in general, the number of hours for such labor, unless in case of sickness, is ten hours daily.

HARDNESS.—The hardness of a body is measured by its power of scratching other substances. Variations in the degree of hardness presented by different crystalized bodies often furnish a valuable physical sign by which one mineral may be readily distinguished from others closely resembling it. Mohs selected ten well-known minerals, each succeeding one being harder than the preceding one, and thus formed the *scale of hardness*, which has been generally adopted by subsequent Mineralogists. Each mineral in the following table is scratched by the one that follows it, and consequently by all the subsequent ones, and the hardness of any mineral may be determined by reference to the types just selected. Thus, if a body neither scratches nor is scratched by feldspar, its hardness is said to be 6; if it should scratch feldspar but not quartz, its hardness is between 6 and 7—the degrees of hardness being numbered from 1 to 10. The figures on the right indicate the number of known minerals of the same or nearly the same degree of hardness as the substance opposite to which they stand:

SCALE OF HARDNESS OF MINERALS.

1. Talc	23	6. Feldspar (cleavable)	26
2. Comp't gypsum, or r'k-salt	90	7. Limpid quartz	26
3. Calcspar(cleavable variety)	71	8. Topaz	5
4. Fluor-spar	53	9. Sapphire, or corundum	1
5 Apatite	43	10. Diamond	1

The cause of the varieties of hardness observed in different bodies is not known. The same substance—as, for example, a piece of steel—may, under the influence of different circumstances, be so soft as to take impressions from a die, or may be nearly as hard as a diamond. Without a certain degree of hardness, the shape of the bore will be rapidly altered by the compressive force of the powder and projectile, and the accuracy and safety of the piece will be destroyed. In rifle cannon hardness is particularly necessary, to enable the spiral grooves to resist this action; at least, the surface of the bore should be relatively harder than the projectile. Steel is generally hardened by heating it until the scales of oxide are loosened (heat to about a cherry-red), and plunging it into a liquid or placing it in contact with some cooling substance which suddenly chills the metal, rendering it hard and brittle. The degree of hardness will depend upon the heat and the rapidity of cooling.

HARE CARTRIDGE-BLOCK.—A block recessed for any convenient number of cartridges in one row. On one side is fixed a leather strap, between which and the block, the left hand is to be passed, the back of the hand being next to the block and holding it in a convenient position for loading. For convenience the block is curved, and the surface next to the hand covered with sheepskin. The cartridge-holes are bushed as in the Benton-block. This block is permanent in its nature, and intended to form a part of the soldier's equipment.

HARMOSTES.—A City Governor or a Prefect appointed by the Spartans in the cities subjugated by them.

HARNESS.—1. The iron covering or dress which a soldier formerly wore, and which was fastened to the body by straps and buckles; the whole accouterments, offensive and defensive. 2. The equipments of a draught-horse. The best method of attaching horses to a carriage is that which enables each one to perform a given amount of work with the *least fatigue*; or, in other words, no horse should be restrained by the efforts of another, and the direction of the traces should be most favorable for draught. Besides these conditions, artillery-harness should be so constructed that it can be put on and taken off promptly, by night as well as by day, in all states of the weather, and in cases of danger, when the drivers would be liable to lose their presence of mind. The fall of one horse should not interfere with another; a dead or a wounded horse should be easily replaced, whatever may be his position in the team. The absence of some of the horses, the unhitching or cutting of some of the traces should not arrest the movement of the carriage. Finally, the drivers, who are mounted for the better command of their horses, should not be incommoded by the pole of the carriage.

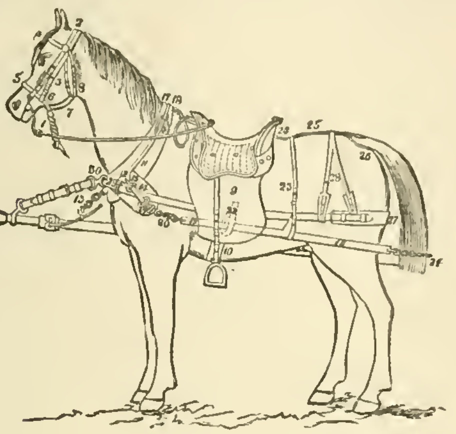
There are three general modes of attaching horses to artillery-carriages, and upon the employment of any one of which depends the construction of the harness. In the first method the wheel-horse is placed between two shafts, by which he guides and regulates the motion of the carriage. The horses may be arranged in single or double file. The former arrangement was much in vogue in artillery before the days of Gribeauval, but at present is only employed in the mountain service. This method has the merit of being well suited for drawing heavy loads over smooth roads, but is not adapted to rapid movements over ordinary roads, as much of the tractile force is lost by the continued change in the line of traction incident to long columns. The force thus lost is expended in a great measure on the shaft-horse, which by constant fatigue, is soon rendered unserviceable. In the English light artillery the horses are arranged in double file, the *off* wheel-horse being placed in shafts.

In the second method the horses are arranged in double file—a wheel-horse being placed on each side of the pole, which is attached to the first axle-tree. The pole is supported and kept steady by the pressure of the body of the carriage on the *sweep-bar*, which projects in rear of the front axle-tree. The leading horses are attached to the *swing-tree* which is fastened to the pole, and the wheel-horses are attached to a *movable splinter-bar*, the center of which is in the axis of the pole. The object of making a splinter-bar movable is to equalize the draught between two horses, one of which works more *freely* than the other. This system of attachment is used in most carriages of commerce, and so far as the draught alone is concerned, is superior to all others. It is also used in all siege-carriages and baggage-wagons of the military service, except that in the former the splinter-bar is fixed.

In field-carriages of late pattern the *sweep-bar* is omitted, to facilitate attaching and detaching the rear carriage in time of action; and the pole is supported by two yokes attached to the collars of the horses. The wheel-horses are attached to a fixed splinter-bar, which is strong and simple in its construction; and the traces of the leading horses are attached directly to those in the rear, giving a continuous line of traction, communicating directly with the carriage. This method of attaching artillery-horses in line is extremely simple, and at the same time it fulfils nearly all the conditions requisite for artillery harness. Its principal defect, however, is that, from the want of a sweep-bar the weight of the carriage-pole is borne on the necks of the wheel-horses, which is a serious inconvenience when making long marches.

Artillery harness is composed of the *head-gear*, to guide and hold the horse; the *saddle*, for the transportation of the driver and his valise; the *draught-harness*, which enables the horse to move the carriage forward; and the *breeching*, which enables him to hold it back, stop it, or move it to the rear. The *collar* prevents the horse's shoulders from being hurt by the two curved pieces of iron called the *hames*; to each hame is fastened a short leather tug ending in an iron ring, to which the front trace-chain is attached. The load is pulled by strong leather straps called *traces*, to the end of which chains are fastened; the front trace-chain plays back and forth in the tug-ring, and makes the wheel-horse independent of the horses in front; the rear trace-chain can be lengthened or shortened at will so as to adapt the harness to different horses. The *pole-yoke* is supported by a chain attached to the hame-clasp and to a ring which slides along the yoke; the branches of the pole-yoke are jointed to a collar near the end of the pole in such a way that they can only play in a plane passing through the axis of the pole; this device enables the horse to keep the pole steady without constraining his motion.

The *breeching* forms a part of the wheel-harness only; it completely encircles the horse, and is held up in the rear by a strap passing over the hips. The traces of the wheel-horses are usually hitched to the splinter-bar; the traces of the lead and swing-horses are hitched to those of the horses in the rear, giving a continuous line of traction from horses to carriage. When wheel-horses are hitched to a splinter-bar trace, there is always an equal bearing on both sides of the collar; this saves their necks from a great deal of chafing, particularly in changing direction.



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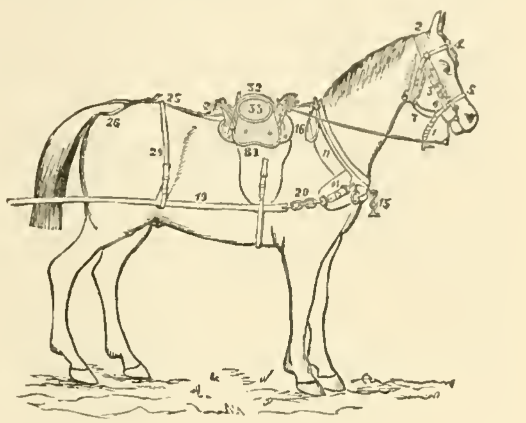


2

As the limber has no sweep-bar, the weight of the pole comes on the necks of the wheel-horses: this defect is somewhat lessened when the limber-chest is loaded, its position over the axle being such as to decrease the weight at the end of the pole.

The following is the nomenclature of the harness, reference being made to Figs. 1 and 2: *Halter*, composed of *head-stall* and *hitching-strap* (1); the head-stall includes, *crown-piece* (2), *cheek-strap* (3), *brow-band* (4), *nose-band* (5), *chin-strap* (6), *throat-strap* (7), and *throat-lash* (or *throat-band*) (8). *Bridle*, composed of *head-stall*, *curb-bit*, and *reins;* the head-stall includes, *crown-piece*, *cheek-strap*, *brow-band*, and *throat-lash;* the curb-bit is of iron and brass-plated; it includes *mouth-piece*, *branches*, *cross-bar*, *curb-chain* (or *curb-strap*), and *curb-chain hook*. *Near saddle* (9), including *saddle-tree*, *seat*, *saddle-skirts*, *stirrups*, and *girth* (10); the saddle-tree consists of *pommel*, *cantle*, and *side-bars;* the girth consists of two *straps* of unequal length. *Collar* (11), including *rim*, *belly*, *pad*, *collar-straps*, *billets*. *Hames* (12), including *branches*, *double-joint loops* for trace-tugs, *links* for breast-straps, *hame-rings*, *hame-clasp*, *chain* and *toggle* (13), *safes* (14), *trace-tugs* (15), *trussing-straps* (16), *hame-strap* (17), and *collar-strap* (18). *Traces* (19): *front-trace chains* (20): *rear-trace chains* (21); *trace-loops; trace-toggles* (22); *belly-band; loin-strap* (23). *Crupper*, including *back-strap* (24), *body* (25), and *dock* (26). *Breeching* including *breech-strap* (27), *hip-strap* (28), *breast-strap* (29), and *sliding-loops* (30) for pole-straps. *Off saddle* (31), including *hook* for reins, and *valise-strap* (32). *Valise* (33). *Coupling-rein*. *Whip*, including *stock* and *lash*. *Leg-guard*, including *body*, *under-strap*, *leg-straps*, and *plate*. *Nose-bag*.

A storehouse for harness should be well ventilated – not too dry, but free from dampness. The different articles should be arranged in bundles, according to kind and class, without touching the wall or each other. Harness should be examined four times a year, at least. The leather parts are brushed and greased with neatsfoot oil as often as condition requires; if they have a reddish hue, add a little lamp-black in the oil. The hair side of the leather should be wet with a sponge dipped in warm water, and the oil applied before the surface is dry. The iron parts which are not japanned should be covered with tallow.

To Harness.—Each wheel-driver places on and buckles the collar of his off horse, smoothing the mane under the collar and adjusting the collar to the shoulders; folds and puts on the saddle-blanket, and then resumes his post in front of his harness. (2) He seizes the saddle by the girth-straps, his hands close to the saddle; raises it from the peg; holds it over his head, arms half extended; approaches the horse on the near side, and places the saddle in its proper position, taking care not to rumple or displace the blanket, and keeping the right arm extended over the horse's back to adjust the girth and traces. (3) He goes to the front of the horse; passes the breast-strap carefully over the horse's head; adjusts the hames to the collar; clasps them together at the bottom, and tightens the hame-strap. (4) He goes to the near side of the horse; lifts the breeching over the cantle; steps to the rear, and pulls it over the horse's croup; arranges the loin-strap; and adjusts and buckles the crupper, taking care that no hairs remain between the crupper and tail. (5) He sees that the harness is properly arranged, buckles and tightens the girth, and then buckles the belly-band. (6) He bridles the horse and ties the coupling-rein to the manger. Lead and swing-drivers harness and unharness in the same manner as wheel-drivers, with such omissions as are required by the difference in the harness. If there be no stable the horses are taken at the picket-line, and the harness from the rack near the carriage to which it belongs. Each driver *stands to horse* as soon as he has harnessed.

To Unharness.—Each wheel-driver ties the coupling-rein fast to the manger; takes off the leg-guard, and hangs it up; unbridles his near horse, and hangs up the bridle. (2) He unbuckles and frees the crupper; raises the breeching from the croup, and lays it over the cantle, resting its middle on the seat. (3) He goes to the front of the horse, draws the breast-strap well forward through the links, loosens the hame-strap, unclasps the hames at the bottom; passes the breast-strap up over the horse's head, and lays it and the hames over the pommel. (4) He unbuckles the belly-band, and then the girth, takes off the saddle, places it properly on its peg or rack, and covers it with the blanket. (5) He then removes and puts up the collar and secures the horse by the halter.

HARNESS-DRESSING.—A preparation for the care and protection of harness, and the leather parts of the accouterments. A variety of dressings are in common use, but the following (ingredients for two gallons of the compound) is mostly used in the service: 1 gallon of neat's-foot oil, 2 pounds of bayberry tallow, 2 pounds of beeswax, and 2 pounds of beef tallow. Put the above in a pan over a moderate fire and let them remain one hour until thoroughly dissolved; then add 2 quarts of castor oil and stir well until the mass comes to a boil so that the ingredients may become thoroughly mixed; after which add—1 ounce of lamp-black and stir well for ten minutes; then strain the liquid while hot through a cotton cloth to remove sediment of beeswax, tallow, and lamp-black, and put aside to cool. Apply this mixture to saddles and harness with a woolen cloth and leave until next day, when they should be wiped off with a woolen cloth to remove the surperfluous lamp-black. For "russet" or fair leather, use the same mixture without the lamp-black.

HARNESS-PEGS.—In artillery stables, harness-pegs for each pair of horses are arranged in the walls of the harness-room, also in the heel-posts of the stalls. The peg for the off harness is above the peg for the near harness; a small peg for the bridles is placed beneath the near harness-peg. The following arrangement is observed: Pommels of the saddles against the wall or heel-posts; breeching hanging over the cantles; breast-straps and hames over the pommels; traces, which are trussed, over the seat; whip on the hook of the off saddle; collars lying horizontally on the saddles, collar-straps against the heel-posts; bridles and leg-guard hanging on their peg: the whole covered by the harness-sack properly secured. The blankets are kept by the drivers in their quarters, but may be put away in the harness-room, or other safe place. A trace is trussed by passing the rear trace-chain through the trussing-strap, from rear to front, and securing the trace by drawing down the sliding-loop.

HAROL.—An Indian term signifying the officer who commands the van of an army. It sometimes means the van-guard itself.

HARPE.—A species of drawbridge used among the ancients, and deriving its name from the musical instrument. This bridge, which consisted of a wooden frame, and hung in perpendicular direction against the turrets that were used in those times to carry on the siege of a place, had a variety of ropes attached to it, and was let down upon the wall of a town by means of pulleys. The instant it fell, the soldiers left the turret, and rushed across the temporary platform upon the rampart.

HARPOON GUN. Agun used for shooting whales. It is frequently employed to great advantage when necessary to throw lines across rivers and the like. It is very similar to the small swivel-guns, weighing with stock complete 75 lbs., 3 feet long in the barrel and of 1¼ inch bore. The charge is very small, barely sufficient to project the arrow and line from the gun.

HARPY.—A fabulous creature in Greek mythology, considered as a minister of the vengeance of the gods. Various accounts are given of the numbers, and parentage of the harpies. Homer mentions but one, Hesiod enumerates two—Aëllo and Okypete, daughters of Thaumas by the Oceanid Electra, fair-haired and winged maidens, very swift of flight. Three are sometimes recognized by later writers, who call them variously daughters of Poseidon or of Typhon, and describe them as hideous monsters with wings, of fierce and loathsome aspect, their faces pale with hunger, living in an atmosphere of filth and stench, and contaminating everything that they approached. The most celebrated tradition regarding the harpies is connected with the blind Phineus, whose meals they carried off as soon as they were spread for him; a plague from which he was delivered by the Argonauts, on his engaging to join in their quest. The Boreads Zetes and Calais attacked the harpies, but spared their lives on their promising to cease from molesting Phineus. A harpy in Heraldry is represented as a vulture, having the head and breast of a woman.

HARQUEBUSE.—An old fire-arm resembling a musket, which was supported on a rest by a hook of iron fastened to the barrel. Many of the Yeomen of the Guard were armed with this weapon, on the first formation of that Corps in 1485. The harquebuse being frequently fired from the chest, with the butt in a right line with the barrel, it was difficult to bring the eye down low enough to take good aim; but the Germans soon introduced an improvement by giving a hooked form to the butt, which elevated the barrel. Soldiers armed with this weapon were designated Haquebutters, and were common in the time of Henry VIII.

HARROW.—An obstacle, in fortification, formed by turning an ordinary harrow upside down with the teeth upward, and the frame buried. This implement consists of a frame of a square or rhombic form in which are fixed rows of teeth, or *tines*, projecting downwards. The harrow is very ancient, having been in use beyond the dawn of history; but as in early times only the lighter soils were cultivated, it often consisted of bushes, or branches of trees, which merely scratched the ground. Subsequently, we find a wooden frame and wooden tines in use; next, the wooden frame with iron tines, a form of the instrument very much used at the present day, and especially in favor for light soils. For heavy soils, the harrow constructed wholly of iron is most used, as it is heavier and does more execution; and of this sort the zigzag form made by Mr. Howard, of Bedford, is preferred.

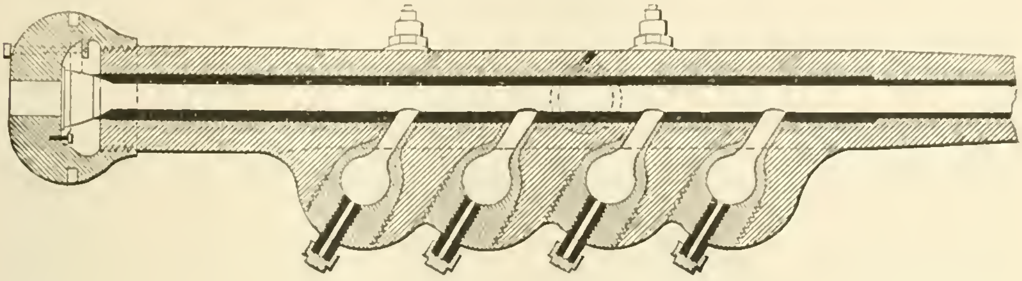
HARSEGAYE.—A kind of demi-lance, introduced about 1114. It is now obsolete.

HASKELL MULTI-CHARGE CANNON.—The Lyman accelerating-gun, patented in 1857, is worked on the principle of giving to the projectile a gradually increasing velocity while in the bore of the gun. Bomford's method of measuring powder-pressures at different points in the chamber of a cannon disclosed the fact that the great pressure on that part of the chamber occupied by the powder-charge rapidly diminished as the shot approached the muzzle, and that lateral pressures were not dangerously great on the gun after the shot was under way, unless something happened to wedge the projectile.

Lyman reasoned that if he could continue to increase the powder-pressure he might make the muzzle end of a gun as strong as the breech, and utilize the added strength to increase the velocity of a projectile in regular ratio up to the very instant of its leaving the muzzle. He accomplished something in this direction with his earlier gun, which was a cast-iron piece with tubes branching from the bore at a point between the breech and the trunnions.

The Lyman gun, as improved by J. R. Haskell, is a cast-iron, steel-lined rifle, having a number of pockets, each formed in a block of steel, which is screwed into an enlargement of the cast-metal body of the gun. Over each pocket there is a priming hole extending out through the upper portion of the gun. This hole is stopped by a bronze metal plug, which screws into place to close the hole entirely, making a smooth surface with the steel bore-tube when the plugs are screwed home. The steel pockets, as a general thing, have cleaning plugs at the bottom.

The piece is loaded by placing a projectile and cartridge of slow-burning powder in the breech, and a charge of quick-burning powder in each of the pockets. The projectile fits the bore tightly, so that no gas can leak past. When the breech-charge is fired it starts the projectile at a moderate velocity, which is rapidly increased after the shot passes the pockets by the explosion of the powder in the pockets, ignition being effected from the primary charge.



Haskell Multi-charge Cannon.

The gun in course of construction at the Scott Foundry, Reading, Pa., now nearly completed, was made under Mr. Haskell's superintendence. The gun is 6 inches bore, 25 feet long, and weighs 25 tons. The lining tube is 2½ inches thick to a point forward of the front pocket; from there to the muzzle it is 2 inches. There are four pockets in the gun, each intended for a charge of 28 pounds of quick powder. The breech charge will be about 18 pounds hexagonal powder. A projectile three calibers in length will weigh 100 lbs.—one of four calibers, 150 lbs.

Mr. Haskell expects to get an initial velocity of 3,000 feet per second with pressure nowhere exceeding 30,000 pounds per inch, and to obtain a penetration equal to 24 inches of iron. In view of the result of past experiments there is little doubt that very good penetration will be obtained, and if such velocities can be had from the moderate pressures proposed by Mr. Haskell, any armor now in existence can be pierced by guns much lighter than the 11-ton monsters used in the Italian or British Navy.

HASTATI.—Up to the time of Marius, by whom the germ of the decadence of the military art among the Romans was sown, a Consular Army consisted of two *Legions;* and of two *Wings* composed of social troops. The legion was composed of infantry of the line, light infantry, and cavalry. The infantry of the line was divided into three classes. 1. The *Hastati*. 2. *Principes*. 3. *Triarii*. These classes wore a very complete defensive armor; they were all armed with the short straight Spanish sword; the *Pilum*, a kind of javelin, about seven feet in length, used equally to hurl at a distance and in hand-to-hand engagements, was added to it for the two first; and the Triarii carried the pike.

HASTY INTRENCHMENTS.—Extemporized shelters which are quickly constructed from materials found upon the spot where the shelter is needed. In consequence of the effectiveness of modern fire-arms a body of troops can not retain a close formation for a single hour even, if in the presence and exposed to the fire of an enemy in force. The men are forced to seek shelter, by lying down on the ground, or by crouching behind any slight inequality which may exist in the surface, or behind some kind of screen which they may be able to construct. The screen may be two or three logs rolled together; a heap of fence rails, a slight mound of earth, or anything whatever its nature which will hide the soldier from the enemy's view.

The simplest forms of *hasty intrenchments*, in an open country, are the rifle pits and trenches. Hasty intrenchments were much used by both of the contending armies in the late war in the United States. They were used so frequently, and found so efficacious, that the men acquired the habit of intrenching their line immediately upon halting after a day's march, if the enemy was near. No compulsion, no orders, even, were necessary for the men to begin this work; the main difficulty was to make them delay enough to allow a proper trace to be marked, by which they might be guided in the construction of their line. Instances are known, where the men, not having intrenching-tools, executed the trench with the bayonet or the tin cup. These shelter trenches, thus rudely constructed, were deepened and strengthened until they were able to resist field artillery, if the position was to be occupied for any length of time. Slight as these defenses were during the early stages of their construction, they formed, when defended by good troops, an obstacle difficult to overcome; and they were captured only by extraordinary effort, accompanied by a great loss of life on the part of the attacking forces.

It will frequently happen that cover can be speedily obtained, and positions rendered defensible in a very short time, by taking advantage of the hedges, ditches and walls, which may be met with, or of the obstacles which may be presented by natural features of the ground. No fixed rules for proceeding under all the numerous circumstances which may occur can be given, but the drawings will show what may be effected in certain cases, and indicate the character of the operations usually required.

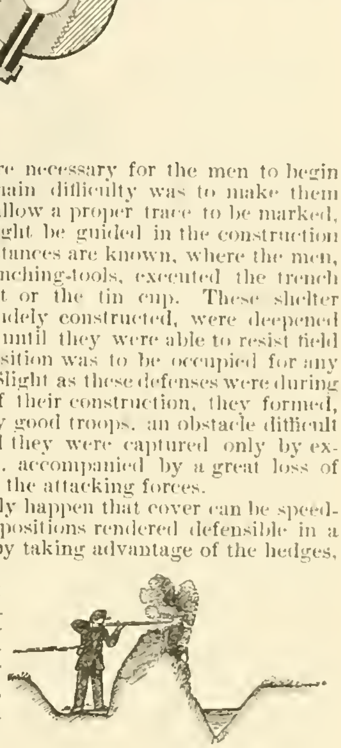


Fig. 1.

Fig. 1, represents the common hedge and ditch turned into a breastwork to be defended from the hedge-side. If the hedge be thick and planted on a bank, as is generally the case, and especially if the ditch be tolerably deep and contain water, the breastwork will be rendered strong at the expense of little labor. A shallow trench should be excavated behind the hedge, and the earth thrown up to raise the bank sufficiently to form a rough breastwork some 18 inches thick at the top. Should the hedge be more than 6 feet high, it should be cut to that height, having the branches interwoven with the lower part to strengthen it. A hedge to be defended from the ditch-side Fig. 2, is a ready-made trench and breastwork, and will become a convenient work by a little scraping of the sides and widening and levelling of the bottom of the ditch, and by the addition of a banquette. See *Walls*.

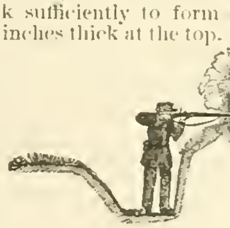


Fig. 2.

HATCHET.—A small, light sort of axe, with bevel edge on the left side, and a short handle. It is used by soldiers for cutting wood to make fascines, gabions, pickets, etc. A brass slide and snap combined is slipped upon the belt, and has a snap on the outer side, from which the hatchet can be hung. There is also a safety attachment through which the handle is passed, making a convenient and secure way of carrying the implement. *To take up the hatchet* among the Indians is to declare war and commence hostilities. *To bury the hatchet*, is to make peace.

HATCHMENT.—1. An ornament formerly much worn on the hilt of a sword. 2. The funeral escutcheon placed in front of the house of the deceased, or in some other suitable place, setting forth his rank with other circumstances. It is in the shape of a lozenge, and in its center are the arms of the deceased, single or quartered, as the case may be. The achievement of a *bachelor* represents his arms in a shield complete, accompanied with helmet, crest, mantling, motto, and various other external ornaments to which he may be entitled, on a black ground. In the achievement of an unmarried lady, her arms are placed in a lozenge on a black ground, but without external heraldic ornaments, except in the case of a peeress, when her supporters, robe of estate, and coronet are added.

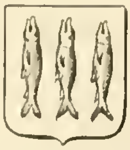
Hatchment of Husband.

The achievement of a husband whose wife survives, impales his arms with his wife's in a shield with the external ornaments to which he is entitled, the ground of the hatchment being, under his side of the shield, black, and under his wife's, white. If the wife be an heiress, her arms are not impaled, but carried in an escutcheon of pretense. The external ornaments are appended, except the insignia of any order of knighthood having a circle or collar, with which heralds do not consider it proper for a knight to encircle his wife's arms. On this account the achievement of a knight has two shields placed side by side, one containing the husband's arms only, encircled by the collar, ribbon, etc., of the order, the other containing those of husband and wife; the ground is divided perpendicularly in the middle of the second shield, and painted black and white. When the wife is a peeress in her own right, there are also two shields—the dexter containing the arms of the husband, with the lady's arms on an escutcheon of pretense ensigned with her coronet; the sinister lozenge-shaped with the lady's alone, and each accompanied with its proper external decorations. The ground is divided black and white in the middle of the dexter escutcheon. The arms of a wife whose husband survives are impaled with her husband's arms in a shield, or, in the case of an heiress, borne on an escutcheon of pretense. There is no helmet, crest, or mantling, but a peeress is entitled to her robe of estate. The ground under the dexter side of the shield is white, and under the sinister, black. The achievement of a widower differs principally from that of a husband, in the ground being entirely black. The achievement of a widow differs from that of a wife, both in having the ground entirely black, and in the form of the escutcheon, which (except in the one case of an escutcheon of pretense), is lozenge-shaped. The arms are encircled by a silver cordon or cordelière, the symbol of widowhood. On the decease of the last of a family, a death's head surmounts the shield in place of a crest. The achievement of a reigning King or Queen, whether married or not, represents the royal arms complete on a ground entirely black. That of an Archbishop or Bishop has the insignia of his See impaled with his paternal arms, and the whole surmounted by a miter, and the ground is per pale ar. and sa. The Dean of a Cathedral or Collegiate Church and a King at Arms, also impale the arms of office with their family arms. In the achievement of the wife of a Prelate, there are two shields—the first containing the impaled arms of the See and the Bishop, surmounted by a miter; and the second, the family arms of the Bishop with those of his wife. The ground is all white, except that part which is under the arms of the wife. The funeral escutcheon of Scotland, France, and Germany differs considerably from that in use in England; it indicates not merely the deceased's right to a coat-of-arms, but his gentility of descent. The hatchment is much larger, consisting of a lozenge above 6 feet square; and the arms of the deceased, which occupy the center, are surrounded by those of the 8 or 16 families from whom he derived his descent, the paternal quarterings on the right side, and the maternal on the left. The deceased is not entitled to an achievement unless all these families had a right to bear arms. On the four corners are death's heads and the initials and title of the deceased, the black interstices are powdered with tears. See *Heraldry*.

HAUBERGIER.—An individual who held a tenure by Knight's service, and was subject to the feudal system which formerly existed in France, and by which he was obliged to accompany the Lord of the Manor in that capacity whenever the latter went to war. He was called *Fief de Haubert*, and had the privilege of carrying a halbert. All vassals in ancient times served their Lords-paramont as Squires, Haubergiers, Lancemen, Bow-men, etc.

HAUBERK.—A long blouse-like garment, having short sleeves descending to the middle of the upper arm, which sometimes was formed of interwoven rings, or chain work, but more generally was constructed of a stout woven fabric, upon which were fixed rows of iron rings or plates of metal, in their form either square, triangular, or circular. This mail-shirt was fitted tightly to the person: and at the bottom it was divided, so that the wearer when mounted might wrap one division of it round each thigh, or when on foot might have his limbs covered by the cleft extremities of his hauberk without any impediment to his free movements. The hauberk was used by the Saxons, as early as the eighth century, as defensive body armor, and called by them the tunic of rings, but by the Normans the *hauberk*. Besides the hauberk of rings, there are some marked with transverse lines, so as to give the idea of being quilted, or stiched in chequers, or covered with small lozenge-shaped pieces of steel instead of rings, known about this period, A.D. 1066–1087, by the name of mascled armor, from its resemblance to the meshes of a net. Other descriptions of armor were in use, and in some instances hauberks appear to be composed of rings and mascles mixed; in others, the body is diamonded, and the cowl and arms covered with rings. On referring to a work entitled "The Conqueror and his Companions," by Mr. J. R. Planché, Somerset herald, the hauberk as worn by William the Conqueror is thus spoken of: "In the Bayeux tapestry we behold him armed in his hauberk, which was not the coat of chain-mail of the thirteenth century, but the *geringhed byrnie* of the eleventh and twelfth, consisting of iron rings, not linked together and forming a garment of themselves, but sewn or strongly fastened flat upon a tunic of leather or quilted linen, buckram, canvas, or some strong material descending to the mid-leg, and which, being open in the skirts both before and behind for convenience in riding, gave it the appearance of a jacket with short breeches attached to it, if, indeed, such was not actually the case in some instances. The sleeves were loose, and reached only just below the elbow." The habergeon of plate-armor was generally worn over the hauberk. See *Habergeon* and *Plate-armor*.

HAURIANT.—A term in heraldry applied to a fish placed upright as if to refresh itself by sucking air. Gules, three lucies (the ancient name of pikes) hauriant in fess argent, the arms of a family of the name of Lucy in Hertfordshire. See *Heraldry*.



HAUSSE.—A graduated piece attached to the barrel near the breech, which has a sliding piece retained in its place by a thumb-screw, or by the spring of the slider itself. This slider ought to have an opening through which the gun can be conveniently aimed; and is raised to such a height as we think will give the necessary elevation for the distance. The term coarse sight means a large portion of the front sight, as seen above the bottom of the rear-sight notch; and a fine sight is when but a small portion is seen. The effect of a coarse sight is to increase the range of the projectile. The *breech-sight*, the *tangent-scale*, and the *pendulum-hausse* are merely different forms of this device, the latter having a bulb at the bottom which keeps it in a vertical position when the two wheels of the carriage are not on the same level. The tangent-scale has steps, corresponding in height to the graduations on the breech-sight for guns of the same caliber and pattern; and is only applied to the gun at the moment of sighting.

HAUSSE-COL.—An ornamental plate similar to the gorget. It was formerly worn by infantry officers.

HAUTES-PAYES.—Soldiers formerly selected by the Captains of companies to attend them personally, for which service they received something more than the common pay. *Haute-pay* became afterwards a term to signify the subsistence which any body of men superior to, or distinguished from the private soldier were allowed to receive.

HAUT-LE PIED.—A term used to distinguish such persons as were formerly employed in the French armies without having any permanent appointment. *Commissaries hauts-le-pied* were known in the artillery during the Monarchy of France. They were usually under the Quartermaster-general.

HAVELOCK.—A light cloth covering for the head and neck, used by soldiers as a protection from sunstroke. This covering derived its name from Havelock, a distinguished English General.

HAVERSACK.—A bag of strong coarse linen, in which, on the march, each soldier carries his own bread and provisions. It is borne on the left side by a strap passing over the right shoulder, and is only used in the field and in cantonments. The haversack of the Roman soldier was an osier basket with a long neck; sometimes, as on the column of Trajan, a wallet carried on the spear. Its contents were salt meat, cheese, onions, and olives. It held sufficient for three days. The term haversack is also applied to the leather bag used in artillery to carry cartridges from the ammunition-chest to the piece in loading.

HAVILDAR.—The highest rank of Non-commissioned Officer among native troops in India and Ceylon. In the Hong-Kong Gun Lascars (a corps now disbanded), the Havildar received 1s. 3d. per diem; but in India his pay is somewhat less. The *Havildar-major* is the Sergeant-major of each native regiment of infantry.

HAVOCK.—A cry originally used in hunting, but afterward in war as the signal for indiscriminate slaughter. The term *havoc* is used in the sense of wide and general destruction, devastation, or waste, hence the origin of *havock*.

HAWK.—The Hawk frequently occurs as a charge in Heraldry, and may be *belled*, *jessed*, and *varveled*. The *hawk's bell*, itself used as a separate charge, is attached to the leg of the bird by *jesses* or thongs of leather. *Varvels* are rings attached to the end of the jesses. The *hawk's lure*, also a heraldic charge, consists of two wings joined with the line, to the end of which is attached a ring. The line is sometimes *nowed* or knotted.

Bell.

Lure.

HAWSER.—A rope made of three strands: it is coiled up right-handed, or what is termed "with the sun." It is one of the ropes used in lifting ordnance. See *Cordage* and *Rope*.

HAXO BASTION SYSTEM.—The siege of this system of fortification is calculated to last fifty days and there are five distinct periods of breaching batteries: 1° Against the reduit of the salient place of arms and the Ravelin. 2° Against the reduit of the reentering place of arms, the coupures and the reduit of ravelin. 3° Against the bastionet and the counterguard. 4° Against the retrenchment. 5° Against the bastion. The front is 360 yards long. The perpendicular is only 40 yards, and the faces 72 yards. The flanks are perpendicular to the lines of defense. The bastions contain interior retrenchments entirely separated from the rear by a ditch. A *chemin-des-rondes* surmounts the scarp of the enciente. The tenaille is not revetted, and it has flanks that can mount three guns. The main ditch is twenty yards wide. The ravelin is made very salient, with a casemated traverse in capital, and coupures cut across its faces. In rear is a reduit of the ordinary outline, and behind is a casemated caponiere or bastionet, the roof of which carries ten guns. The counterscarp of the main ditch is produced to within ten yards of this bastionet, and in front of it slants a glacis, which closes the ditch of the ravelin and that of the reduit. The bastionet sweeps the interior glacis and co-operates with the flanks of the inner works to impede the construction of the counterbatteries.

HAXO CASEMATE.—A work built inside the parapet, arched and covered with earth, opening in the rear to the terreplein. The guns are protected from the enemy's fire, and can be entirely hidden by masking the embrasures.

HAY.—A very important article of forage in most armies. The management of the natural grasses of which most hay consists is somewhat different, and the process is seen to perfection in Middlesex and various Counties about London. The great matter—too generally overlooked in Scotland—is to preserve the color and flavor of the grass; and this can only be done by keeping it constantly turned, and having it rapidly dried, if possible, without the deteriorating washing of repeated rains. Artificial drying best attains this end, but is of course impracticable on a large scale. In the best style of English haymaking, the grass, after being cut with a scythe or machine, and as soon as the dew is off, is shaken and spread out by means of forks or of a *tedding*-machine drawn by a horse. It is not allowed to lie long exposed to the sun, but before evening, is drawn together by rakes into *wind-rows*, which, if there is any prospect of rain, are made up into small heaps or cocks. It is again spread out next morning, or on return of favorable weather; and when the operations are expedited by wind or sun, the hay will be ready for the rick by the second or third day. There is, however, much difference in the time during which the hay requires to lie out; the bulk of the crop and the quality of the land must be especially considered. When the grasses are cut, as they should be when in bloom, and before their seeds ripen and their stems get rough and hard, they contain the greatest amount of moisture, and require careful making, but produce a very nutritive and palatable hay. As soon as thoroughly dry, it should be put at once into the stack or rick, and well trodden down. A certain amount of heating improves the flavor, and renders the hay more palatable to every sort of stock. When, as is sometimes the case, it is imperfectly made, or picked up too soon, it gets over-heated, and becomes dark brown or black, its nutritive properties are diminished; it is, moreover, apt to disagree with both horses and cattle, and can only be profitably used when mixed with straw and cut into chaff. Hay put together when damp from rain or dew does not heat, as when it contains an undue amount of natural moisture, but speedily molds. When hay has been injured and weathered by repeated rains, it may be rendered more palatable by scattering a little common salt over the rick whilst it is being built. Throughout Scotland eight or ten pounds of salt to the ton is very generally used alike for clover and grass hay. In the midland and southern districts of England the best hay is generally got up in June; but in Scotland, little is carried until the middle of July. When the crop is good, and everything done well, the cost of hand and horse labor expended upon the hay before it is safely ricked will approach 20s. per ton. The crop averages from one to two tons per acre. Hay that has stood for seed is tougher and less nutritive than that cut earlier, for the sugar, gum, and glutten of the matured seed have been abstracted from the stems, which are then apt to be little better than straw.

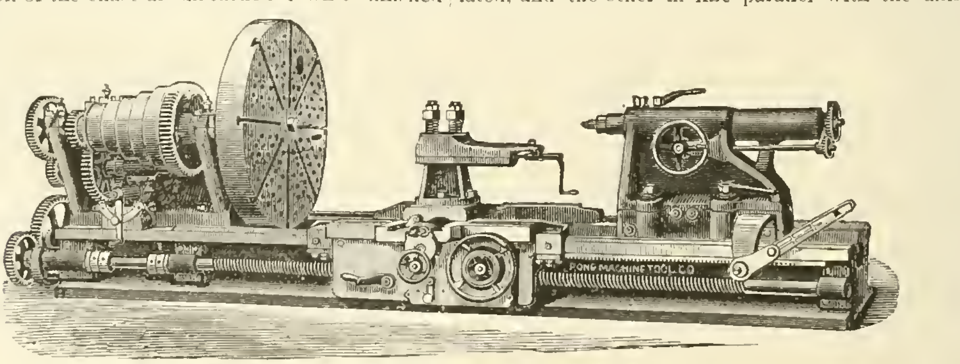
HAZAREE.—An Indian term signifying the Commander of gun-men. It is derived from *hazar*, which, in its literal interpretation, signifies a thousand.

HEAD.—In gunnery, the fore part of the cheeks of a gun or howitzer-carriage. The term *head* is employed with other words, in various military phrases as, the *head of a work*, in fortification, or the front next to the enemy, and farthest from the place; *head of an army*, or the front, whether drawn up in lines or on a march, in column, etc.; *head of a camp*, or the ground before which an army is drawn up. The *head* of a double tenaille is the salient angle in the center and the two other sides which form the re-entering angles.

HEADER.—In a revetment, a brick, stone, or sod laid with its end outward. See *Sod Revetment*.

HEADING.—1. The device of the signal-rocket; such as a *star-heading*, or a *bounce-heading*. 2. In mining, the end of a drift or gallery; the line of an intended tunnel, especially one of relatively small size, which forms a *gullet* in which the workmen labor; also a horizontal passage between the shifts or turns of the working parties.

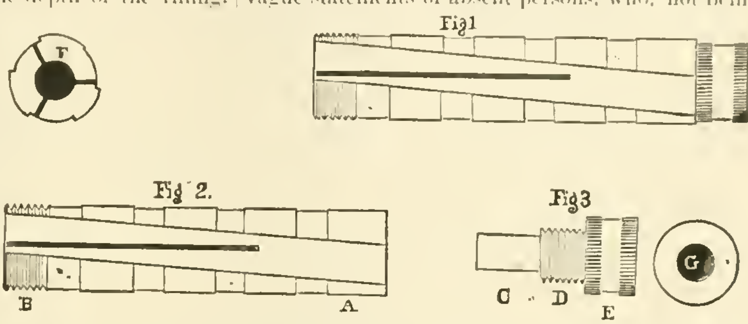
HEADING-LATHE.—A lathe used for turning down gun castings, and for preparing them for the boring-machine. The cascabel-bearing, base of breech, and a section of the chase are all turned down to finished muzzle is introduced and projects several inches beyond the face of the muzzle-ring, in which position it is approximately centered, and held firmly in place by adjustable screws in the chuck and muzzle-ring. The breech is adjusted by placing a sharp pointed instrument in the rest, and bringing it in contact with the surface of the casting near the base-line, and while turning the gun—which is done by machinery—the screws in the chuck are moved until coincidence of the line around the gun is obtained. At the muzzle a bar of iron is laid upon blocks, so that it shall be just inside the bore, and nearly in contact with its interior surface. As the gun turns, the distance between this point and the metal of the bore is observed, and equalized approximately, by the screws in the muzzle-ring bearing. A wooden disk turned to fit the bore accurately, bearing a string attached to its center, is then pushed to the bottom of the bore, and made to assume a position in a plane perpendicular to its axis. The string from the center of the disk is long enough to reach some distance outside the muzzle; the outer end being made fast to an upright the same height as the inner end or center of disk; the string is now hauled perfectly taut, and the gun again turned, a square being placed upon blocks about one foot in front of the muzzle, close to the string; and as the gun revolves, the distance, if any, which the string deviates from the square, is observed and corrected by again moving the screws in the muzzle-bearing. When properly centered, the string will remain in the same position in the square and be the same distance from the interior surface of the gun, throughout an entire revolution, showing that the axis of the gun and lathe coincide. With the hollow-cast gun it is necessary that it should be centered from the bore, as it sometimes happens that its axis does not coincide with the axis of the casting, which is one reason for casting them above the true size, to admit of being finished by the interior, or so that the axis of the cast bore shall coincide with that of the gun when turned. The gun being centered, the turning commences at the muzzle; this is done by placing a tool in the rest, which is brought in contact with the surface at the desired point, the metal being turned off as the gun revolves. The *rest*, or support which holds the tool, is arranged to move in two directions, one towards the gun, or at right angles to the axis of the lathe, by which means the depth of cut is regulated, and the other in line parallel with the axis,



Heading lathe.

dimensions while in this lathe, as the chase and rounded part of the cascabel-knob form the bearings for the boring-lathe. The cut at the muzzle, or place where the *sinking-head* is to be broken off, is also made in this lathe. The bearing in which this muzzle-ring revolves is a heavy casting, the bottom of which fits into grooves in the rack, and can be moved to or from the chuck, being adaptable to long or short guns. To make the adjustment in the lathe, the gun is lowered into place, the square knob in rear of the cascabel fitting into the chuck, while the that is from muzzle to breech. The last movement is effected by means of a *feed*, the motion being given by a fork attached to one of the trunnions, and at every revolution of the gun the rest is made to advance. The first cut is usually an inch deep, commencing at the muzzle where the sinking-head is to be cut off and extending 30 inches towards the trunnions. The second and third cuts are commenced at the same point as the first, and are about one and one-eighth inches deep; increasing as the tool advances in the gun, other cuts are made until the metal is reduced to the finishing diameter. The cut at the muzzle, or the place where the "sinking-head" is to be broken off, is next made; its depth is usually about seven inches, or to within three or four inches of the cast bore. The gun is now taken from the lathe, and the "sinking-head" broken or wedged off, at which time the appearance of the metal at the fracture should be examined as to color, form, and size of crystals, texture, and whether sharp to the touch; it is also necessary to ascertain its degree of hardness and how the metal works under the tools, in the different stages of its fabrication; all of which should be duly noted and form part of the record of the gun. See *Finishing* and *Lathe*.

HEADLESS SHELL EXTRACTOR.—This implement, devised by Lieutenant-colonel A. R. Buffington, United States Army, for the Springfield rifle and carbine, consists of two parts of tempered steel, the extractor proper, Fig. 2, and small cylindrical drift, Fig. 3, for setting out the prongs, carried screwed into end, A, of extractor. Fig. 1 shows them together as they should be habitually kept and used for all extractions from the *bore* of the rifle. The extractor proper is a hollow cylinder, rifled on the exterior to correspond with the rifling of the rifle barrel, with four transverse grooves to the depth of the rifling. Inside it is shaped at the prong-end to receive the point, C, of drift and permit a limited expansion; at the other end it is tapped for the screw-thread, D, of the drift. Three cuts longitudinally divide one end into 3 prongs, F, around which is a screw-thread, B, for taking hold of the shell *when in the chamber*. The drift is a cylindrical piece of three diameters: the head, E, thread D, and point, C. The head is sufficiently small to allow it to pass through the bore; the cavity, G, in it prevents injury to firing-pin. The thread secures it to extractor. The point, when driven between the prongs of extractor as far as possible, sets them out sufficiently to remove a shell, but not far enough to touch the walls when passed into the empty chamber.



Headless Shell-extractor.

The parts should be kept screwed together and never separated for use, in *any case*, until after passing it as a whole—solid (drift) end foremost through the bore from the muzzle—and failing to remove the shell. Passing it thus—using larger end of hammer to do so—will remove any shell or part of shell in the bore, or slightly protruding into it from the chamber. Failing to do so, unscrew the drift; insert the extractor, prong end foremost, into the chamber; close the breech; pass the drift, point foremost, into the bore at the muzzle; follow it with the larger end of rammer; drive it gently "home" between the prongs of extractor; open the breech and drive out the shell. After the shell is out, the two parts either separate or can be separated by the fingers, and the shell removed from the extractor. The prongs being in the mouth of the chamber, the point of drift invariably enters between them if the drift be passed through the bore as directed. In case of accumulated or hardened fouling or dirt in the bore, the extractor as a whole, as directed, may be passed through it with advantage either as a preliminary to cleaning or wiping, or to remove the *cause* of swelled and burst barrels. In the latter case it should be used just before each shot when at the target, or as often as convenient when hunting or in battle. See *Springfield Rifle*.

HEAD-QUARTERS.—A term generally understood to mean the residence of the Commander-in-Chief, whether in camp or elsewhere. It is also applicable to the place where the officer, commanding any independent position or body of troops, resides; hence, the center of authority or order. The headquarters of the whole British Army is at the Horse Guards, where the Commander-in-Chief has his permanent offices.

HEADSTALL.—That part of the bridle which encompasses the head; the bridle minus the bit and rein; the halter minus the hitching-strap.

HEAD STOCK.—That portion of a lathe which contains the mandrel or *live* spindle on which the work is chucked or to which it is dogged, in contradistinction to the *tail*-stock which contains the *dead* spindle. The *live*-head as distinguished from the *dead*-head.

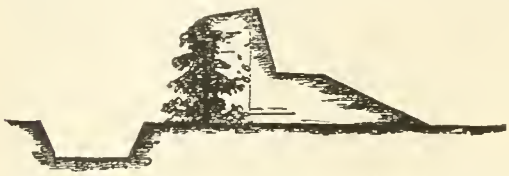
HEARSAY EVIDENCE.—Evidence given at second-hand, where the witness states not what he himself saw or heard, but what somebody else said. This evidence is, as a general rule, inadmissible, because the axiom is, that the best evidence that can be had must be produced, and therefore each witness must be confined to stating what he knows of his own personal knowledge, or what he has learned by the aid of his own senses; and as he is sworn to the truth, his truthfulness is thus secured, as far as human testimony can be so. If evidence were once admitted at second-hand, there would be no limit to its uncertainty, and there would be thus introduced vague statements of absent persons, who, not being sworn when they made them, are therefore incapable of being punished if they speak falsely, and cannot be cross-examined. Though such is the general rule, yet there are a few exceptions which are unavoidable, owing to the nature of the thing. Thus, in proving pedigrees, the hearsay evidence of persons connected with the family, and those only, is admitted in England; but in Scotland it is admitted though the persons were not connected with the family. A remarkable exception also exists in the case of dying declarations, i. e., statements made by persons mortally wounded and in the prospect of death; but in England such evidence is only admitted in criminal cases, on a charge of manslaughter or murder. In Scotland such declarations are admitted in all cases of violence, and though the party at the time did not believe he was dying. There is another exception to the non-admissibility of hearsay evidence allowed in Scotland, but not in England, viz., where the person who made the statement is dead, and therefore cannot be produced as a witness. In England there is no help for such a state of things, and the statements of the dead person cannot be admitted; but in Scotland, if there was no reason to suppose the contrary, it is presumed the dead witness spoke the truth, and what he said may be given in evidence for what it is worth, both in civil and criminal cases.

HEAUME.—A word derived from the German, which formerly signified *casque*, or helmet. The heaume has been sometimes called among the French *salade*, *armet*, and *celate* from the Latin word which means engraved, on account of the different figures which were represented upon it. The heaume covered the whole of the face, except the eyes, which were protected by small iron bars laid crosswise. It served as an armament or helmet in coats of arms and armorial bearings; it is still preserved in Heraldry, and is a distinguishing mark of nobility.

HEAVE.—A command given when lifting heavy weights or moving guns into position. The handspikes being in position and manned, at the command, *heave*, all bear down or up on the handspike simultaneously.

HEAVIES.—The common expression for European heavy cavalry. They receive their name in contradistinction to the light cavalry, from their equipment and weight being greater than the latter. In the British service there are 7 regiments of *Heavies*, viz., the dragoon guards. The weight the horse of *Heavies* has to carry is over 19 stone. See *Heavy Troops*.

HEDGES.—A thin-set hedge cannot be placed in a good state of defense, and should therefore be destroyed, to prevent its interfering in any manner with the defense. At the best this defense will only serve as a screen, the hedge holding the earth up. A thick-set hedge, if over six and a half feet high, should be cut down to this height, and the cuttings be set into the hedge to back the earth better; a small ditch is dug in front of the hedge, the earth from which serves to form a banquette and a slight parapet, which are thrown up against the hedge. If the hedge is less than six and a half feet high it is cut down to the height of four and a quarter feet; a ditch or trench, about three feet wide at bottom, and two feet deep, is dug behind the hedge, and the earth is thrown up against it, as in the last case. A width of two or three feet should be left between the trench and the earth thrown against the hedge to serve as a banquette. A simple ditch behind a hedge will often serve as a good cover for light troops without any other preparation. See *Walls*.



Section of Parapet behind a Hedge and a Ditch in front of it.

Section of a Hedge Defense with Trench in rear.

HEAVY-ARMED INFANTRY.—Among the early soldiery, such of the infantry as wore complete armor, and engaged with broad shields and long spears. They were the flower and strength of the Grecian armies, and had the highest rank of military honor. See *Infantry*.

HEAVY MARCHING ORDER.—An expression applied to troops equipped for permanent field service with arms, accouterments, knapsacks, canteens, and haversacks.

HEAVY METAL.—Large guns carrying balls of a large size; also, large balls for such guns.

HEAVY ORDNANCE.—Ordnance of great weight and caliber. In the United States the term is restricted in the land service to sea-coast ordnance. See *Ordnance*.

HEAVY TROOPS.—The troops which compose the *three principal arms* are generally subdivided into two classes, *heavy* and *light;* partly arising from the nature of their weapons, and partly from their destination on the field of battle. This subdivision is less marked in the infantry than in that of the other arms; for although in most foreign armies, a portion of the infantry carries a saber with the musket, still this additional weapon is of rather questionable utility; for the musket is the one which, under all circumstances of attack and defense, will be resorted to. All infantry now receive the same instruction; but whether a portion of it ought not to be reserved especially for the duties consigned to light troops, is still a disputed point. As the functions of heavy cavalry are to bear down all opposition, and present an impassable wall to the enemy's efforts, its duties are confined to the battle-field; there, placed in the reserve, it is held in hand until the decisive moment arrives, when it is launched forth to deal a blow from which the enemy hopelessly struggles to recover, either to achieve victory, or to fend off utter defeat. To light cavalry are intrusted the important duties of securing from surprise the flanks of the heavy; to watch over the safety of horse artillery, and to perform the services required of them by infantry divisions, and those of detachment service in general. The artillery, which had for a long period, and even still, preserves the character of eminent respectability, has of late years begun to infuse a dash of dare-devil spirit of the cavalier into its ranks. If it has not yet taken to charging literally, it has, on some recent occasions in our service, shown a well-considered recklessness of obstacles and dangers, fully borne out by justly deserved success. The distinction between light and heavy in this arm arises, not only from the difference of caliber in the pieces, but also in a difference of their tactical application.

HEEL.—That part of a thing corresponding in position to the human heel; the lower back part, or part on which a thing rests. In a small-arm it is the corner of the butt which is upwards in the firing position. The *heel* of a sword is the uppermost part of the blade, next to the hilt. It is generally larger and more massive than the rest of the blade.

HEEL-PIECE.—The armor for the heels; also, the plate on the butt-end of a gun-stock. This is sometimes called the *heel-plate*.

HEGEMONY.—Leadership; preponderant influence or authority; usually applied to the relations of a Government or State to its neighbors or confederates.

HEIRESS.—In Heraldry, a lady is accounted as an heiress if she has no brothers who leave issue. The husband of an heiress is entitled to bear her arms in an escutcheon of pretense, i. e., a small escutcheon in the center of his paternal shield, and the children of an heiress may quarter her arms with their paternal coat. Neither practice is of very early introduction in Heraldry. See *Marshaling of Arms*.

HELEPOLIS.—In the ancient art of war, a machine for battering down the walls of a place besieged. Its invention is ascribed to Demetrius Poliorcetes. Diodorus Siculus says that each side of the helepolis was 450 cubits broad, and 90 in height; that it had nine stages, or floors, and was carried on four strong solid wheels, 8 cubits in diameter; that it was armed with huge battering-rams, and had two roofs capable of supporting them; that in the lower stages there were different sorts of engines for casting stones, and in the middle they had large catapults for launching arrows.

HELIOGRAPHY.—The name applied to the method of communicating between distant points in which visual signals are obtained by reflecting the rays of the sun from a mirror or combination of mirrors in the required direction. This method can be only employed to advantage in places where the sky is free from clouds and the atmosphere clear for considerable periods of time, and the fact that an atmospheric change may indefinitely delay the transmission of a message is an insuperable objection to the establishment of permanent heliographic stations in most climates. In suitable localities, however, heliography possesses important advantages for military signalling over other methods, the principal being the portability of the apparatus, the great distance to which messages can be sent without retransmission, and the fact that the signals are visible to those only who are on the direct line of signalling. An interesting and instructive paper entitled "The Elements of the Heliograph," by Lieutenant Fred-

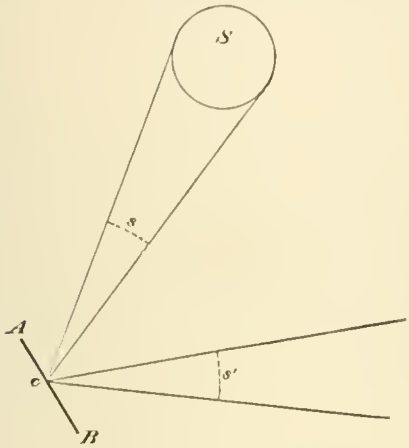


Fig. 1.

erick K. Ward, United States Army, has been published in Signal Service Notes, No. XI; and to this paper we are indebted for the substance of the following discussion.

A complete instrument consists essentially of two plane mirrors and a sighting-rod, and, when a "stand-

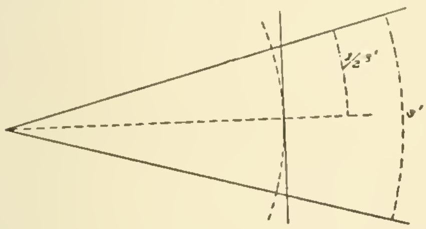


Fig. 2.

ing flash" is used, a screen. The mirrors are firmly supported, usually on a tripod, and are fitted with vertical and horizontal tangent-screws. By means of the tangent screws the mirrors can be turned on their supports so as to face in any desired direction toward the sky. When a movable flash is used, one

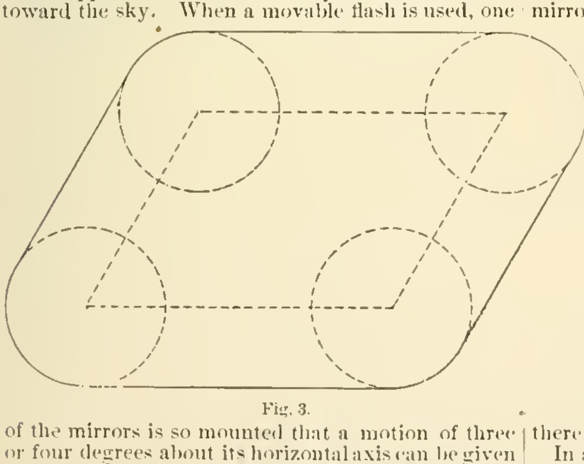


Fig. 3.

of the mirrors is so mounted that a motion of three or four degrees about its horizontal axis can be given it independently of the tangent-screw, so that the flash can be thrown on and off the receiving-station at will, and quickly. The screen, when used, is on a separate support, in order, when working, to avoid any shaking of the mirrors. Both mirrors are used when the signalman facing the receiving-station has the sun in his rear. When the sun is in his front, or nearly at his right or left, only one mirror is used. The sighting-rod, as its name implies, is an auxiliary used with the tangent-screws, to put and keep the mirrors in such a position that the flash can be thrown with certainty on the receiving-station.

The principles involved in the heliograph are few and simple: Let *S*, Fig. 1, represent the sun, and *AB* a plain mirror. Consider first the light from the sun incident on *AB* at a single point, *c*. Only two outside rays are shown in the figure. Since angles of incidence and reflection are always equal, the angle *s'* is equal to the angle *s*, and it is apparent, without further explanation, that the converging cone of light from *S*, incident at *c*, becomes, after reflection, a diverging cone of precisely the same dimensions. A spectator anywhere within this diverging cone will see the reflected light on looking toward *c*. The incident cone is a right cone with a circular base; therefore a right section of the reflected cone will be a circle whatever may be the angle of incidence. The radius of the circle will be equal to the natural tangent of $\frac{1}{2}s$, or the natural tangent of the sun's semi-diameter to a radius equal to the distance from *c* to the plane of the section. This will be apparent from Fig. 2.

Now, suppose *AB* to be a square mirror, and consider next the four cones of light reflected from the four corners. The angle at the sun subtended by the diameter of the mirror would be inappreciable, therefore the axes of these four cones are sensibly parallel. The cones themselves evidently define the figure of illumination. Pass a plane perpendicular to the axes and they will pierce it in four points, defining a parallelogram, the sides of which will not exceed those of the mirror in length. The axes proceed obliquely from the mirror, therefore the parallelogram will be oblique. This parallelogram is represented in full in Fig. 3. The cutting-plane makes a right section of the cone surrounding each axis, and we have already seen that this section is a circle having a radius equal to the natural tangent of the sun's semi-diameter to a radius equal to the distance from the cutting-plane to the apex of the cone on the mirror. With these radii describe circles about the corner points, and join these circles by tangents. The resulting enclosed figure is a right section of the solid of illumination. Now, since the axes of the four cones are parallel, the dimensions of the parallelogram will be constant for all positions of the cutting-plane. The radii of the four circles increase with the distance from the mirror. The mean value of the semi-diameter of the sun is about 16 minutes, the natural tangent of which to a radius of one mile is 24½ feet, very nearly. The mirrors used in heliographs are usually from 4 to 6 inches in diameter. Therefore at a distance of one mile, the circles will overlap and the figure of illumination will be sensibly a circle 49 feet in diameter. At a distance of 10 miles from the mirror to the cutting-plane, or from the sending to the receiving-station, the circle of illumination is 490 feet in diameter. And, generally, the diameter of the flash at the receiving-station, in feet, is equal to 49 multiplied by the distance between the stations in miles. As the diameter of the flash increases directly with the difference between the stations, the adjustment of the instrument is no more difficult for a very distant station than for one comparatively near, provided, of course, that there is some distinguishable landmark to adjust by.

In all patterns of the heliograph yet made the mirror is kept in adjustment by means of what is called the "dark spot." To explain this, let *AB*, Fig. 4, represent a glass mirror, from which the silvering has been removed from a small circle represented by *cd*, about the center of motion of the mirror. The center of the motion must lie in the plane of the silvered surface, and it is usually at the center of the mirror. Let *fcf* and *gdg*, represent the cones

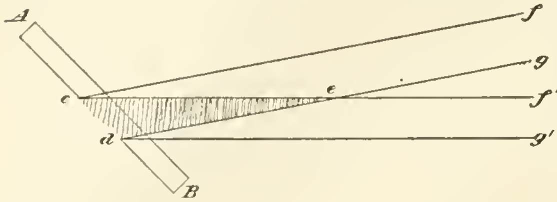


Fig. 4

of light reflected from *c* and *d*, respectively. Between *c* and *d* very little light is reflected, and a dark cone represented by *ced* is formed, the angle *ced* being equal to the diameter of the sun. To deduce a general expression for the length of the dark cone, let *c e d*, Fig. 5, represent the cone, and *me* its axis, the length of which represent by *L*. From *m* draw *m n* perpendicular to the reflecting surface. The angle *i* is equal to the mean angle of reflection or incidence. Let *d* represent the diameter of the unsilvered spot *cd*, and *s* the angle *ced*, which is equal to the diameter of the sun. Then,

$$L = \frac{\frac{1}{2}d \cdot \cos\,(i - \frac{1}{2}s)}{\sin\,\frac{1}{2}s}.$$

Returning to Fig. 4, it is evident that the axis of the dark cone is parallel to the axis of the cone of re-

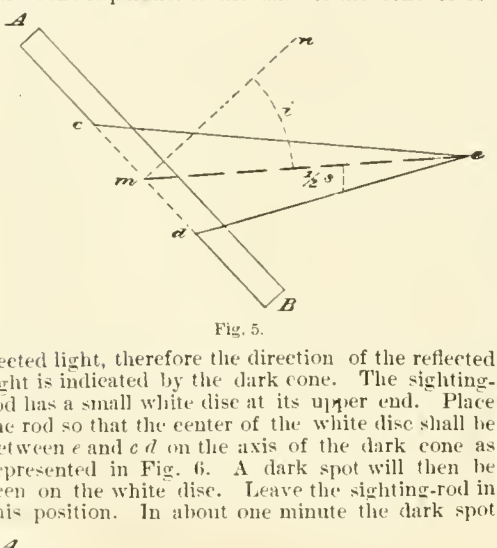


Fig. 5.

flected light, therefore the direction of the reflected light is indicated by the dark cone. The sighting-rod has a small white disc at its upper end. Place the rod so that the center of the white disc shall be between *e* and *c d* on the axis of the dark cone as represented in Fig. 6. A dark spot will then be seen on the white disc. Leave the sighting-rod in this position. In about one minute the dark spot

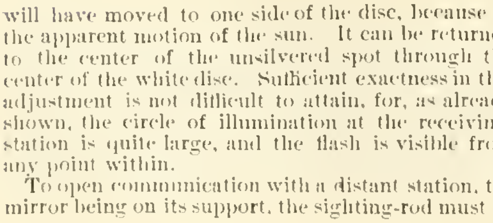


Fig. 6.

will have moved to one side of the disc, because of the apparent motion of the sun. It can be returned to the center of the unsilvered spot through the center of the white disc. Sufficient exactness in this adjustment is not difficult to attain, for, as already shown, the circle of illumination at the receiving-station is quite large, and the flash is visible from any point within.

To open communication with a distant station, the mirror being on its support, the sighting-rod must be so placed that the centers of the unsilvered spot of the white disc, and of the receiving-station, shall be on the same straight line. This may be done by looking through the unsilvered spot at the station and placing the white disc to cover it. In practice, however, it is found easier to set the sighting-rod by looking into the mirror, so placing the eye that the unsilvered spot exactly covers the reflection of the distant station, and then, without moving the eye or the mirror, bringing the sighting-rod into view by reflection, and so adjusting it that the reflection of its disc is also covered by the unsilvered spot. Then, if the mirror is turned by its tangent-screws so as to throw the reflected sunlight past the sighting-rod in such a direction as to show the dark spot on the disc, the flash will be visible from the distant station. If the instrument gives a standing flash, the screen must now be placed so as to hide or cut off the flash except when it is given to view by the operator working the screen. If the instrument gives a movable flash, the mirror must be so turned that the dark spot will appear on the white disc when the key provided to work the mirror is pressed down. When the key is not pressed down, the dark spot will be on the sighting rod a little below the disc, and the flash will not then be visible. No particular value of the angle of incidence has yet been considered. It is necessary to consider what would be the effect if the light from the sun should fall very obliquely upon the mirror. It has already been shown that the dimensions of the flash are sensibly independent of the angle of incidence. But the case is different as regards the strength of the flash, and on this the range of the instrument depends. As the obliquity increases, the mirror intercepts less and less light, the reflected flash becomes correspondingly weaker, and the maximum distance from which it can be seen distinctly, that is, the range of the instrument, is decreased; and further, the expression for the length of the dark cone shows that the length decreases as the angle of incidence increases, becoming practically zero when the angle of incidence is nearly ninety degrees. The dark cone would then fail to reach the sighting-disc and there would be no longer any means for keeping the flash on the receiving-station. These difficulties are avoided by the use of a second mirror. Fig. 7 illustrates how the two mirrors are made to serve the purpose. The figure needs no explanation. The mirror which faces the receiving-station is usually called the second mirror. The preliminary adjustment with two mirrors is very similar to that with one. In the explanation for the single mirror, mention was made of cones of diverging reflected rays only. That there are also converging reflected rays will be evident by supposing the eye placed in front of the mirror and looking into it. There would then be visible an image of the sun (see Fig. 8). This imaginary sun takes the place of a real sun situated back of the first mirror on the straight line through the centers of the two mirrors. The first mirror gives the light to the second from a fixed direction; therefore, after the preliminary adjustment of both mirrors is completed, the second should not be touched. The flash is kept on the distant station by the tangent-screws of the first mirror.

With the sun at the zenith the angle of incidence would be about 45°. Should the angle of incidence with a single mirror approach 60°, the second mirror would be brought into use to decrease it. 60° then may be assumed as the maximum angle of incidence. The maximum of the sun's semi-diameter is 16′ and 18″. The diameter of the unsilvered spot is usually about $\frac{2}{10}$ of an inch. These values in the expression for *L*, give 10 and $\frac{6}{10}$ inches as the length of the dark cone. It follows that when the unsilvered spot is $\frac{2}{10}$ of an inch in diameter, the distance from the center of the mirror to the sighting disc, or from the center of the first mirror to the center of the second, must not exceed nine inches, in order that there shall always be a distinct dark spot

It may be of interest to determine the figure and size of plane mirror requisite to give the maximum strength of flash. Let *AB*, Fig. 8, represent a plane mirror situated a short distance from the eye at *e*

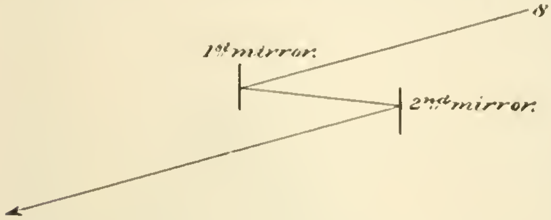


Fig 7

looking at the imaginary image of the sun, formed by reflection. The image will seem to cover a part of the surface of *AB* represented by *mn*. With a very small angle of incidence *mn* will be sensibly a circle from every point of which light is reflected to

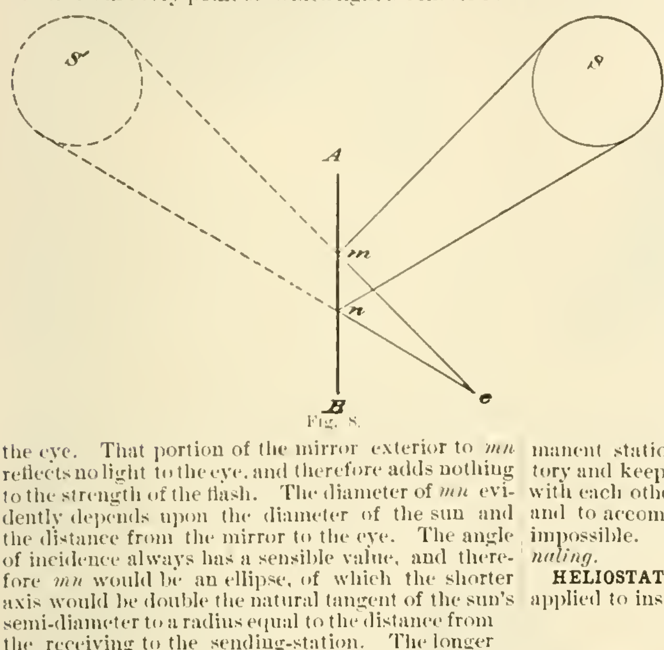
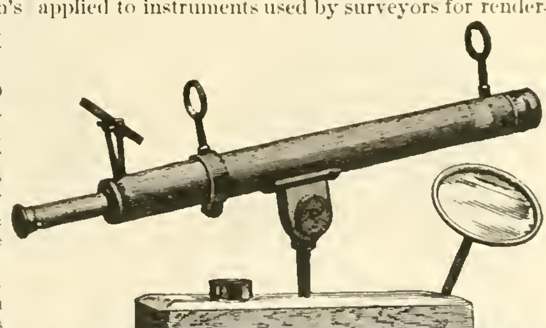


Fig. 8.

the eye. That portion of the mirror exterior to *mn* reflects no light to the eye, and therefore adds nothing to the strength of the flash. The diameter of *mn* evidently depends upon the diameter of the sun and the distance from the mirror to the eye. The angle of incidence always has a sensible value, and therefore *mn* would be an ellipse, of which the shorter axis would be double the natural tangent of the sun's semi-diameter to a radius equal to the distance from the receiving to the sending-station. The longer axis would increase with the angle of incidence. From this it appears that, at a distance of, say, 10 miles, a mirror 490 feet in diameter would be required for the maximum strength of flash. But that would be impracticable, and indeed it would never be desirable, for the flash from a 4-inch mirror has been seen with the naked eye at a distance of over 35 miles, and that from a 15-inch mirror has been seen with the aid of a small telescope at a distance accurately determined to be 192 miles.

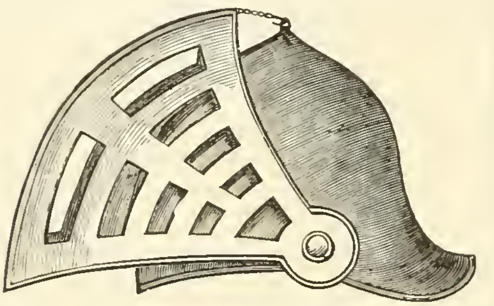
The mirrors of a heliograph should be of glass. Metallic mirrors would be hard to keep bright in service, and they are open to a still more serious objection. It is necessary that mirrors should be as nearly plane as possible. If of metal they would be liable to become bent or indented. The injury might be so slight as not to be apparent and still be sufficient to make it impossible to give a good flash to the receiving-station. Glass mirrors are free from these objections, and experience has shown that those of the small size needed are not likely to be broken. And, too, in the field it would be easier to replace a glass mirror than one of metal. The heliograph, by the reason of its greater range, is a much more valuable instrument for field signaling than the flag. The extreme range of the flag without glasses is not over two miles, and with a telescope having a power of 30 diameters it cannot be read more than twenty miles. At the latter distance it is only when the atmosphere is exceptionally clear that the flag can be seen at all. The average speed in the transmission of messages by flag is about three words per minute, and the labor of swinging is by no means light. A man well practiced in the use of the heliograph can send eight words per minute, and no manual labor is involved. It is more tiresome to receive from the heliograph than from a flag, because the concentration of attention required and the strain upon the eyes are greater. The latter trouble may be much lessened by the use of colored glasses, or better still, of a screen which will cut off the glare of the sky and ground without obstructing any of the light from the distant instrument. The flash from a field instrument can be seen with the naked eye from 35 to 50 miles, and that from a larger instrument having 8 or 9 inch mirrors, could be seen 80 miles or more without glasses. Permanent stations should be supplied with both sizes. The dust of a command can be distinguished at great distances with glasses. The flash being then thrown on the advance, the command would be almost sure to see it before having moved across and out of it, for at a distance of 30 miles it is nearly one-third of a mile wide. It would most certainly be seen by some one if the whole command was instructed to be generally on the watch for such signals. With each command there should be, of course, a heliograph. By halting a short time the Commanding Officer might obtain information of the greatest value, and at the same time give for transmission to other commands or to headquarters such information as he might possess. In a section where the natural features are favorable, it is easy to see how a few permanent stations could cover a large extent of territory and keep several commands in communication with each other, enabling them to operate in concert and to accomplish what would otherwise have been impossible. See *Heliostat* and *Looking-glass Signaling*.

HELIOSTAT.—Heliostat and heliotrope are names applied to instruments used by surveyors for render-



ing the distant stations distinctly visible. This is managed by placing a mirror at the distant station, and adjusting it so that at a particular hour of the day (arranged beforehand), the light of the sun shall be reflected from the mirror directly to the surveyor's station. The surveyor must make his observation at the instant he sees the glancing of the mirror, as the constant change of the sun's position in the heavens produces a corresponding change in the direction of the rays reflected by the mirror. Gauss invented such an instrument about 1821, which is much used in America, for Geodetic Surveys, and is said to possess such power, that a mirror 1 inch square is visible eight miles off, in average sunny weather, and appears as a brilliant star at a distance of two miles; while some heliotropes have been used so powerful as to be visible nearly 80 miles off. The term heliostat, applied by Captain Drummond to an instrument invented by him for the same purpose, more properly belongs to an instrument invented by S'Gravesande, consisting of an equatorial revolving on its polar axis, so that the sun, when once accurately in the focus of the telescope, continues steadily fixed there. Drummond's heliostat is chiefly used in Britain. The drawing shows the instrument as made by Fauth & Co., United States, for the Coast and Geodetic Survey. The telescope body is an iron tube; a wood screw with a joint is attached at the middle, so that the instrument can be screwed to any tree or post. See *Heliography*.

HELM, HELMET.—1. In Heraldry, the representation of a helmet over shields or coats of arms. From the early simple form known as the Norman, the helmet, at a later period, came to vary in shape



Helmet of the Middle Ages.

according to the degree of the person who wore it, and helmets were set over coats of arms to bear the crest, and indicate by their form the rank of the bearer. The part of the helmet which opens to show the face is called the *visor* or *beaver* (to allow

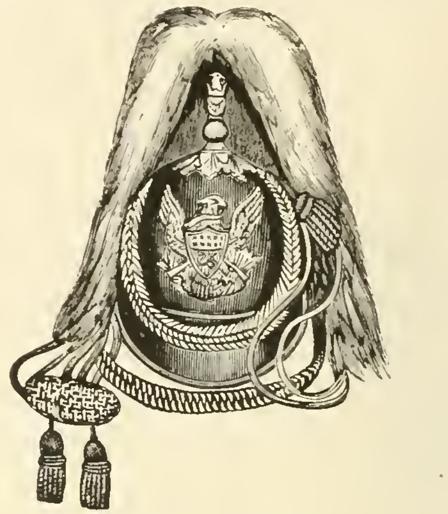
Line Officers' Helmet, U. S. Army.

Privates' Felt Helmet, U. S. Army.

Summer Helmet, with spike.

of drinking). The following forms of helmet are in use in English Heraldry: 1. The helmet assigned to the King and Princes of the blood-royal, which is full-faced, composed of gold lined with crimson, and has the vizor divided by six projecting bars. 2. The helmet of the nobility, of steel, with five bars of gold. When placed on the shield, it is exhibited in profile. 3. Knights and Baronets have the full-faced steel helmet with the vizor thrown back and without bars. 4. The helmet of Esquires, always represented in profile, of steel with the vizor closed. These distinctions are of comparatively recent date. A much greater variety of helmets is in use in Continental Heraldry. A Helmet is never placed over the arms of any woman except the Sovereign.

2. A covering of metal or leather to protect the head in warfare. The earlier Greek and Roman helmets, as shown in many extant sculptures, were surmounted by plumes, but unlike their modern successors, did not protect the face. During the Middle



Field Officers' Helmet with Plume.

Ages, helmets were made of the finest steel, often inlaid with gold, and provided with bars and flaps, to cover the face in action, and to allow of being opened at other times. As the employment of firearms became more general, helmets naturally lost their utility, especially as regarded the face. Those still remaining are in military matters limited for the most part to heavy cavalry, afford no protection to the face, and must be considered as rather for ornament than use. Firemen wear a heavy head-piece of leather and brass, to protect them as far as possible from falling ruins at conflagrations. In India and other hot climates, helmets of white felt, with the additional screen of rolls of linen, are constantly worn by military men, to protect them from the rays of the sun.

In the United States army, light helmets of the following descriptions are worn as a part of the full dress:

Helmets for Field Officers—The body: of cork or other suitable material, covered with black cloth, or of black felt, at the option of the wearer. Trimmings: cord and tassels, top-piece and plume-socket, chain chin-strap and hooks, eagle with motto, crossed cannon, rifles, or sabers, all gilt, with the number of the regiment on the shield in white: plume of buffalo-hair, white for infantry, yellow for cavalry, and red for artillery. *Helmets for other Mounted Officers and Officers of the Signal Corps*—Same as above except that the color of plume is orange for Signal Corps. *Helmets for other Officers of Foot Troops*—Same as above, except that the trimmings are as follows:—Top-piece spike, chain chin-strap with hooks and side buttons, eagle with motto, crossed rifles or cannon, all gilt, with the number of the regiment on the shield in white. *Officers' Summer Helmets*—Body: of cork, covered with white facing cloth; top-piece spike, chain chin-strap, and hooks all gilt. The helmet cords are attached to the left side of the helmet and come down to the left shoulder, where they are held together by a slide; one cord then passes to the front and the other to the rear of the neck, crossing upon the right shoulder and passing separately around to the front and rear of the right arm, where they are again united and held together by a slide under the arm; the united cords then cross the breast and are looped up to the upper button on the left side of the coat.

Helmets for all Mounted Troops—Body: of black felt, with leather chin-strap, large crossed cannons or sabers, letter of company and number of regiment, plain side buttons, top-piece and plume-socket, all brass; horse-hair plumes and cords, and band with rings of the color of the arm of service. *Helmets for all Foot Troops*—Of same pattern and material as for mounted troops, with leather chin-strap; and plain side buttons, top-piece and spike, of brass. *Trimmings*—Commissary Sergeants, a crescent of white metal; Hospital Stewards, a wreath of brass, with letters U. S. in white metal; Engineers, a castle, with letter of company; Ordnance, a shell and flame; Artillery, crossed cannons; Infantry, crossed rifles, and letter of company and number of regiment, all in brass. Cork helmets are supplied only to troops serving in extremely hot climates, in the first and third years of their enlistment, and these only in lieu of the campaign hat. The necessity for such issue must in all cases be certified to by the Department Commander. See *Chapeau Bras*.

HELM-GUN.—A breech-loading small-arm, having a fixed chamber closed by a movable barrel, which rotates about an axis parallel to the axis of the barrel. The peculiar feature of this arm is the connection of the tumbler with a movable butt-plate, so arranged that by pressing the piece against the shoulder, in aiming, the hammer may be simultaneously cocked. The cylinder also can be conveniently removed from the side, and replaced by a loaded one, if desired.

HELOTS.—The population of ancient Sparta was divided into four classes, the lowest of which was formed of serfs or slaves, called Helots (probably meaning *captives*, from *helein*, to capture). These Helots are generally supposed to have formed the original population of the country, and to have been reduced to bondage by their Dorian conquerors, the numbers, however, being swelled from time to time by the conquest of enemies. They belonged to the State, which had the power to set them at liberty; but they toiled for individual proprietors, and were *bound to the soil*, i.e., they could not be sold away from the place of their labor. They were the tillers of the land (for which they paid a rent to their masters), they served at the public meals, and were occupied on the public works. In war they served as light troops, each free-born Spartan who bore heavy armor being accompanied to battle by a number of them, sometimes as many as seven. On rare occasions they were used as heavy-armed soldiers. It is a matter of doubt whether after emancipation they could ever enjoy all the privileges of Spartan citizens. They were treated with much severity by their masters, and were subjected to degradation and indignities. They were whipped every year to keep them in mind of their servile state; they were obliged to wear a distinctive dress (clothes of sheep-skin, and a cap of dog's skin), and to intoxicate themselves, as a warning to the Spartan youth; and when multiplied to an alarming extent, they were often massacred with the most barbarous cruelty. On one occasion, 2000 of them, who had behaved bravely in war, were encouraged to come forward for emancipation, and were then most treacherously put to death. The Spartans organized, as often as necessity required it, *Secret Service Companies* of young men, who went abroad over the country armed with daggers, and both by night and day assassinated the unfortunate Helots, selecting as their special victims the strongest and most vigorous of the oppressed race.

HELVE.—1. A tilt-hammer, used for shingling the balls as they come from the puddling-furnace. 2. The wooden handle of entrenching tools, such as axes (felling and pick,) hatchets, kodalies, shovels, spades; also the handle of certain artificers' tools, axes, and sledge-hammers.

HELVETII.—A Celtic people inhabiting, according to Cæsar, the region between the mountains of Jura on the west, the Rhone on the south, and the Rhine on the east and north, the region corresponding pretty closely with modern Switzerland. They had 12 towns and 400 villages. The great and fatal event in their history is their attempted irruption into and conquest of Southern Gaul, in which they were repulsed by Cæsar with frightful slaughter. The story of this expedition is circumstantially narrated by the Roman Commander. They collected 3 months' provisions, burned their 12 cities, 400 villages, and all isolated dwellings, and made a general rendezvous by Lake Leman in the spring of 58 B. C. Cæsar hastened to Geneva, destroyed the bridge, raised two legions in Cisalpine Gaul, and when the Helvetians sent delegates to demand a passage, delayed them until he had built a wall along the Rhone, 16 feet high and about 19 Roman miles in length, flanked with redoubts. Having vainly attempted to pass this barrier, the Helvetii took another route, but were followed and defeated with a terrible slaughter at Bibracte (modern Autun, in Burgundy), and the remnant obliged to return to their own country, where they became subject to the Romans. Of 368,000 who left their homes, including 92,000 fighting-men, only 110,000 returned. In the commotions which followed the death of Nero, the Helvetians met with another terrible catastrophe. Remaining faithful to Galba, they were fallen upon by Cacina, a General of Vitellius, who gave them to the rapacity of his legions. They were massacred by thousands, multitudes were sold into slavery, and their towns pillaged and burned, their Capital destroyed, and their Governor executed. From this time they scarcely appear as a distinct people.

HEMERODROMI.—In Grecian antiquity, runners or couriers, who could hold out to run all day. In a country like Greece, where the roads were few and bad, the Hemerodromi were indispensable for the rapid diffusion of important news. Every Greek State made a point of training a number of these men who could travel great distances in an incredibly short space of time, and at every dangerous crisis they were stationed on commanding points to observe and report at head-quarters what it was necessary for the authorities to know. In the service of the Persian Kings, these men were called *Angori*, and the service *Angerion*. Among the Romans they were known as *Cursores*.

HEMP.—The fiber of certain plants grown both in Europe and India, known as the *Cannabis sativa* and *indica*, which have been pronounced identical plants. In various notices of Indian fibers, we frequently meet with the word *sunn* as indicating a particular kind of hemp. Sometimes we find it called Indian hemp, and we may often see hemp enumerated as one of the exports from India, at other times we may see either the same or another fiber mentioned by the name of brown hemp. These various names are sometimes applied to the fiber of one or two different plants, or are employed to distinguish the fiber of three distinct plants, all of which are grown for their fibers, and have been and might be exported from India; though only two of them are now usually to be found among the exports from that country. Hence, to avoid ambiguity, it is necessary to notice the plants to which these several names are correctly applicable. The true hemp (*Cannabis sativa*), *gunja* of the natives, is everywhere cultivated in the plains of India, not on account of its fibers, but for its intoxicating leaves and their secretions. In the Himalayas, however, the fiber is separated for economic purposes, and was exported from India to England during the last war, and this has been the case for many years. The fiber of the *sunn* or *taag* (*Clotalaria juncea*) is often called Indian hemp, but incorrectly. It is the kind most generally cultivated all over India on account of its fiber, and is that usually mentioned in the exports from Calcutta under the name of hemp, but also as *sunn*. The plant may be distinguished by its flowers being of a bright yellow color, and of the form of the pea and of the laburnum, while the leaves are entire and lanceolate. The fiber alluded to is very valuable for cordage, canvas, twine, etc. Madras and Bombay both export large quantities of hemp.

HENCHMEN.—The name given to the soldiers who guarded the King's person in the time of Henry VIII. The word, signifying a page or servant, is now obsolete or rare.

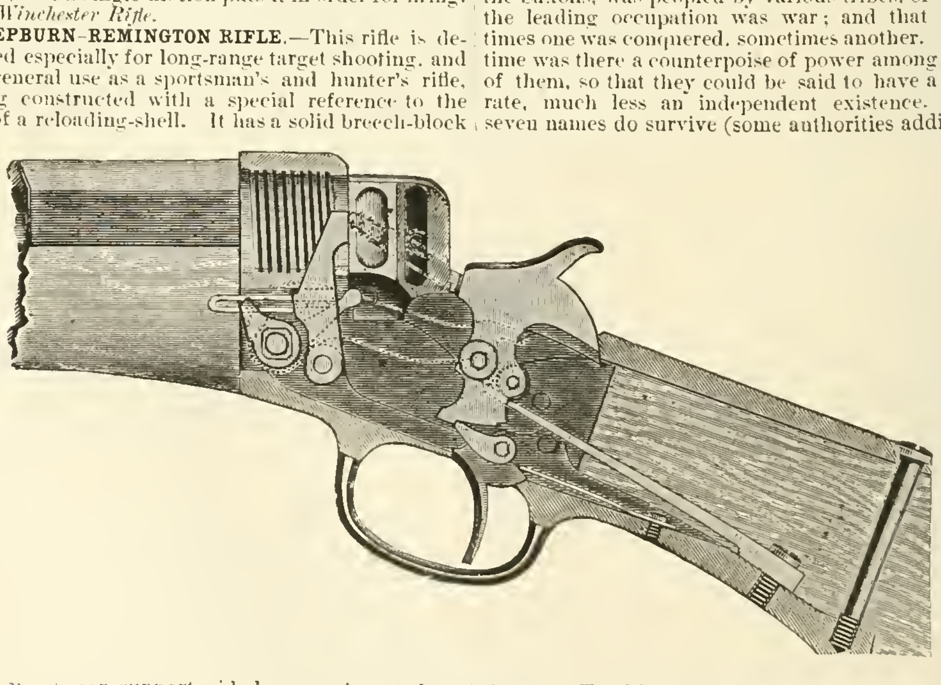
HENRY RIFLE.—This magazine-gun is now generally known as the Winchester. It may be used as a single-loader or a repeater. As a repeater, the motion of the lever withdraws the spent shell of the previous charge, raises the hammer, recharges the gun, and relocks the breech mechanism. With single loading, the cartridge is placed in the carrier-block, and a single motion puts it in order for firing. See *Winchester Rifle*.

HEPBURN-REMINGTON RIFLE.—This rifle is designed especially for long-range target shooting, and for general use as a sportsman's and hunter's rifle, being constructed with a special reference to the use of a reloading-shell. It has a solid breech-block with direct rear support, side-lever action, and rebounding hammer, so that the arm always stands with the trigger in the safety notch, thus rendering premature discharge impossible, and is believed to be the best in use for the purpose described. They are all made with pistol-grip stocks; which heretofore have been furnished only with the higher priced rifles, and are chambered for the straight 38 and 40 cal. and 45 cal. shells, using either a patched or cannelured bullet. The sectional drawing shows the arm with the breech closed.

To take the gun apart: Remove the *upper-screw* in the left-hand side, and the *breech-block* may be taken out. To take out the *hammer*, remove the next upper screw and slip the *hammer* forward into the breech-block hole. To take out the *extractor*, remove the forward screw on left-hand side. The *lever* which operates the breech-block passes through the *rocker-sleeve* with a square stud, and is held in place by a set screw directly under the *fore-stock*, which must be removed if it is ever desired to take off the *lever*. If necessary to remove the *guard*, it can be done by taking off the *butt-stock*, and taking out the *side-screws* in the usual way. The *barrel* should not be unscrewed from the frame, except by experienced hands and with proper appliances. When necessary to unscrew the *frame*, the *extractor* should be taken out, and the breech-block and guard put back in place, before putting on the wrench. If at any time the primer should be driven back into the firing-pin hole, so as to make the breech open stiffly, it can be relieved by snapping the hammer against the firing-pin. The military long-range rifle has been adopted by the National Rifle Association, who recommend it to competitors for the American Team. It has a heavy barrel, with new system of rifling, chambered for $2\frac{6}{10}$ inch, 44 caliber, straight shell, using from 85 to 100 grains of powder and water-proof patched bullet 520 and 550 grains of lead. See *Remington Rifle*.

HEPPAH.—A New Zealand fort, or space surrounded with stout palisades. Also written *Hippa*.

HEPTARCHY.—The name given to seven kingdoms said to have been established by the Saxons in England. The common idea is, that these seven kingdoms were contemporaneous; but all that can be safely asserted is, that England, in the time of the Saxons, was peopled by various tribes, of which the leading occupation was war; and that sometimes one was conquered, sometimes another. At no time was there a counterpoise of power among seven of them, so that they could be said to have a separate, much less an independent existence. Still, seven names do survive (some authorities adding an eighth). The king of the one that had the fortune to be most powerful for the time being, was styled Bretwalda or Ruler of Britain, but in most instances the power of this supposed Ruler beyond the limits of his own Territory must have been very small.



Under Egbert, Wessex rose to be supreme, and virtually swallowed up the others.

HERALD.—An officer whose duty consists in the regulation of armorial bearings, the marshalling of processions, and the superintendence of public ceremonies. In the Middle Ages, Heralds were highly honored, and enjoyed important privileges; their functions also included the bearing of messages, whether of courtesy or defiance, between royal or knightly personages; the superintending and registering of trials by battle tournaments, jousts, and all chivalric exercises; the computation of the slain after battle; and the recording of the valiant acts of the falling or surviving combatants. The office of Herald is probably as old as the origin of coat-armor. The principal heraldic officers are designated Kings-of-Arms or Kings-at-Arms, and the novitiates or learners are styled Pursuivants. Heralds were originally created with much ceremony; they are now appointed by the Earl Marshal in England, and by the Lyon King of-Arms in Scotland. There are now in England three Kings-of-Arms, named by their offices Garter, Clarencieux, and Norroy; six Heralds—Somerset, Chester, Windsor, Richmond, Lancaster, and York; and four Pursuivants, Rouge Dragan, Porteullis, Blue Mantle, and Rouge Croix. There have been at different periods other Heralds, whose titles are now laid aside; Heralds extraordinary have also sometimes been created, as Edmonson, by the title of Mowbray, in 1764. In Scotland, the principal heraldic officer is Lyon King-of-Arms; and there were till lately six Heralds—Snowdoun, Albany Ross, Rothesay, Marchmont, and Ilay; and six Pursuivants—Unicorn, Carrick, Kintyre, Ormond, Dingwall, and Bute. Recently the permanent number of Heralds and Pursuivants in Scotland has been reduced to three of each. Ireland has one King-of-Arms, Ulster; two Heralds, Cork and Dublin; and two Pursuivants, of whom the senior bears the title of Athlone, and the other is called the Pursuivant of St. Patrick. The official costume of a Herald consists of an embroidered satin tabard or surcoat of the royal arms, and a collar of SS. See *College-of-Arms*, *King-at-Arms* and *Pursuivant*.

HERALDRY.—Heraldry is properly the knowledge of the whole multifarious duties devolving on a Herald; in the more restricted sense, in which we shall here consider it, it is the science of armorial bearings. After occupying for ages the attention of the learned, and forming an important branch of a princely education, the study of Heraldry fell, in latter times, into neglect and disrepute, and was abandoned to coach-painters and undertakers, a degradation owing in part to the endless tissue of follies and mystifications that had been interwoven with it. Modern criticism has rescued Heraldry from the pedantries and follies of the Heralds, and imparted to it a new interest, as a valuable aid to historical investigations. Though we have instances in remote times of nations and individuals distinguishing themselves by particular emblems or ensigns, nothing that can properly be called armorial bearings existed before the middle of the 12th century. The shields of the French knights in the First Crusade presented a plain face of polished metal, nor is there any evidence of heraldic devices having been in use in the Second Crusade in 1147. But the Anglo-Norman poet Wace, who flourished in the latter part of the twelfth century, mentions devices or cognizances as being in use among the Normans, "that no Norman might perish by the hand of another, nor one Frenchman kill another"; and Wace is curiously corroborated by the Bayeux tapestry of the twelfth century, where there are figures of animals on the shields of the invaders, while the Saxon shields have only borders or crosses. The rude devices on these shields have nothing approaching to an armorial form or disposition, yet it is probable that systematic Heraldry sprang out of them, but it is difficult to say when they assumed that hereditary character which is essential to the idea of armorial bearings. Some sort of armorial insignia were depicted on the shields used in the Third Crusade, which took place in 1189; and in the same half-century originated the fleurs-de-lis of France and the lions of England. The transmission of arms from father to son seems to have been fully recognized in the thirteenth century, and in the practice then introduced of embroidering the family insignia on the surcoat worn over the hauberk or coat of mail, originated the expression *coat of arms*. Arms were similarly embroidered on the jupon, cyclas, and tabard, which succeeded the surcoat, a practice which survived till the time of Henry VIII., when the tabard came to be entirely disused except by Heralds, who still continue to wear on their tabards the Royal Arms. It was by slow degrees that the usage of arms grew up into the systematized form which it assumes in the works of the established writers on Heraldry. The principal existing data for tracing its progress are English rolls of arms yet extant of the times of Henry III., Edward I., and Edward III. The earliest formal treatises date no further back than the end of the fourteenth century, before which time the whole historical part of the subject had been obscured by a tissue of gratuitous fictions, which has misled most subsequent writers up to a very recent period. The Professors of the science represent the Heraldry of the tenth and fourteenth centuries as equally sharply defined with that of the fifteenth and sixteenth. The arms of William the Conqueror and his sons are described with all their differences; arms are ascribed to the Saxon Kings of England, to Charlemagne, and even to half-mythical persons and heroes of classical times. It is rather surprising to find this fictitious Heraldry understood and systematized early in the fourteenth century. The arms traditionally considered to be those of Edward the Confessor were sculptured in Westminster Abbey in the reign of Edward II.

In the infancy of Heraldry, every knight assumed what arms he pleased, not consulting the Sovereign or King-at-Arms. Animals, plants, imaginary monsters, things artificial, and objects familiar to Pilgrims, were all fixed on; and whenever it was possible, the object chosen was one whose name bore sufficient resemblance in sound to suggest the name or title of the bearer of it. There is reason to believe that early arms were generally *armes parlantes*, though the allusion has in many cases ceased to be intelligible from the old name of the object being forgotten. The charge fixed on was used with great latitude, singly or repeated, or in any way which the bearer chose, or the form of his shield suggested. But as coats of arms became more numerous, confusion often arose from different knights adopting the same symbol; and thus confusion was increased by a practice which crept in of sovereigns or feudal chiefs allowing their arms, or part of them, to be borne as a mark of honor by their followers in battle. Hence different coats of arms came in many instances so closely to resemble each other that it was imperative, for distinction's sake, that the fancy of the bearer should be restrained, and regulations laid down regarding the number and position of the charges, and the attitudes of the animals represented. This necessity led in the course of time, to the systematizing of Heraldry, a process which the rolls alluded to show us was going on gradually throughout the thirteenth and fourteenth centuries. By the time that Heraldry was consolidated into a science, its true origin had been lost sight of, and the credulity and fertility of imagination of the Heralds led them to invest the most common charges with mystical meanings, and to trace their original adoption to the desire of commemorating the adventures or achievements of the founders of the families who bore them. The legends ascribing an origin of this sort to the early armorial bearings have, in nearly all instances wherein it has been possible to investigate them, turned out to be fabrications. It was only when Heraldry began to assume the dignity of a science that augmentations of a commemorative character were granted, one of the earliest known instances being the heart added to the coat of Douglas, in commemoration of the good Sir James's pilgrimage with the heart of King Robert. After the science became thoroughly systematized, augmentations and new coats were often granted with the reference to the supposed symbolical meanings of the charges. In England, the assumption of arms by private persons was first restrained by a proclamation of Henry V., which prohibited every one who had not borne arms at Agincourt to assume them, except in virtue of inheritance or a grant from the Crown. To enforce the observance of this rule, Heralds' visitations or processions through the countries were instituted, and continued from time to time till the reign of William and Mary. Jurisdiction in questions of arms is executed by the Heralds' College in England, the Lyon Court in Scotland, and the College-of-Arms in Ireland. No one within the United Kingdom is entitled to bear arms without a hereditary claim by descent, or a grant from the competent authority; and the wrongful assumption of arms is an act for which the assumer may be subjected to penalties. The use of arms, whether rightfully or wrongfully, subjects the bearer of them to an annual tax. It is illegal to use without authority not only a coat of arms, but even a crest. Any figure or device placed on a heraldic wreath, is considered a crest in questions with the Heralds' College or Lyon Court, as well as in questions with the Commissioners of Inland Revenue. It shows how deeply the passion for outward distinction is implanted in human nature, when we find people in countries such as the United States, where all differences of rank are theoretically repudiated, assuming heraldic devices, each man at his own hand.

Besides individuals, Communities and States are entitled to the use of arms, and Heralds have classified arms, in respect of the right to bear them, under the following ten heads: 1. Arms of dominion; the arms borne by Sovereigns as annexed to their territories. 2. Arms of pretension, which Sovereigns have borne, who, though not in possession, claim a right to the territories to which the arms belong. Thus, England bore the arms of France from the time of Edward III. till 1801. 3. Arms of community; the arms of Bishops' Sees, Abbeys, Universities, Towns, and Corporations. 4. Arms of assumption; arms which one has a right to assume with the approbation of the Sovereign. Thus, it is said, the arms of a prisoner at war may be borne by his captor, and transmitted by him to his heirs. 5. Arms of patronage; added by Governors of Provinces, Lords of the Manor, Patrons of Benefices, etc., to their family arms, as a token of superiority, right, or jurisdiction. 6. Arms of succession, borne quartered with the family arms by those who inherit fiefs or manors, either by will, entail, or donation. Thus, the Dukes of Athole, as having been Lords of the Isle of Man, quarter the arms of that Island, and the Duke of Argyle quarters the arms of the Lordship of Lorne. 7. Arms of alliance, taken up by the issue of heiresses, to show their maternal descent. 8. Arms of adoption, borne by a stranger in blood, to fulfil the will of a testator. The last of a family may adopt a stranger to bear his name and arms and possess his estate. Arms of adoption can only be borne with permission of Sovereign or King-at-Arms. 9. Arms of concession; augmentations granted by a Sovereign of part of his royal arms, as a mark of distinction, a usage which, we have already observed, obtained in the earliest days of Heraldry; and hence the prevalence among armorial bearings of the lion, the fleur-de-lis, and the eagle, the bearings of the Sovereigns of England and Scotland, of France, and of Germany. 10. Paternal or hereditary arms, transmitted by the first possessor to his descendants. A coat of arms is composed of charges depicted on an escutcheon representing the old knightly shield. The word escutcheon is derived from the French *écusson*, which signified a shield with armorial bearings, in contradistinction from *écu*, a shield generally. The shields in use in England and France in the 11th and 12th centuries were in shape not unlike a boy's kite, a form which seems to have been borrowed from the Sicilians; but when they became the recipients of armorial bearings, they were gradually flattened and shortened. From the time of Henry III., the escutcheon has been most frequently represented on seals as of something approaching to a triangular form, with the point downwards, the exceptions being that the shield of a lady is lozenge-shaped, and a knight-banneret square.

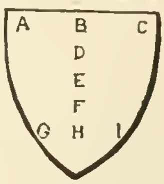


Fig. 1.

To facilitate description, the surface or field of the escutcheon has been divided into nine points, as in (Fig. 1), technically distinguished by the following names: A, the dexter chief point; B, the middle chief; C, the sinister chief; D, the honor or collar point; E, the fess point; F, the nombril or naval point; G, the dexter base point; H, the middle base; and I, the sinister base point. It will be observed that the dexter and sinister sides of the shield are so called from their position in relation not to the eye of the spectator, but of the supposed bearer of the shield.

Coats of arms are distinguished from one another, not only by the charges or objects borne on them, but by the color of these charges, and also of the field on which they are placed. The field may be of one color, or more than one, divided by a partion-line or lines varying in form. The first thing, then, to be mentioned in blazoning a shield—that is, describing it in technical language—is the color, or, as it is heraldically called, the *tincture* of the field.

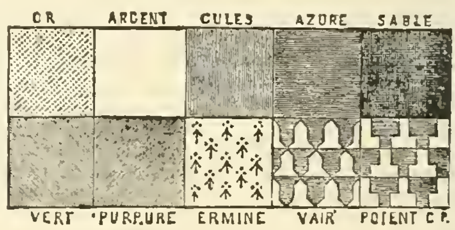
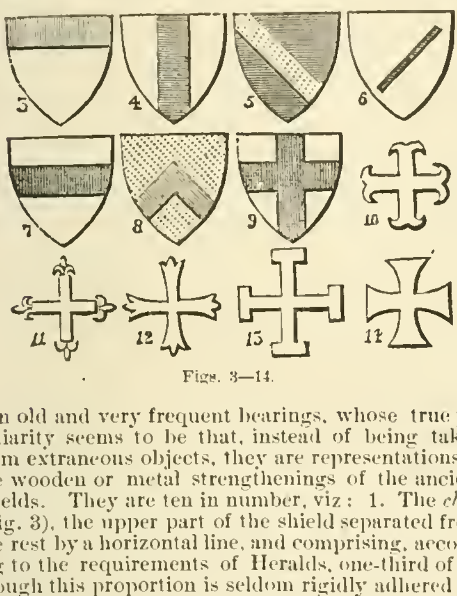


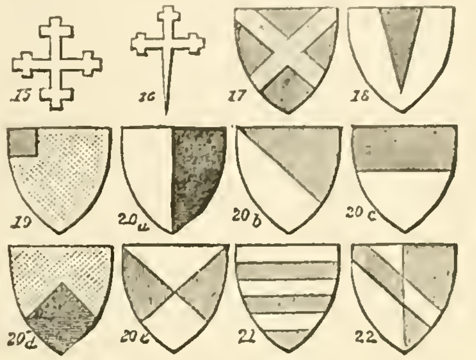
Fig. 2.

Tinctures are either of metal, color strictly so called, or fur. The metals used in Heraldry are two—gold, termed *or*, and silver, *argent*—represented in painting by yellow and white. The colors are five—red, blue, black, green, and purple, known as *gules*, *azure*, *sable*, *vert*, and *purpure*. Metals and colors are indicated in uncolored heraldic engravings by points and hatched lines, an invention ascribed to Father Silvestro di Petrasancta, an Italian Herald of the seventeenth century. *Or*, (Fig. 2) is represented by points; for *argent*, the field is left plain. *Gules* is denoted by perpendicular, and *azure*, by horizontal lines; *sable*, by lines perpendicular and horizontal crossing each other; *vert*, by diagonal lines from dexter chief to sinister base; *purpure*, by diagonal lines from sinister chief to dexter base. The *furs* were originally but two, *ermine* and *vair*. The former is represented by black spots resembling those of the fur of the animal called the ermine, on a white ground. *Vair*, said to have been taken from the fur of a squirrel, bluish-gray on the back and white on the belly, is expressed by blue and white shields, or bells in horizontal rows, the bases of the white resting on the bases of the blue. If the vair is of any other colors than white and blue, they must be specified. Various modifications of these furs were afterwards introduced, among others *ermines*, or ermine with the field sable and the spots argent; *erminites*, with a red hair on each side of the black spot; *pean*, with the field sable, and the spots or; *counter-vair*, or vair with the bells of one tincture placed base to base; and *potent counter-potent*, vair with crutch-shaped figures instead of bells. It is an established rule of Heraldry that metal should not be placed on metal, nor color on color; a rule more rigidly adhered to in English than in foreign Heraldry. We have one remarkable transgression of this in the arms of the kingdom of Jerusalem founded by the Crusaders, which are argent, a cross potent between four crosses or. A recognized exception exists wherever a charge lies over a field partly of metal and partly of color, or where an animal is (see *Infra*) attired, armed, unguled, crowned, or chained with a tincture different from that of his body. Marks of cadency, chiefs, cantons, and bordures are also occasionally exempted from the general rule, being, according to some Heralds, not laid on the shield, but *cousu*, or sewed to it.

Everything contained in the field of an escutcheon is called a *charge*. Charges are divided by Heralds into the three classes of honorable ordinaries, subordinaries, and common charges. Under the name of ordinaries or *honorable ordinaries* are included certain old and very frequent bearings, whose true peculiarity seems to be that, instead of being taken from extraneous objects, they are representations of the wooden or metal strengthenings of the ancient shields. They are ten in number, viz: 1. The *chief* (Fig. 3), the upper part of the shield separated from the rest by a horizontal line, and comprising, according to the requirements of Heralds, one-third of it, though this proportion is seldom rigidly adhered to. Its diminutive is the fillet, supposed to take up one-fourth the space of a chief, in whose lowest part it stands. 2. The *pale* (Fig. 4), a band or stripe from top to bottom, said, like the chief, to occupy one-third of the shield. It has two diminutives, the *pallet*, one-half in breadth of the pale, and the *indorse*, one-half of the pallet. 3. The *bend* (Fig. 5), a similar band crossing the shield diagonally from dexter chief to sinister base. Its diminutives are the *bendlet* or *garter*, one-half of its breadth; the *cost* or *cotise*, one-half of the bendlet; and the *riband*, one-half of the cotise. The bend is sometimes borne between two cotises, in which case it is said to be *cotised*, a term sometimes applied with doubtful propriety to the other ordinaries when accompanied with their diminutives. 4. The *bend sinister*, a diagonal band from sinister chief to dexter base. Its diminutives are the *scarpe*, one-half of the bend sinister; and the *baton* (Fig. 6), one-half of the scarpe. The baton stops short of the extremity of the field at both ends, and has been considered a mark of illegitimacy. 5. The *fess* (Fig. 7), a horizontal band in the middle of the shield, said, like the ordinaries already enumerated, to occupy one third of it. Its principal diminutive is the *bar*, containing the fifth part of the field; and there are also the *closet*, one-half of the bar, and the *barrulet*, one-half of the closet, the latter seldom borne singly. 6. The *chevron* (Fig. 8), composed of two strips descending from the center of the shield in diagonal directions like the rafters of a roof. Its diminutives are the *chevronel* of half, and the *couple-close*, one-fourth its width, the latter borne, as its name implies, in pairs, and generally accompanying the chevron—on each side of it. 7. The *cross* (Fig. 9), uniting the pale and fess, an ordinary which was originally like the rest, composed of the clamps necessary to the strength of the shield, but had also the deeper meaning of the symbol of the Christian faith. Besides its plain form, the cross was varied in numerous ways, most of these varieties being, however, rather common charges than ordinaries. Of the 39 lesser crosses mentioned by Guillim, and 109 by Edmonson, a few of the most frequently occurring are the following: The *cross moline* (Fig. 10), with the ends turned round both ways; the *cross fleury* (Fig. 11), of which each limb terminates in a fleur-de-lis; the *cross patonée* (Fig. 12), each limb of which has three points; the *cross potent* (Fig. 13), crutch-shaped at the ends; the *cross pattée* (Fig. 14), small in the center, but widening toward the ends; and the *cross crosslet* (Fig. 15), crossed at the ends. The latter is the most frequent of all, and borne oftener in numbers than singly. Any of these crosses is said to be fitchée when the lower limb terminates in a sharp point, as in Fig. 16. There is also the *cross Maltese*, whose limbs have each two points, and converge to a point in the center of the cross; though not frequent as a heraldic charge, it derives an importance from being the badge of the Knights of Malta and of many other orders. 8. The *saltire*, or St. Andrew's Cross (Fig. 17), formed by a junction of the bend dexter and bend sinister. 9. The *pile* (Fig. 18), a wedge with point downwards. A single uncharged pile should, at its upper part, occupy one-third the breadth of the shield, but if charged, it may be double that width. 10. The *quarter*, consisting of the upper right-hand fourth part of the shield cut off by a horizontal and a perpendicular line. Its diminutive is the *canton* (Fig. 19). Armorial figures may be depicted on any of these ordinaries, but not on their diminutives, with the exception of the canton.



Figs. 3—14.



Figs. 15—22.

We observed that the field of an escutcheon may be of two different tinctures, divided by a partition-line, which line may vary in direction. When divided by a partition-line in the direction of one of the ordinaries, the shield is said to be *party per* that ordinary; thus we may have (Figs. 20) a shield party per pale, bend, fess, chevron, or saltire. An escutcheon divided as by a cross is said to be quartered. A shield divided into any number of parts by lines in the direction af a pale, bend, or bar, is said to be *paly*, *bendy*, *barry*, the number of pieces being specified, as in the example Fig. 21, barry of six, argent and gules. When the field is of metal and color separated by any of the lines of partition, and the charge placed on, it is said to be *counter-changed:* this means that the part of the charge which is on the metal is of the color, and *vice versa*, as in Fig. 22, the arms borne by Chaucer the poet, per pale argent and gules, a bend counter-changed. The partition-line, or the boundary-line of an ordinary, is not always even.

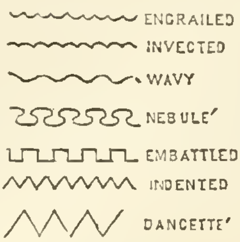
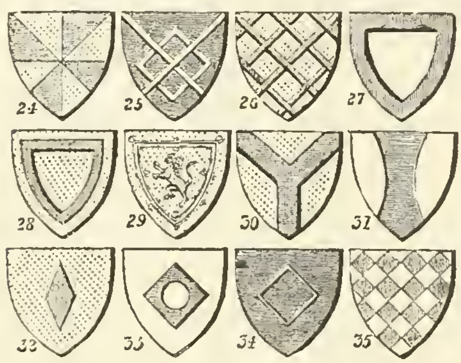


Fig. 23.

Fig. 23 shows the commonest forms of irregular partition-lines in use, viz., the *engrailed*, *invected*, *wavy*, *nebulé*, *embattled*, *indented*, and *dancetté*. An ordinary engrailed has the points of the engrailed line turned outwards, and an ordinary invected, inwards. Dancetté differs from indented by the partition-line being marked with only three indentations. The *subordinaries*, or subordinate ordinaries, are generally enumerated as the following, though there is no very broad line of demarkation between them and the common charges. 1. The *gyron*. When a shield is at once quartered and party per saltire, as in Fig. 24, the division is called *gyronny of eight* (from *gyrus* a circle), and one of the triangles, or at least that triangle in



Figs. 24—35.

dexter chief is a gyron. Gyronny of six, ten, or twelve also occasionally occur, so called according to the number of the triangles. 2. The *fret* (Fig. 25) is a cognizance derived from the banding or ornamenting of the shield, and a shield covered with this lattice-work decoration (Fig. 26) is said to be *fretty*. 3. The *bordure*, or border (Fig. 27) is a stripe encircling the shield. It is much used to distinguish different branches of a family, and is often charged with small devices, on which account it has sometimes been reckoned an honorable ordinary. 4. The *orle* (Fig. 28) differs from a bordure in not touching the extremity of the shield. 5. The *tressure*, regarded as a diminutive of the orle, is generally borne double, and flory counterflory, as in the arms of Scotland, or a lion rampant within a tressure flory counterflory gules (Fig. 29). 6. The *pall* (Fig. 30), the archiepiscopal ornament of that name, sent from Rome to metropolitans, and resembling in form the letter Y. 7. The *flanches* (Fig. 31), the dexter and sinister sides of the shield cut off by a curved line. Flanches are always borne in pairs, and sometimes charged. 8. The *lozenge*, a figure of four equal sides, with the upper and lower angles acute and the others obtuse. 9. The *fusil* (Fig. 32), longer and more acute than the lozenge. 10. The *rustre* (Fig. 33), a lozenge pierced round in the center. 11. The *mascle* (Fig. 34), a lozenge perforated, and showing a narrow border. Mascles were probably originally links of chain-armor. A field is said to be *lozengy* (Fig. 35), *fusilly* or *mascally* when divided by diagonal lines in the direction of these subordinaries. A field divided by horizontal and perpendicular lines into squares of different tinctures is said to be *checky;* in the case of a *fess checky* there are three such rows of the squares. Among the subordinaries are sometimes reckoned certain circular charges called *roundels* or *roundlets*, distinguished in English Heraldry by very different names according to their tinctures. When of or, they are called *bezants;* of argent, *plates;* of gules, *torteaux;* of azure, *hurts;* of purpure, *golpes;* and of sable, *ogresses*, or *pellets*.

We now come to the third class of figures occurring in armorial bearings. We have seen that the ordinaries and subordinaries are for the most part purely heraldic figures, connected in their origin with the shield itself; the *common charges*, on the other hand, are representations more or less conventional of familiar objects, which have no necessary relation to the shield; but are in some way emblematic as concerns family or individual history and character. The knights, in the early days of Heraldry, ransacked the animal, the vegetable, and the mineral kingdom, as well as the range of things natural and artificial, for cognizances which would be distinctive, and at the same time suggestive, of the name or title of the bearer of them. We can only enumerate a few of the charges of most frequent occurrence. Of the beasts, the *lion* requires special mention. The king of beasts is one of the most frequent of heraldic devices, and is made to assume a great variety of attitudes, for which see LION. Lions and other beasts of prey are said to be *armed* or *langued* of any tincture when their teeth and claws, or their tongue, is of that tincture. With some change of color or position, the royal beast came to be used by all who could claim kindred, however remote, with royalty, and lions were further multiplied by augmentations granted by the Sovereign to favorite followers. The heraldic *leopard*, which has been the subject of much controversy, was originally but another designation for the lion passant-gardant. Bears, boars, bulls, stags, are favorite heraldic beasts. A stag walking is said to be *trippant;* he is *at gaze* when a lion would be statant-gardant; he is *attired* of any tincture when his horns are of that tincture. The animals that possess horns and hoofs are said to be *armed* and *ungled* in respect of them. The heads and limbs of animals are often borne as charges, and they may be either *couped*, cut off in a straight line, or *erased*, cut off with jagged edge. Of birds, we have first the *eagle*. The sovereign of birds, and symbol of imperial Jove, was, next after the lion, the most favorite cognizance of royal personages, and was adopted by the German Emperors, who claimed to be successors of the Cæsars of Rome. The imperial eagle had at first but one head; the monstrosity of a second head seems to have arisen from a dimidiation of two eagles, to represent the Eastern and Western Empire. The eagle of Heraldry is most generally *displayed*, i.e., its wings are expanded; sometimes it is *preying*, or standing devouring its prey. The *alerion*, the cognizance of the Duchy of Loraine and the family of Montmorency, was originally but a synonym for the eagle assumed as an anagram for the word Loraine, but modern Heralds have degraded it into a nondescript creature without beak or claws. The *martlet* was originally a martin, a species of the swallow, which has also in course of time been deprived by heralds of its legs and beak. The pelican, the swan, the cock, the falcon, the raven, the parrot or popinjay, and the peacock, are all of tolerably frequent occurrence. The *pelican* has generally her wings *indorsed*, or placed back to back, and is depicted pecking her breast. When in her nest feeding her young, she is called a pelican *in her piety*. A *peacock* borne affronté with his tail expanded is said to be *in his* *pride*. Birds of prey are *armed* of the same color of which their beak and talons are represented. Such as have no talons are *beaked* and *membered*. The *cock* is said to be *armed*, *crested*, and *jelloped*, the latter term referring to his comb and gills. Birds having the power of flight are, in respect to their attitude, *close*, *rising*, or *volant*. Fishes and reptiles occur as charges: the former are said to be *naiant*, if drawn in a horizontal, and *hauriant*, if drawn in a perpendicular position; and the *dolphin*, in reality straight, is conventionally borne *embowed* or bent. The *escallop shell* is of frequent occurrence, and is said to be the badge of a pilgrim. Sometimes the conventional heraldic form of an animal differs from its true form, as in the case of the *antelope* of Heraldry, which has the head of the stag, a unicorn's tail, a tusk issuing from the tip of the nose, a row of tufts down the back of the neck, and similar tufts on the tail, the chest, and thighs. Of "animals phantasticall" we have among others the griffin, wyvern, dragon, unicorn, basilisk, harpy. We have the human body in whole or part, a naked man, a savage, or wild man of the woods, also arms, legs, hearts, Moors' heads, Saracens' heads, and that strange heraldic freak, the three legs conjoined, carried in the escutcheon of the Isle of Man.

Of plants, we have *roses*, *trefoils*, *cinquefoils*, *leaves*, *garbs* (sheaves of corn), *trees*, often *eradicated* or *fructuated* of some other color, and, above all, the celebrated *fleur-de-lis*, used as a badge by Louis VII. of France, before Heraldry had an existence. When a plant, or an animal, or other charge is blazone *proper*, what is meant is that it is of its natural color. The heavenly bodies, the sun, moon, and stars, are also pressed into the service of Heraldry, as are things inanimate and artificial without number, particularly such as were familiar to the warriors and pilgrims of the 12th and 13th centuries. Helmets, buckles, shields, hatchets, horseshoes, swords, arrows, battering-rams, pilgrims' staves, mullets (for spur-rowels), and water-bougets, or bags, in which in crusading times water was carried a long distance across the desert, also the clarion or war-trump, generally or erroneously called a *rest*. Even the letters of the alphabet have been used as charges. Charges may be placed either simply on the field or on one of the ordinaries; in some instances, one of the ordinaries is placed over a charge, in which case the charge is said to be *debruised* by the ordinary. Three charges of one kind are placed two above and one below, unless blazoned *in fess* or *in pale*. In the 14th and 15th centuries, the simplicity of early Heraldry began to be departed from by accumulating a variety of charges on one shield, and in later times we have sometimes a charge receiving another charge like an ordinary. The growing complexity of shields arose from the augmentations granted to distinguish the younger branches of a family, or charges assumed from the maternal coat by the descendants of an heiress. In the end of the last and beginning of the present century, a practice prevailed for a time of introducing into armorial bearings matter-of-fact landscapes, representations of sea-fights, and of medals and decorations worn by the bearer, setting all heraldic conventionalities at defiance, and dealing in details not discernible on the minutest inspection. Such charges are frequent in the arms of the heroes of the old wars; as, for an example, in the augmentation granted to Sir Alexander Campbell, bart., in addition to his paternal arms—viz., "A chief argent charged with a rock proper, subscribed *Gibraltar*, between two medals; and on the dexter representing the silver medal presented to Sir A. Campbell by the Supreme Government of India, for his services at the storming of Seringapatam, in 1799; that on the sinister representing the gold medal presented to him for his services in the battle of Talavera." The grants proceeding from the present Kings-of-Arms are made conformable to the usages of Heraldry, and do not stand in need of such lengthened explanations to make them intelligible. The arms of the different members of a family have been distinguished from one another, sometimes by the use of a bordure or other difference; and sometimes, especially by English Heralds, by the use of certain figures called *marks of cadency*, *the label*, *crescent*, *mullet*, *martlet*, *annulet*, *fleur-de-lis*, to designate the eldest, second, third, fourth, fifth, or sixth son and his descendants—an invention originating about the time of Henry VII., but which cannot consistently be carried through all the ramifications of a family for a succession of generations. *Blazonry* is an essential part of the science of arms. To blazon a coat is to so describe it that any one with an ordinary knowledge of Heraldry will be able to depict it correctly. In the language of blazonry, all tautology must be avoided. The tincture of the field is first mentioned; the ordinary, if any, follows, unless it be a chief; then the charges between which the ordinary is placed. The charges on the ordinary follow, and, lastly, we have a canton or chief, and marks of cadency. Besides the heraldic devices depicted on the shield, there are the following borne external to it—the helmet, the mantle, the wreath, the crest, the motto and scroll, the supporters, and the coronet. The *helmet*, originally a piece of defensive armor,, became in the course of time one of the usual accompaniments of the shield; and, placed over the arms, it came by its form to mark the rank of the wearer. For these distinctions, which are of comparatively recent date, and applicable only to British Heraldry, see HELMET. The *mantling* is an embellishment of scroll-work flowing down on both sides of the shield, and originating in the *cointoise*, or scarf, wrapped round the body in the days of coat-armor. From the center of the helmet, within a *wreath* of two pieces of silk of the first two colors of the armorial bearings, issues the *crest*, originally a special mark of honor worn only by heroes of great valor, or advanced to a high military command; now an inseparable adjunct of the coat of arms in English, though not in Continental Heraldry, and often assumed and changed arbitrarily without the proper authority. The *scroll*, placed over the crest or below the shield, contains a *motto* bearing in many cases an illusion to the family name or arms. *Supporters* are figures or animals standing on each side of the escutcheon, and seeming to support it. They were in their origin strictly ornamental devices, which only gradually acquired a heraldic character. In England, the right to use supporters is confined to the Royal Family, Peers, Peeresses, and Peers by courtesy, Knights of the Garter, Knights Grand Cross of the Bath, and a very few families whose ancestors bore supporters before their general use was restricted. In Scotland, supporters are also used by the Baronets of Nova Scotia and the chiefs of various families. The crown of the Sovereign, the miter of the Bishop, and the coronet of the Nobility are adjuncts appended to the shield of those whose dignity and office entitle them to that distinction. The subject of *marshaling arms*, or arranging various coats in one escutcheon, is explained in a separate article. Here it may suffice to lay down a few general rules. A husband is entitled to *impale* the arms of his wife, i.e., to place them on the same shield side by side with his own. When the wife is an heiress, the husband bears her arms in an *escutcheon of pretense*, or small escutcheon in the center of his own shield, and the descendants of the heiress may quarter her arms with their paternal coat. A Sovereign also quarters the arms of his several States, and feudal arms are quartered by subjects. An elective King may place his herditary arms on an escutcheon of pretense over the insignia of his dominions.

HERALDS' COLLEGE.—A collegiate body, founded by Richard III. in 1493, consisting of the heraldic officers of England, who were assigned a habitation in the Parish of Allhallows-the-Less, in the city of London. See *College of Arms*.

HERBORT SYSTEM OF FORTIFICATION.—In this system, the angles of the polygon are covered by casemated reduits, surrounded by barracks loop-holed for musketry and artillery. These are flanked by two redoubts, covered by a glacis, before which stands a counter-guard. The extremities of these course-faces form a low flank before the redoubts. Defensive barracks connected by an earthen parapet form a general retrenchment. An envelope of counter-guards flanked by lunettes, which have also their glacis, casemates, extra flanks, etc., surrounds the whole. The system is ingenious; but, the outlay is enormous. The unrevetted parapets and the flanks rising in tiers would expose it to an attack of vive force, and it would also suffer much from ricochet.

HERCOTECTONIQUE.—A term in fortification signifying that branch of military architecture which specifically points out the best means of defense and the surest method of providing stores. The word is derived from the Greek.

HERCULES POWDER.—A mixture of carbonate of magnesia with carbonizing and oxidizing materials, combined with nitro-glycerine in varying proportions, to produce different grades of explosiveness. Although Sobrero well established the fact that nitro-glycerine was a powerful explosive—and about 1852 the French Academy made several practical tests showing it was an agent of great importance, and scientific men occasionally wrote upon the subject—the article of glycerine had not yet been produced in large quantities, mostly on account of the expense attending its manufacture, which was still in its infancy; and hence the manufacture of nitro-glycerine had remained wholly impractical, for common mining and engineering purposes, until about the year 1862. The Hercules Powder Company, well knowing that nitro glycerine had been used as mixed with gunpowder many years before, commenced the manufacture of a high explosive, in 1868, compounded in that manner. But it was found that all these mixtures of the nitro-glycerine compounds were faulty in two particulars, viz:—1st. A tendency to decomposition when exposed to much summer heat, or long storage or use in very hot mines, etc., in consequence of some small particles of nitric acid remaining in the nitro-glycerine, rendering it more or less dangerous from decomposition. 2nd. The noxious fumes arising from this decomposition, both in storehouses and in the mines, causing nausea and headache and in some cases weakening the quality of the powder. As a remedy for the first, the carbonate of magnesia entirely neutralizes any free acid that may chance to remain in the nitro-glycerine, and converts it into nitrate of magnesia, which is explosive, and renders it so perfectly free from any liability to spontaneous combustion that it may be safely stored, for many months, in the hottest weather, or be transported through the longest voyages in the tropics, without undergoing any chemical change. The remainder of the mixture is compounded upon strict chemical principles to neutralize noxious fumes that would otherwise be generated. See *High Explosives*.

HEREFARE.—An old term from the Saxon, signifying the same as warfare.

HEREGELD.—A term derived from the Saxon, signifying a tax which was formerly levied for maintaining an army.

HERESILIA. A term derived from the Saxon, signifying a soldier who abandons his colors, or deserts the service. Also written *Heresliti*.

HERETOCH.—The leader or the commander of an army. The term frequently means a Constable or Marshal, and is sometimes written *Heretog*.

HERETUM.—A court in which the guards or military retinue that usually attended the old British Nobility and Bishops were accustomed to draw up.

HERÔATE. A term derived from the Saxon signifying a tribute which was paid in ancient times to the Lord of the Soil, to enable him to carry on war.

HERISSON.—A formidable hedge or chevaux-de-frise. It is made of one stout beam fenced by a number of iron spikes, and which, being fixed upon a pivot, revolves in every direction upon its being touched, always presenting a front of spikes.

HERLIN SYSTEM OF FORTIFICATION.—This system proposes an enciente of detached bastions and javelins, and divides the town into quarters by double cavaliers erected behind the gorge of the bastions. The ramparts are casemated with a double parapet and a fausse-braye.

HERMANDAD.—An Association of the principal cities of Castile and Aragon, bound together by a solemn league and covenant for the defense of their liberties in seasons of trouble. These Confederacies were sanctioned by the Sovereigns, as agents for suppressing the increasing powers of the Nobles, and for maintaining public security through the land with no cost to the Government. In Aragon, the first Hermandad was established in the middle of the 13th century, and in Castile about 30 years later; while in 1295, 35 cities of Castile and Leon formed a joint Confederacy, and entered into a compact, by which they pledged themselves to take summary vengeance on every Noble who had either robbed or injured a member of their Association and refused to make such atonement for the wrong; or upon any one who should attempt, even by the order of the King, to levy an unjust tax. During the long period of Anarchy in which the Christian Rulers of Spain were impotent to maintain order in their own Dominions, the *Santa Hermandad*, or Holy Brotherhood, had presented the only check against the unbounded license of the Nobles; and Isabella of Castile, seeing the beneficial effects which an extension of the Institution was capable of producing, obtained the sanction of the Cortes for its thorough reorganization and extension over the whole Kingdom in 1496. The crimes reserved for its jurisdiction were all acts of violence and theft committed on the high-roads or in the open country, and the penalties attached to each misdemeanor were specified with the greatest precision in the codes of laws which were enacted at different times in the yearly assemblies of the deputies of the Confederate cities. An annual contribution was, moreover, assessed on every hundred householders or *vecinos* for the equipment and maintenance of the horsemen and the *quadrilleros* or officials of the Brotherhood, whose duty it was to arrest offenders and enforce the sentence of the law. Although the Hermandad was regarded with much disfavor by the aristocracy, it continued for many years to exercise its functions, until the country was cleared of the banditti and the Ministers of Justice enabled to discharge their duties without hinderance from lawless disturbers of the peace. In 1498, the objects of the Hermandad having been obtained and public order established on a firm basis, the Brotherhood was disorganized, and reduced to an ordinary police, such as it has existed, with various modifications of form, until the present century. The laws enacted at different times in the Juntas or Assemblies of the Hermandad were compiled, in 1485, into a code, known as the *Quaderno de las Leyes nuevas de la Hermandad*, which was first printed at Burgos in 1527.

HEROES.—In the Homeric period, Kings, Princes, Generals, Leaders, all brave Warriors, and men who excelled in strength, courage, wisdom, and experience. Many of these had, on account of such qualities, a fabled origin, half human, half divine, and were honored, after death, with a kind of adoration or inferior worship. These heroes and demigods were recognized as the special patrons or protectors of particular countries or cities, and to them were raised temples and altars. These examples of heroic character, held up constantly to the admiration and imitation of peoples, tended to strengthen their peculiar character, and to impress them with the greatness and glory of courage, contempt of danger, and nobility of purpose. Poetry exalted the heroic sentiment to sublimity; and poems which celebrated the deeds of heroes are themselves termed heroic. The imaginary time when heroes and other semi-divine beings lived on earth was commonly called the Heroic Age.

HERRISON.—In Heraldry, the hedgehog, a charge allusively borne by families of the name of Harris.

HERSE.—In fortification, a kind of gate or portcullis, with iron bars like a harrow, set in with iron pikes, placed above gates and lowered, to impede the advance of an enemy. It is usually hung by a rope and is fastened to a moulinet, which is cut in case of a surprise, or when the first gate is forced by a petard, so that it may fall like a portcullis and stop the passage of a gate or any other entrance of a fortress.

HERSILLON.—A strong beam, whose sides are stuck full of spikes, which is thrown across the breach made by an enemy to render it impassable. See *Herse*.

HERULI.—A nomadic and warlike German tribe, who inhabited the north shores of the Black Sea, but afterwards divided into sections and wandered into different parts of Europe. They first appear in history in the third century as taking part with the Goths in their excursions against the eastern provinces of the Roman Empire. In the fourth century they acknowledged the supremacy of the Gothic King Ermanric, but when Attila, King of the Huns, made his descent upon Gaul, they joined his standard. After the overthrow of the Huns, in which they suffered considerably, they established an organized and distinct Confederacy on the banks of the Danube, and under the leadership of Odoacer, assisted in 476 in the overthrow of the Western Empire. Under their King Rudolph they, in the beginning of the sixth century, attempted the subjugation of the Longobardi, but were defeated and dispersed, some of them proceeding to Scandinavia, and others being allowed by the Emperor Anastasius to settle on the south bank of the Danube. In the time of Justinian some of them embraced Christianity. A large portion of them afterwards joined the Gepidæ in their wars against the Eastern Empire; but others fought with Justinian against the Vandals and East Goths. Towards the end of the sixth century they were merged into other nations, and disappeared from historical records. The Heruli were bold, hardy, and extremely pugnacious. For a considerable period they retained their strong individuality, and presented a firm resistance to the influences of civilization. They are said to have offered human sacrifices. Also written *Æruli*, and *Eruli*.

HESSIANS.—Troops belonging to Hesse-Cassel, Prussia. They have been frequently hired in Great Britain, particularly in the war of American Independence, when they were sold at £40 sterling a head, £9 of which was to be repaid if returned alive.

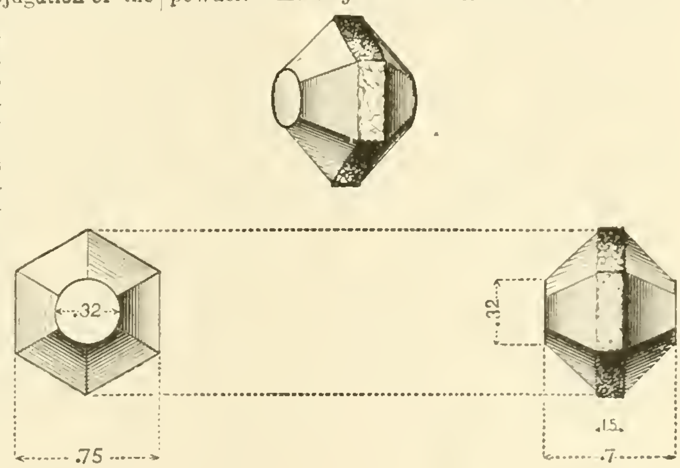
HETMAN.—The title of the Head or General of the Cossacks, now retained only among the Cossacks of the Don. From the earliest times the Hetman was elected by the voice of the assembled people; the mode of election being by throwing their fur-caps at the candidate they preferred, and the one who had the largest number of caps was declared duly elected. The power of the Hetman was very great, and extended over life and death. When the Cossacks in 1644, submitted to the Russians, the Hetman was permitted to retain his rights as formerly. The Empress Catherine entirely abolished the dignity of Hetman of the Ukraine, and substituted a Government consisting of eight members. The Don Cossacks have, indeed, retained their Hetman, and even he possesses but the shadow of his former power. The latest elective Hetman was Count Platoff, who played a prominent part in the wars with France (1812-14). After his death the Hetman was appointed by the Czar, and ultimately the title was made hereditary in the Grand Duke, the heir to the throne. Also written *Ataman*.

HEURTEQUINS.—Two pieces of iron resembling a knocker, which are placed over the trunnions, or axis of a cannon.

HEUSE.—An iron shoe, sometimes called *pedieux*, attached to the greaves of ancient armor, having an iron sole, and the upper composed of mail.

HEXAGONAL POWDER.—Experiments were made at Fort Monroe in 1872 and 1873 with what is known as hexagonal-grained powder, manufactured by the Messrs. Dupont & Co., of Wilmington, Del., which demonstrated its superiority for heavy ordnance, giving low maximum pressures, with good velocities and great uniformity of action. One of the samples was selected for proof of the converted 8 and 9-inch rifled guns in 1874. Hexagonal powder has been employed since that date in trial and proof of all 8-inch converted guns. The uniform size of grain, and their polyhedral shape, insure great uniformity in position and size of the interstices in the make-up of the cartridge; this insures with a uniform density of grain a high degree of uniformity in pressures and velocities from given charges of powder and weights of projectiles. The drawing shows the shape and dimensions of this powder, the specific gravity being 1.7511.

The proportions of the ingredients of hexagonal powder conform to the United States standard, and up to the completion of the incorporation in the wheel-mill, its manufacture is like that of ordinary powder. *Mealing*—The wheel mill-cake is revolved



in a cylinder of wire-wove cloth, with wooden-balls, until it is mealed. *Pressing*—The mealed powder is then carefully pressed between horizontal metallic plates or dies. The powder comes out in a sheet or cake of polyhedral granules united along their vertical edges, the dies being nearly perfect dodecahedrons. *Graining*—The press-cake is passed between rollers armed with brass cutting teeth at an angle of from 60° and 120° to the axis, which cut the cake into granules, their cross-section being almost *hexagonal*, whence the powder derives its name. *Glazing*—The powder is then sent to the glazing-mill and glazed. *Brushing*—The powder is next passed repeatedly through the brushing-machine. This consists of a frame with brushes revolving near an inclined plane along which the powder passes by the motion of the brushes. *Drying*—The brushing ended, the powder goes to the dry-house where it is dried. The powder is now minutely examined, its specific gravity is taken, and a count made of the granulation; a variation of two granules to the pound being enough to condemn the powder. *Re-brushing and re-drying*—If satisfactory, the powder is again passed through the brushing-machine, re-dried, and then receives a third brushing. *Packing*—The powder is finally packed in barrels and is ready for inspection. See *Gunpowder*.

HIBERNIAN ROYAL SCHOOL.—A School established in Great Britain for the maintenance of 350 children of military officers who are supported and educated at the School, at an expense of £7,000 per annum to the country.

HIDE-BOUND.—A term which, when applied to a horse, signifies that his skin cannot be pulled up or raised from his ribs and back; caused from bad keep, poverty, internal disease. The remedy consists in good grooming and diet, with gentle medicine and keeping the animal warm.

HIDES.—The skins of buffaloes, cows, bullocks, and other animals. Buffalo-hides are used in India for the manufacture of buff accouterments, belting of machinery, etc.; bullock or cow-hides for mending cartouches and priming-pouches, and a variety of other leather-work. Buffalo-hides which have undergone the process of tanning are used for covering the floors of powder-houses and charge magazines.

HIERARCHY.—The essential element for the government and service of an Army is a military hierarchy or the creation of different grades of rank, to which different functions and powers are assigned, the lower in regular subordination to the next higher in the ascending scale. It should be founded on the principle that every one acts in an Army under the orders of a Superior, who exercises his authority only within limits established by law. This authority of the Superior should be greater or less according to rank and position, and be proportioned to his responsibilities. Orders should be executed without hesitation; but responsibilities should be confined to him who gives orders in virtue of the superior authority with which he is invested; to him who takes the initiative in an order; to him who does not execute an order that he has received; and to him who usurps a command or continues illegally to exercise its functions. The military hierarchy is determined and consecrated within its sphere of action by:—1. Grades of rank created by military laws; 2. By other laws regulating the exercise of rank; 3. By military insignia; 4. By military honors: and 5. By the military oath.

HIGH-ANGLE FIRE.—The fire from guns, howitzers and mortars at all angles of elevation exceeding 15°. See *Fire*.

HIGH EXPLOSIVES.—The name given to the various nitro-glycerine compounds. The value of these compounds depends in a very great measure upon the quantity of nitro-glycerine contained in them. The table herewith gives the distinguishing marks adopted by the leading manufacturers of high explosives in the United States, and the percentage of nitro-glycerine contained in the powder they represent. See *Explosive Agents*.

ATLAS. (Standard).		HERCULES.		GIANT.		ÆTNA.		HECLA.		JUDSON.	
BRAND	Per Cent N. G.	BRAND.	Per Cent N. G	BRAND.	Per Cent N. G.	BRAND.	Per Cent N. G	BRAND.	Per Cent N. G	BRAND.	Per Cent N. G.
										R. R. P..	5& under
										F,........	10
F+,...	15					No. 5,....	15			FF,.......	15
E.	20	No. 4,....	20	M,........	20			No. 3,....	20	FFF,....	20
E+.	25	No. 4 S.	25			No. 4×...	25	No. 3×..	25		
				×××,....	27						
D. ..	30	No. 3,....	30					No. 2,....	30		
				No. 2 C,..	33						
D+,.	35	No. 3 S,..	35			No. 3×...	35	No. 2 ×..	35		
C,.......	40	No. 2,....	40	No. 2,....	40	No. 2,....	40	No. 1,....	40		
C+, .	45	No. 2 S,..	45	No2Extra	45						
B, ...	50	No. 2 SS.	50	New No.1	50	No. 2× ×	50	No. 1×...	50		
B+,.	60	No. 2 SSS	55								
		No. 1,. ..	65			No. 1,....	65				
A,......	75	No 1××	75	No. 1,....	75			No. 1××	75		

HIGHLAND REGIMENTS.—The origin of the first of these regiments, the 42d, has been given under the head Black Watch. The valuable services of this regiment encouraged the Government to augment the force; and accordingly seven other Highland Regiments have been raised from time to time —viz., the 71st, in 1777; the 72d, or Duke of Albany's Own, in the same year; the 74th, in 1787; the 78th, or Ross-shire Buffs, in 1793; the 79th, or Cameron Highlanders, in 1805; the 92d, or Gordon Highlanders, in 1796; and the 93d, or Sutherland Highlanders, in 1800. The uniform of each of these corps is the Highland dress, including a distinctive tartan. The soldier wears a coatee of scarlet, a kilt (in most, but not all, of the regiments), a plaid across the shoulders, a plume, and the other attributes of the Gaelic costume. In an army where officers are appointed by general competition, nationality is necessarily disregarded; but these Corps are those in which Scotch gentlemen most frequently seek appointments, and a large proportion of the officers are Scotch. Of the men, at least 79 per cent. are Scotch, 11 per cent. English, and 10 per cent. Irish. The regiments are recruited at Stirling, Aberdeen, Perth, Fort George, and Lanark.

HIGH SEAS.—The open sea, including the whole extent of sea so far as it is not the exclusive property of any particular country. The rule of international law is that every country bordering on the sea has the exclusive sovereignty over such sea to the extent of three miles from its shore; but all beyond, and which is not within three miles of some other country, is open or common to all countries. The part of sea within three miles' distance is generally called the territorial sea of the particular country, or *mare clausum*. The distinction has little effect on the right of navigation, but as regards fishing it is otherwise. Thus, for example, foreign fishermen have no right to fish within three miles of the British coast without a license from the Crown, or unless some special treaty—as for example, the French and English treaty—has laid down other arrangements.

HIGH STEEL.—For the construction of cannon, steel may be divided into *high* and *low* steel, the difference being that the former contains more carbon that the latter. High is very hard and has a great ultimate tenacity. It has but little extensibility either within or without its elastic limit; it is therefore too brittle for use in cannon, unless used in such large masses that the elastic limit will not be exceeded by the explosive force of the powder. It melts at a lower temperature than wrought-iron, and is difficult to weld as its welding temperature is but little less than that at which it usually melts. See *Steel*.

HIGH TREASON.—Treason against the State or the security of the Sovereign, whether by imagination, word, or deed. In the United States, treason is confined to the actual levying of war against the

United States, or any adhering to their enemies, giving them aid and comfort. See *Treason*.

HILT.—The handle of a cutting instrument, especially of a knife or sword. *Hilted* is a term used in Heraldry, to indicate the tincture of the handle of a sword.

HINNY.—The hybrid produced between a horse and a female ass. It is smaller than a mule, but the body is more bulky in proportion to the legs, and its strength is inferior. It is less valuable than the mule, although it is more docile. The hinny is rare. It was described by some of the earlier naturalists as a hybrid between the ox and the ass, and even Buffon seems to have entertained this notion.

HIPPODROME.—The Greek name for the place set apart for horse and chariot races. Its dimensions were, according to the common opinion, half a mile in length and one-eighth of a mile in breadth. In construction and all important points of arrangement, it was the counterpart of the Roman circus, with the exception of the arrangement of the chariots at the starting-place. In the hippodrome, the chariots were arranged so as to form two sides of an isosceles triangle, with the apex towards the goal and a little to the right side. But as this would have given the chariots on the left side a longer course than those on the right, the hippodrome was constructed with the right side longer than the other. The start was effected by setting free the chariots on the extreme right and left, when they came opposite the next two, by setting them free also, and so on till all were in motion. The hippodrome was also much wider than the Roman circus, to allow room for the greater number of chariots, for though we have no precise information as to the number that usually started in one race, we know that Alcibiades on one occasion sent seven; Sophocles mentions ten chariots, as competing at the Pythian games; and the number at the Olympic games must have been considerably greater. There is a beautiful description of a chariot-race in Homer (*Iliad*, xxiii. 262-650). The golden age of the hippodrome was during the lower Greek Empire. The blue and green factions in the hippodrome carried their animosity into all departments of the public service, and laid the foundation of that perpetual disunion which rendered the Byzantine Empire a prey to every aggressor.

HIRCARRAH.—An Indian term for a messenger, guide, footman, or a spy. Sometimes written *Hircarra*.

HIRING OF DUTY.—Hiring of duty is forbidden in all Armies. In the United States, the Articles of War provide that no soldier, belonging to any regiment, troop, battery, or company, shall hire another to do his duty for him, or be excused from duty, except in cases of sickness, disability, or leave of absence. Every such soldier found guilty of hiring his duty, and the person so hired to do another's duty, shall be punished as a Court-Martial directs. Every Non-commissioned Officer who connives at such hiring of duty shall be reduced. Every Officer who knows and allows such practices shall be punished as a Court-Martial may direct.

HIRPINI.—A people of Italy who inhabited the south portion of Samnium. They have been considered by some authorities as merely a Samnite tribe, while by others they are looked upon as an independent nation. The country they inhabited was the wild and mountainous district traversed by the Sabatus, Calor, and Tamarus, tributaries of the Vulturnus, and on the east side of the Apennine ridge, the upper course of the Aufidus. In the early history of Rome the Hirpini are found identifying themselves with their Samnite neighbors against their common foes. They seem to have been subdued in the early part of the third century B. C., as in 268 B. C., Beneventum, the key of all their military postions, was colonized by Roman settlers. They appear in history for the first time as an independent people after the second Punic War. Revolting from their old Conquerors, they joined the Carthaginian Invaders, and though they were unable to retake the stronghold of Beneventum, they kept faithful to Hannibal till defeat at the Metaurus restored the Empire of Italy to his opponents. In the year of that event the Hirpini made peace with their old masters by betraying into their hands the garrisons of their Allies. From this time till the outbreak of the Social War, the Hirpini seemed to have continued steadfast in their allegiance. On that occasion, however, they set the example of revolt to the Allies, and might have become formidable enemies, had not the rapid successes of Sulla induced them to repair their error by a complete submission. At the close of this war the Hirpini obtained the franchise, and do not again appear in history as an independent people. Their towns were Beneventum, Aeculanum, Equus, Tuticus, Trivicum, Murgantia, and Aquilonia.

HISTORY.—Military history may be defined as a narrative or description of the several military transactions, as campaigns, battles, sieges, marches, etc., of armies. A thorough knowledge of this branch of history is necessary to make the military man apt in his profession, self-reliant, and capable of command. It is indeed the secret of many a Commander's success in the varied positions he is placed in his career, as in the study of military history he finds a precedent for every strategic emergency, and a solution of the many difficult problems in the art of war, which great Generals have overcome. The study of military history further tends to create high aspirations after military glory, from the perusal of deeds of valor performed by men who have devoted and virtually sacrificed their lives for the good of their country.

HITCH.—The name given to certain knots, such as the *timber-hitch*, *clove-hitch*, and others. These knots are very valuable for artillery and engineer purposes, the advantage being that, as long as the strain is kept upon them, they never give way. Hitches may be described as overlaying a part of a rope with itself in such a manner that a loop or loops are formed to jam on each other. See *Knots*.

HITCHCOCK FORGING.—This system of forging is designed to insure sound welding in the fabrication of large cannon. The iron is heated in a reverberatory furnace, to avoid its contact with sulphur and other impurities of coal. The gun is forged of rings of wrought-iron, or low-steel made without welds, and upset or butted together, as by Ames's process. The rings are so formed as to be united first in the center, that the superfluous cinder may be squeezed out. An anvil is seated on the piston of a hydrostatic press, so as to be lowered as the successive rings are added. A furnace is situated between the anvil and a steam-hammer, and so arranged that the rings project into it from below, and the hammer drops into it from above. The ring to form the muzzle of the gun is laid upon the movable anvil and projected sufficiently into the furnace to allow the flame to raise it to the welding heat. Meanwhile, in another part of the furnace, the rings are heated to welding in the same time, by proportioning the heat, by means of dampers to the relative bulks of the two parts. Without removing the parts from an atmosphere in which there is very little if any oxygen, they are laid together and instantly welded by a few strokes of the steam-hammer. The anvil is then lowered by the thickness of another ring, and the same process is repeated.

Although the *gun* may be of any size, the parts actually united at one operation, may be made so light by reducing their thickness, that the pressure of a hammer of moderate weight will be adequate. And when the whole operation of upsetting is confined to one joint, exactly the requisite pressure for that joint can be applied; and there is no fear of injuring other parts by setting it up soundly, because the mass of the gun below it is cold, and forms a rigid pillar—practically a continuation of the anvil. It would appear that all the conditions of sound welding may thus be attained, if the process can be practically carried out. This process was intended especially for fabricating guns of low-steel, the rings to be made without welds, by being originally cast in the form of small thick rings, and then rolled, in a modification of the tire-rolling machine, to a larger diameter and a smaller section. This treatment would develop an endless grain in the rings, in the direction of the circumference.

HOBBLE—HOPPLE.—A fetter for horses, or other animals, when turned out to graze—chiefly used in the plural. When in the vicinity of the enemy or horse-thieves, the stock may be permitted to graze,

and at the same time be secured by means of the *hopples* or *side-lines*. They are likewise of inestimable value for use on animals prone to stray far away from the camp or herds. The drawing shows the usual form of their construction, the fetlock straps being made of a thick leather, the inside smooth and soft, and the sewn edges uppermost when on the animal's legs. For military purposes, it is decidedly better to have the leglets made of steel, with a light connecting lock and chain of the same material. Leather hopples deteriorate in strength upon exposure to moisture and the weather, and may be readily cut and removed by the enemy or robbers. Steel hopples have the advantages of being less cumbersome, much more secure, lighter in weight, and can be placed on or taken off the animal with greater facility, by those having the means of unlocking them. In the absence of this very important equipment, the soldier may successfully hopple his horse with a stirrup-leather, by putting its middle round one fetlock, then twisting it half-a-dozen times, and finally buckling it round the other fetlock.

HOBILERS.—An inferior variety of cavalry used or raised in the reign of Edward II. They were stationed at Portsmouth and at other maritime places, and bound to keep a little flag for the purpose of giving notice of invasion. They wore an aketon or armor of plates, a bascinet, iron gauntlets, a sword, knife, and a lance. Also written *Hobeliers*.

HOBITS.—Small mortars of 6 or 8 inches bore, mounted on gun-carriages; they were in use before the howitzer.

HOCHE BOS.—Certain soldiers among the ancients, who were so called from their brandishing the pike. This term has likewise been applied to the pike itself.

HODOMETER. An instrument for measuring the distance traveled over by any conveyance, and consisting of an arrangement of toothed wheels, like clock-work, fixed on one side of a machine, and connected with the axle, from which motion is communicated to it. An index and dial show the exact distance the vehicle has traveled. See *Odometer*.

HOG-GUM.—The name given in the West Indies to a resinous substance, which is there extensively used as a substitute for pitch to tar boats and ropes, also for strengthening plasters, etc., and internally as a diuretic, laxative, and stimulant medicine. It is still disputed what tree produces the true hog-gum; some ascribing it to *moronobea coccinea*, of the natural order *guttiferæ*; some to *rhus metopium*, a species of sumach of the order *anacardiaceæ*; and others to *helwigia balsamifera*, of the order *amyridaceæ*. The probability seems to be that all these—and perhaps other—trees yield resinous substances of very similar quality, and commonly designated by the same name.

HOIST.—1. The perpendicular height of a flag, as opposed to the *fly*, or breadth from the staff to the outer edge. 2. A machine for hoisting ores, metals, castings, workmen, etc., in mines and foundries. A very primitive hoisting-machine, which resembles the modern capstan, is used in the Convent of St. Catharine, at the foot of Mount Sinai, to raise travelers to a door in the second story. This is a somewhat inconvenient and tedious operation, but is used in a land where robbers go on horseback. It is also worthy of remark, that the people of the land have no idea of the value of time, and so set six men to help another in at the door. The obelisks in ancient Egypt may have been raised by gradually lifting the apex and scotching up by introducing earth beneath them. The Stonehenge blocks were very probably raised in the same way. When Chersiphon built the Temple of Ephesus, in the time of Amasis of Egypt, he raised the architrave by surrounding the columns with bags of earth, which served as an inclined plane.

HOISTING APPARATUS.—In designing and building machinery for hoisting and transferring light loads, many of the same problems are presented

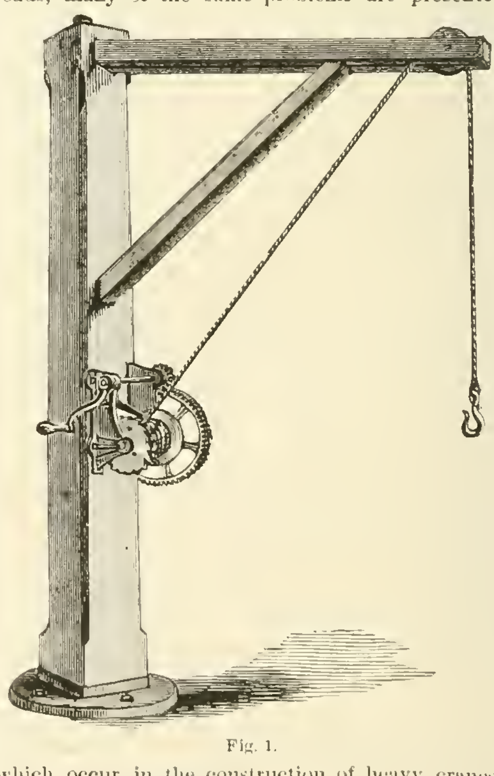


Fig. 1.

which occur in the construction of heavy cranes, and the experience gained in one is available in the other. Too much has heretofore been left to "rule of thumb" practice in the designing of light hoisting machinery, and frequent accidents to life and limb still needlessly occur from continued adherence to old types of machines in which safety, both of person and load, depends upon the care and intelligence of the operator. It is possible to so construct hand-hoisting machinery that accidents arising from carelessness in its use are practically impossible. Such construction involves no sacrifice of simplicity or efficiency, and no material increase in cost. To adhere to the old, therefore, is to assume needless risks to property and unjustifiable risks to human life. The risks referred to arise chiefly from two causes; *first*, a deficiency of material in parts subject to strain; and, *second*, the use of ratchet-wheels to hold the load suspended, and of non-automatic brakes to effect lowering. The first defect, a want of proper kind or amount of material, arises from unskilful designing and from the effort after cheapness. The second is adherent in the elements of mechanism employed, and can only be avoided by the use of new and better devices, so constructed as to be automatic in all functions where carelessness is potent to produce harm.

The active operation of *hoisting* is usually free from danger in any machine of sufficient strength. It is the *descent* of the load, whether by intent or by accident, that involves danger. During the act of hoisting the operator slowly expends power, which is stored up as latent energy in the mass he has raised, and which, if expended or given back suddenly, as in falling, is capable of working serious mischief. The mechanism should, therefore, be so constructed that the load, when lifted, shall be sustained independently of the operator, so that should he cease his efforts, or even suddenly let go the rope or handles, the load will simply cease to move and will remain suspended. Under no circumstances should the load be permitted to descend by gravity unaided by the controlling hand of the operator. This principle of construction, namely, the control of the load, at all times and under all conditions, by reliable automatic devices, is embodied in all of the hoisting appliances described in this work, designed and built by the Yale and Towne Manufacturing Company.

Winding-drums or barrels should have a diameter and length such as will enable them to receive the whole length of rope or chain to be hauled in by winding it upon their surface in one coil, without overlapping. In large cranes the load is usually carried upon four, six, or even eight parts of rope or chain, so that the length to be wound up amounts to four, six, or eight times the effective hoist, and the dimensions of the barrel thus become very large. Moreover, this barrel must either be caused to travel longitudinally on its shaft, so that the rope or chain as it leads off shall be always in the center of the crane and hoisting mechanism (which method of construction involves a serious complication and greatly widens the space occupied by the gearing), or the rope or chain, as it uncoils, be permitted to vary in position from one end to the other of the barrel, in which case it is nearly out of center, thus inducing objectionable lateral strains and causing greater friction and wear. Fig. 1 shows a simple arrangement of gears and crank, winding the lifting rope on drum or cylinder. It may be easily fastened on any post, or part of a building, or used in connection with a crane as shown.

Chain-wheels require a width only slightly greater than a single part of the chain, and a diameter merely sufficient to give the proper engagement with it, so that both dimensions become much smaller than in a winding-barrel, and the total space occupied is but a small fraction of that required for the latter device. The *chain-wheel* is fixed in direct line with the chain, and all lateral strains are avoided, while the flat bearings afforded for the chain by the pockets preserve the shape of the links and protect them from bending strains. The slack chain, after passing over the wheel, falls into a proper receptacle below. From this analysis of the facts is deduced the proposition that chains, if well made, constitute the best form of flexible cord for sustaining the load in a crane, and that a well constructed *chain-wheel* (as contradistinguished from a winding-barrel) is the best form of device for hauling in and paying out the chain; and, therefore, that the best method of crane construction involves the use of these two elements.

When using the chain-wheel system, great effort must be made to secure chains of perfectly uniform pitch. Chain-making is one of the few remaining manual trades in which modern machinery has not to a greater or less extent displaced the skill of the individual workman. Many attempts have been made to produce chains by machinery, and although some success has been attained, no machine-made chain has yet been produced having sufficient reliability and uniformity of quality to adapt it to use in cranes. The all-important operation in chain-making is the process of welding the links, and in this the personal element seems indispensable to a perfect result, no machine, however perfect, taking the place of the skill and intelligence of the workman.

As used in the Weston cranes, the pitch-chains of the smaller sizes are made entirely of Norway iron, while for the larger sizes either the Norway iron or American iron of high elasticity and ductility, is used. Each link is forged and welded with great

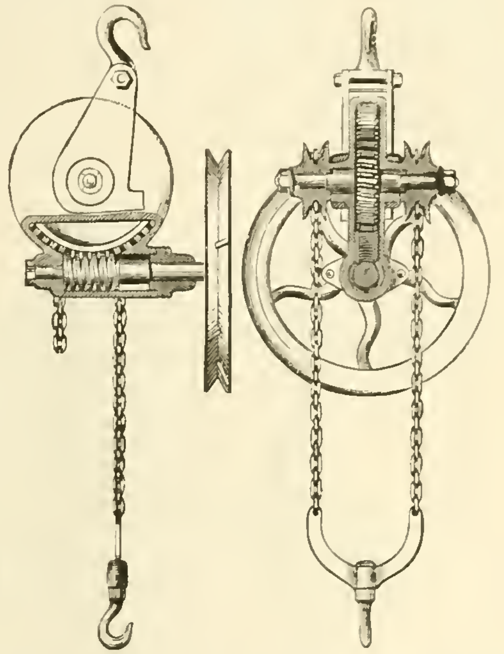


Fig. 2.

care, and much more time and labor is expended on this part of the work than is the case with common chain. All of this pitch-chain is made under a patented process, which consists in forging the chain slightly under pitch, after which it is first cleaned and brightened by "rattling," and then stretched in a special machine to the final gauge or pitch. The first process causes the several links to come into more perfect contact or bearing by removing the scale and other slight asperities from their surfaces. The second process assists in bringing their adjacent surfaces into closer contact, tends to strengthen the sides of the links, and gives the iron a slight initial set by straining it to a degree somewhat greater than that which will be caused by the load which it is intended to carry. The final step in the process is a careful and rigid inspection of each link of the chain and the removal of any which are at all imperfect. As a result of this treatment, a chain is obtained which is accurately uniform in pitch, and which, when used within the intended limit of load, will not stretch or alter its pitch. It is believed that the chain thus produced is more perfect and reliable than any made heretofore.

In determining the diameter of iron for the several sizes of chain, those sizes have been adopted which will limit the stress upon the links of the chain to a maximum of from 9,000 to 10,000 lbs. per square inch of cross-section when carrying the full load. As the pitch-chain was designed primarily for use in the Weston Differential Pulley-blocks, in which the load is always carried upon two parts of chain, the nominal capacity of the several sizes indicates in each case the maximum load intended to be carried upon *two parts* of the chain. A single part is, of course, capable of carrying a load of one-half the amount given in the table. The following table gives the dimensions of the several sizes of the pitch-chain above described.

Nom'al cap'y, Tons*	$\frac{1}{8}$	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	3	4	5	6	8	10
Diam. iron, inch's...	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{9}{32}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{13}{16}$

*The upper line indicates the load which can be safely carried on two parts of the chain, i.e., as used in a one-sheave tackle-block. Each part of the chain thus carries one-half of the total load If the load is to be carried by a single chain, select a chain of a nominal capacity of twice the intended load.

Fig. 2 gives a sectional view of a double-chain screw hoisting-machine.

Many advantages accrue from the use of worm-gearing in the construction of hoisting machinery. Among these may be mentioned its compactness as compared with spur-gearing, the ability to operate shafts at right angles to each other without resort to bevel gears, and great facility in the application of automatic brakes where necessary. In well proportioned worm-gearing with cut teeth, friction cannot be relied upon to hold a suspended load from running down, but a very moderate brake resistance applied to the worm-shaft will accomplish this result. If a load suspended through a train of spur-gearing be allowed to run down, it will do so at an accelerating velocity approximating to that of a falling body. With the worm-gearing, however, very little acceleration takes place after certain speed has been attained, and gearing of this kind thus becomes a safety device which prevents undue acceleration of the load even when running free, and is a most valuable means of preventing accidents, both to the mechanism and to those operating it.

The ordinary ratchet-wheel is a disc with teeth or indentations on its periphery, and in practice it is employed in combination with a pawl or a dog arranged to engage with its teeth in such a manner that the ratchet-wheel, being attached to a rotating shaft, is entirely free to revolve in one direction, but, by the action of the pawl, is prevented from rotation in the contrary direction. Thus arranged it is generally attached to the primary shaft of a winch, or other hoisting-gear, so that, while it opposes no resistance to rotation of the shaft in the direction necessary for hoisting, it effectively prevents motion in the contrary direction. When it is desired to lower the load the pawl is thrown out of engagement with the ratchet-wheel, and the load then lowered by turning the cranks backward, or by letting go of the cranks and controlling the descent of the load by a brake applied to the shaft.

Both of these arrangements are dangerous, and are productive of serious accidents. Where lowering is effected by turning the cranks backward with the pressure due to the load upon them, it frequently happens that a heavy load overcomes the operator, in which case the cranks begin to revolve with great

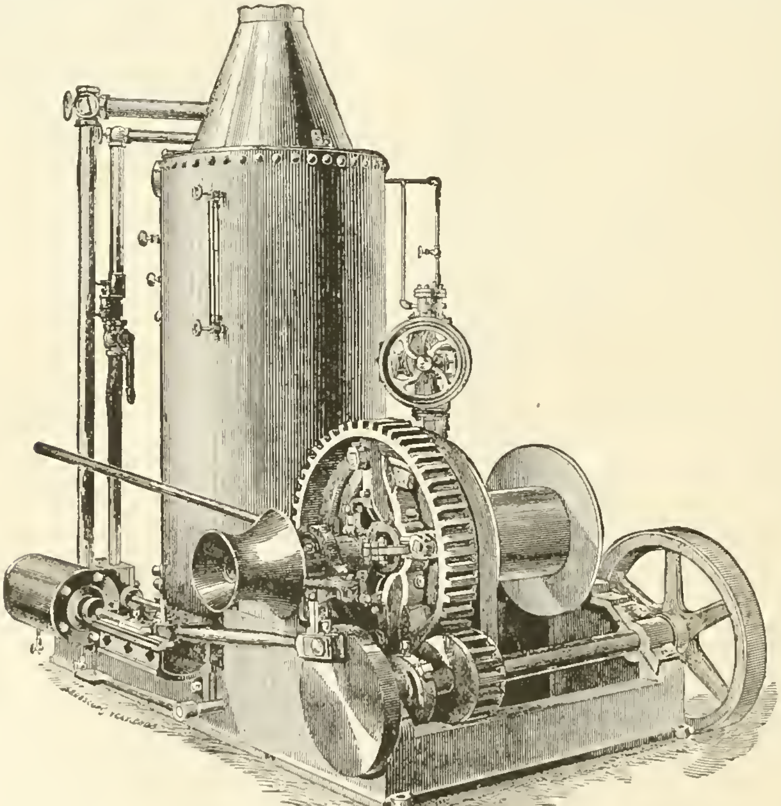


Fig. 3.

violence, and often strike the operator before he can escape from their reach. Where a brake is used, there is less danger, but even the safe descent of the load is contingent upon the skill with which the brake is used, and any lack of skill or watchfulness will result in a rapid descent of the load. In this case, if the motion is not checked the load may descend so rapidly as to cause damage, while if its motion be suddenly arrested by the brake, the shock and strain thereby induced are apt to damage the crane.

A friction ratchet is one in which the action of friction is substituted for the teeth and pawl of the common ratchet, so that the retaining action of the ratchet will take place instantly and in all positions. A safety ratchet may be defined as one in which lowering of the load is effected by reversing the motion of the shaft to which the ratchet is attached without any disengagement of the pawl or its substitute, the construction being such that so long as this backward motion is continued the load will descend, but that when it is discontinued the load will automatically come to rest, from which it follows that with a safety ratchet the cranks or handles of a hoisting-machine may be "let go" at any time, either in hoisting or in lowering, the ratchet thereupon automatically holding the load suspended and preventing "running down" or descent of the load. The great desirability of so important a result has long been conceded, but most of the devices heretofore invented for its accomplishment have been so complicated, or so uncertain in action, as to find little favor.

In cranes operated by power one or more clutches are essential to the convenient operation of the mechanism. Experience has demonstrated that the best and most reliable clutch for this purpose is that invented and patented by Mr. Thomas A. Weston, M. E., and first fully described in a paper read by him before the British Institution of Mechanical Engineers. The essential basis of the Weston clutch or coupling consists of two series of friction discs arranged alternately with each other upon a common axis, one series being carried by one shaft, and the other series connected to the other shaft or wheel which is required to be coupled with the first shaft. The great advantage arising from this alternate arrangement of the discs is that the frictional effect of any pressure applied to couple them is repeated as many times as there are discs in the two series, that is, the number of all the discs is a constant multiplier for the friction produced between a single pair of the rubbing surfaces by any given pressure.

A most perfect and an effective hoisting-engine, made by Messrs. Frisbie & Co., of Philadelphia, is represented in Fig. 3. A distinctive feature of this engine is the manner of connecting the spur-gearing to *friction-drums* by bolting directly to the rim of the drum. This does away with all torsion of the shaft and wear upon keys and feathers, which is a serious defect in most hoisting-engines, causing the shafts to split at key-way. This engine is well suited for all hard duty, such as pile-driving, hauling logs, bridge-building, and many other kinds of work where engines are liable to be broken by sudden strains. The clutch can be set so as to do the work the ropes are safe at, and then will slip, and save the engine and gearing from breaking. The motion to operate the clutch is easy and natural, and with a powerful strap-brake we can hold or lower carefully any load we can hoist. See *Cranes*, *Differential Pulley-block*, and *Mechanical Maneuvers*.

HOLD.—A place of security; a fortified place, fort, or castle. Often called a stronghold. The expression *to hold*, is frequently employed to mean the fact of being in military possession of any place; while *to hold out* means to maintain any place, ground, etc., against an enemy.

HOLDALL. A portable case for holding small articles required by soldiers. Leather bags or cases are generally used for carrying implements for the equipment of guns, and are known as "off" and "near." Each has links at the back for hanging it on the saddle.

HOLDFASTS.—The most essential subjects to be considered before any heavy weight is moved or suspended, are the nature and condition of the securing points, together with the strain that will be brought on them. Natural holdfasts—such as the piers of casemates, pintles for guns of position, trees, etc.—may frequently be found, around which straps may be placed. In such cases all corners should be protected by wood, or the rope itself *parceled* to prevent chafing. In places where holdfasts can be driven or sunk, the ordinary picket-post can be made use of, but only when light weights have to be dealt with. In securing to a holdfast from which it may become necessary to ease off, at least one complete turn must be taken before making fast; otherwise, when the strain is on it, it is difficult to cast off. Precise rules cannot be laid down as to the description of holdfast best suited for particular operations, but it should be borne in mind that it will save much time and trouble to make it in the first instance considerably more secure than seems to be absolutely necessary, as when a holdfast once begins to give, it is difficult to strengthen it. Whatever holdfast may be used, the strain should be taken by the entire structure at once; otherwise it might give way in detail when it would not do so as a whole. The drawings represent some of the methods of customary holdfasts, using pickets, anchors, heavy cannon, etc. When the strain to be sustained is very great, the holdfast shown in Fig. 2. may be used to advantage; *a b c d* is a trench from ten to fifteen feet long and two to four feet in width and depth. It is dug in a direction perpendicular to the strain. Several heavy stakes are driven into the trench far

Fig. 1.

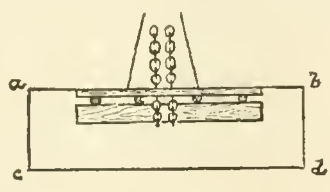


Fig. 2.

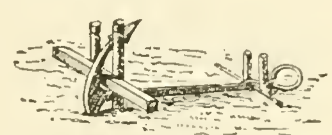


Fig. 3.

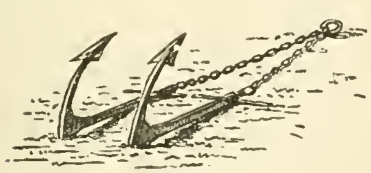


Fig. 4.

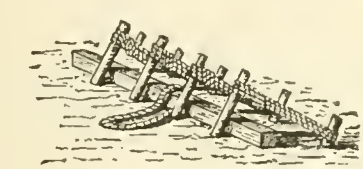


Fig. 5.

enough from the side to admit planks being placed between them and the earth. A heavy beam, with the bight of a chain around it, is then laid on at the bottom of the trench against the stakes, the ends of the chain being brought up between the planks along a trench, rising gradually to the surface so that there will be no tendency to lift the beam up when the strain is on it. The whole trench is then filled in and rammed.

HOLLOW-BALLS.—In military pyrotechny, many varieties of balls are made, differing in purpose from bomb-shells, but, like them, filled with ignitible composition. They are used either to give light, to produce very dense smoke, or to diffuse a suffocating odor. Some of them, although designated balls, are not globular in shape. *Light-balls* consist of canvas stretched over a skeleton-frame, and painted; the frame is filled with a composition of saltpeter, sulphur, resin, and linseed-oil, rammed down hard; and is provided with a fuse, the length of which determines the time that will elapse before the composition ignites. These light-balls weigh from 5 lbs. to 70 lbs. each, according to their size. They are intended to give out a brilliant light, which may reveal the operations of the enemy, during night, at a siege or in the field. *Smoke-balls* are made of several thicknesses of paper, shaped by means of a globular core or a mould. They are filled with gunpowder, saltpeter, powdered sea-coal, Swedish-pitch, and tallow; and are calculated, after being fired off, to send out a dense smoke for nearly half an hour, in order to blind or incommode the enemy. *Stink-balls* are filled with a composition which, when ignited, diffuses an odor almost intolerable. Some of the contrivances of Captain Norton and other inventors at the present day, are extensions of the same principle as these inflammable balls. It may here be added, that most of these projectiles, especially light-balls, and smoke-balls, are fired from mortars rather than from guns. See *Pyrotechny*.

HOLLOW OF THE ARM.—An expression for the slight inclination of the axle-tree-arms downwards (when the wheels have dish), so that the lowest spoke of each wheel may be vertical.

HOLLOW PROJECTILES.—Under the head of Hollow Projectiles are included shells for guns, howitzers, and mortars. These are usually made of cast-iron, and are classified according to the diameter of the bore of the piece or their weight.

A shell is a hollow projectile filled with gunpowder, which is ignited by a fuse at the required moment, the bursting of the shell causing destruction by its explosive force and by the fragments and, if the object be combustible, by setting it on fire. The thickness of metal must be such that the shell may contain as large a bursting charge as possible, but that it be strong enough to withstand the shock of the discharge within the bore of the gun. The thickness of metal in a spherical shell is about one-sixth of the diameter, and the weight of the shell is about three-fourths that of the solid shot of the same caliber. The shell of a rifle-gun being elongated, is, by giving it a greater length than the shot, brought up to the same length as the latter.

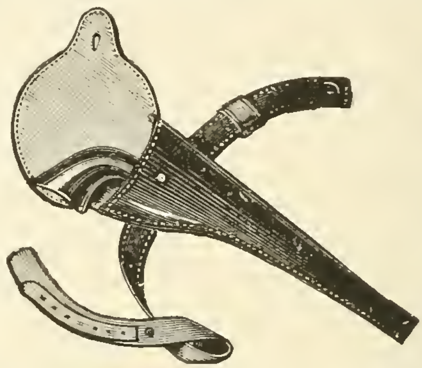
Mortar-shells are fired from mortars at high angles, being intended to fall upon and set fire to buildings, vessels, or other combustible constructions; to destroy earthworks, or by their great penetration before bursting, to explode magazines protected from other projectiles. They are fitted with two *lugs*, placed one on each side of the fuze-hole, which serve for attaching a pair of *shell-hooks*. The fuze-holes of mortar-shells are larger in diameter than those of other common shells, and they are not counter-sunk or bouched with composition. See *Projectiles* and *Shells*.

HOLLOW REVETMENT.—When arches are constructed from one counterfort to the next, the name *hollow* or *counter-arched revetment* is given to the disposition, which is both excellent and economical for high scarps.

HOLLOW SQUARE.—The form in which a body of foot is drawn up with an empty space in the middle for the colors, drums, baggage, etc. A body of troops formed into a squad to resist the charge of cavalry on critical occasions.

HOLLOW TOWER.—A rounding made of the remainder of two brisures, to join the curtain to the orillon, where the small shot are placed, that they may not be so much exposed to the view of the enemy.

HOLSTER.—The leather case which holds the pistol. Holsters are either worn on the belts, or are affixed to the pommels of the saddles. In the latter instance, they are frequently covered with wool or fur, to prevent injury to the riders in the event of being thrown forward upon them. The drawing



shows the form and construction of the regulation holster. In the English service, Lancers and Non-commissioned Officers of cavalry have two holsters attached to the front part of their saddles. Wallets have been introduced in lieu of holsters for the Staff and certain regiments of the service.

HOLY ALLIANCE.—A league formed after the fall of Napoleon by the Sovereigns of Russia, Austria, and Prussia, nominally to regulate the relations of the States of Christendom by the principles of Christian Charity, but really to preserve the power and influence of the existing Dynasties. Most of the other European Rulers acceded to it, and the treaty was formerly made public in the *Frankford Journal*, February 2, 1816. It was in virtue of this league that Austria, in 1821, crushed the Revolutions in Naples and Piedmont, and that France, in 1823, restored Absolutism in Spain. Subsequently, both France and England seceded, after which it became a mere *nominis umbra*. A special article of the treaty excluded forever the members of the Bonaparte Family from any European throne.

HOLY LEAGUES.—The name applied to certain political alliances in Europe; the principal are as follows: 1. In 1511, between the Pope, Spain, and Venice, the object being to expel the French from Italy. 2. In 1538, between Charles V. and the Roman Catholic Princes of Germany in opposition to the league of Schmalkend. 3. In 1571, the Pope, Spain, and Venice against the Turks. 4. Of the Guise family, the Pope, Spain, and the French Parliament against the Huguenots. 5. In 1609, between the Pope and the Roman Catholic States of Swabia and Bavaria. 6. In 1684, of Poland, Germany, and Venice against the Turks.

HOLY SEPULCHER.—The Knights of the Holy Sepulcher constituted an Order of Knighthood instituted, probably, by Pope Alexander VI., for the guardianship of the Holy Sepulcher, and the relief and protection of pilgrims. The Pope was originally the Grand-master, but he subsequently ceded his rights to the Guardian Father of the Holy Sepulcher. The Knights must, by the rules of the Order, be all of noble descent; they were bound to hear mass daily, to fight, to live, and to die for the Christian faith, etc. In return for these duties, the Knights had the most unusual and extraordinary privileges conferred upon them: they were exempt from taxation, could marry, and yet possess church property, legitimize bastards, and cut down and bury the bodies of criminals who had been hanged. On the recapture of Jerusalem by the Turks, the Knights retired into Italy, and settled at Perugia. After a temporary union with the Hospitalers, the Order was reconstructed in 1814 both in France and in Poland, and is still in existence within a very small circle of Knights elected by the Guardian Father from the most respectable pilgrims who come to Jerusalem.

HOLY-WATER SPRINKLER.—A name applied to the *flail*, both from its shape and from the drops of blood which started from those upon whom it was used.

HOMAGE.—The service or a show of respect due from a knight or vassal to his Lord in feudal times. The word is derived from the form of expression used in doing the service, which was—*jeo devigne vostre home*—I become your man. Since the abolition of tenures, the word has no substantial legal meaning in the law of England, except in a limited sense as to copyholds, to denote the kind of acknowledgment made by a tenant to the Lord of the Manor. The Homage Jury consisted of the tenants who did homage, and their presence was necessary to attest some acts. *Homagium reddere* was the expression, now obsolete, signifying a solem renunciation of homage or fealty to the Lord, and a defiance of him. The word homage is not used in Scotch law, though the feudal system is not obsolete in Scotland in many other repects.

HOME.—In artillery, the term used to express the position of a shot when the gun is loaded. Thus, "Is the shot well home?" is a common expression amongst artillerymen.

HOMICIDE.—The killing of one human being by another either innocently or feloniously. To say that there has been a homicide does not necessarily imply that a crime has been committed; for though every murder is a homicide, every homicide is not a murder. The law permits a man to kill another in self-defense when his own life is assailed or threatened; but the danger must be real, or in good faith and for sound reasons deemed so by the person threatened. A man may lawfully kill another, after due warning, in defense of his property, or to prevent the escape of one who has committed felony. An Officer of Justice charged with the duty of arresting a criminal or with the performance of any other lawful act, may kill a person who resists or attempts to thwart him by force. A person charged with felony, seeking to escape after arrest or any one fleeing to avoid capture, may be lawfully killed by an officer if he cannot otherwise be taken. A person engaged in committing a felony may be lawfully killed by an eyewitness if there be no other way of preventing the crime. The keeper of a prison may, if necessary, prevent the escape of a prisoner by taking his life. In all such cases, however, it must appear that the killing was resorted to as a last alternative. Justifiable homicide is the term applied by law in all such cases. Where one kills another by accident, without any intention to do him injury, and while exercising a proper degree of caution, the law deems it an excusable homicide; as, for example, when a man driving in the highway in the darkness runs over and kills another without knowing it, or, discovering the danger, has yet no time or power to avert the calamity. The line between justifiable and excusable homicide is vague and, in a legal sense, not important, since neither the one or the other exposes a man to punishment. In some of the States of the Union no distinction is made between them.

HOMING PIGEON.—The result of the investigation into the practicability of using pigeons to carry messages in time of war is not so encouraging as was hoped. Although there are instances when they have been used to great advantage, and when they have been the only means of communication, there seem to be obstacles to their certain and systematic use in the time of actual hostilities. It is a fact that, despite the greatest care in training, the pigeon sometimes fails at the critical moment. When it succeeds, however, the stake is generally very great. To attain one success it may be worth while to suffer many failures. For this reason, perhaps, those Nations who devote most time and money to the perfecting of their military systems, still systematically train large numbers of pigeons for use in war. When Paris was about to be besieged in 1870, the pigeon-fanciers in that city suggested to the military authorities that the pigeons within the city limits be sent out, and that others from the provinces be sent into the city. The latter proposition was acted upon, but the former was not, until balloons were used, when there was an opportunity to send out pigeons in the balloons, it being intended that the birds should return with messages. Pigeons had been declared contraband of war early in the Franco-Prussian war of 1870. There was taken out of Paris, in balloons, 363 pigeons. Of this number, fifty-seven only returned. These bore letters, photographed in finest characters upon scraps of paper so minute that 200 of them weighed only one-eighth of a grain. Newspapers, reduced by photography to microscopical characters, were carried by these pigeons. The magic-lantern was made use of to enlarge the letters, which, thrown upon a prepared surface, were read by the public. These 57 birds were not the only ones sent into Paris during the siege. A pigeon post service was established at Tours, for the purpose of conveying messages into the Capitol. The regular rates for this service made it possible for one bird to carry $500 worth of despatches, but, during the latter days of the siege, the Germans introduced trained hawks that were used to destroy the pigeons. These instances show sufficiently, that while the pigeon has been used for carrying messages, many causes—some understood and others not understood—unite to make them uncertain and untrustworthy means of communication.

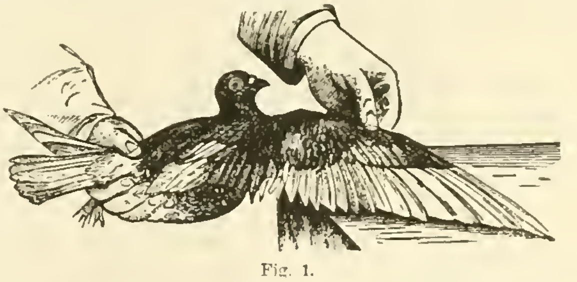


Fig. 1.

The reason why the pigeon seeks its home, the fact that makes possible its use a carrier, has never been satisfactorily given, and its discussion involves the most interesting inquiry concerning the bird. Some have believed the action of the bird due to instinct, others to training, while one of the most experienced and practical French fanciers has recently advanced the theory that the pigeon is guided in its flight by currents of electricity in the air, or by other atmospheric influences; others, again, differing from all these, believe that instinct, intelligence, and careful training, combined, account for the action of the birds. What is instinct? To this there may be many answers, but when considered in connection with the flight of birds, instinct is illustrated by the stork, which, traveling only at night, flies North in the spring and returns in the fall. Swallows and wild geese, and many other birds, move North and

South at the same seasons. They do not, however, confine all their movements to the night-time. All these move by what we term instinct. Whatever that may be, it is all-powerful in its influence on the birds. But it is not so with the homing pigeon. Experience shows that the flight of that bird is not certain unless it has been trained, and unless atmospheric conditions are favorable to its flight. Notwithstanding this, however, there are sometimes circumstances that give color to the theory that the bird flies by instinct alone.

The message should be adjusted to the middle feather of the tail, first shaving both sides to within an inch of the end; then lash the message, with waxed silk, firmly, so that the bird cannot pick it off. One person must hold the bird to prevent it from fluttering while another attaches the message. Messages should be written with lead pencil (ink runs if wet) on a very fine tissue or manifold paper, and folded very tight. Messages should be sent off on several birds, and if of very great importance, on ten or fifteen, so that some will be sure to reach the fort. The message on the middle feather of the tail will not annoy the bird, for when he is at rest it folds on top. It will not do to tie the message on the legs, as it is necessary for the bird, in flying, to hide the feet in the breast feathers so as not to offer a resistance to the air. Fig. 1 shows the best manner of holding the pigeon, when attaching the message, or when handling the bird for other purposes.

There are numerous varieties of homing pigeons remarkable for their powers of flight and their attachment to the home in which they have been reared and first flown. Prominent amongst these

Fig. 2.

are the Dragon, the well-known flying Tumbler, and the Skimmer, or a mongrel race between these two breeds. Among the pure breeds that can be flown good distances may be mentioned that called the Owl pigeon. But the varieties in which this homing faculty is developed to the highest degree is unquestionably the different races of Belgian birds, which are termed in England by the general name of Antwerps, and in Belgium are known as Smerles, Cumulets, Demi Bees, etc. Of these varieties the Smerles are the most important. They are rather small birds, and look very much as if they had been originally bred from a rather coarse blue Owl pigeon, crossed with a Blue Rock. The head is arched and the skull capacious, indicating a full development of brain, and offering a striking contrast to the flat narrow skull of the English fancy Carrier. The most striking characteristic of these birds is the firmness and great breadth of the flight feathers of the wings. These overlap each other to a great extent, and afford a strong firm wing with which the flight is urged. The keel of the breast-bone is deep and well covered with strong muscles; and there is altogether an absence of any offal or large development of any part not used in flight.

Of all the pigeon-tribe the Pouter, shown in Fig. 2, in appearance perhaps the most strange, is the furtherest removed from the ancient dove or common typical pigeon of the universe. This remarkable variety of our domesticated pigeon seems to be the extreme, the very utmost point, the greatest stretch of latitude to which the fertile imagination of man can be carried, or, indeed, to which the almost inexhaustible resources of nature might be expected to sport, or culture be extended. Here we have a pigeon which is a pigeon, but does not look like a pigeon—an estimable variety whose merits have been extolled by its admirers—a kind whose peculiarities are the cause of frequent surprise, doubt, and even ridicule. There are nine recognized kinds, or rather sub-varieties of the Pouter, viz.: black, red, yellow, blue, silver, mealy, creamy, blue-checkered, and white.

The Jacobin shown in Fig. 3, is a most popular variety, and its fanciers number some of the most earnest and painstaking breeders. It, as a bird, has proved to be a great bone of contention, and the various contestants have held so firmly to their opin-

Fig. 3.

ions and objections that for a long time there existed several types. These differences the National Peristeronic Society finally arranged. Twenty years ago the name was not known; it is an innovation and an eyesore to those who have seen the pure-bred bird.

The home of the pigeon should be as conspicuous as possible. Notwithstanding the fact that the flag at posts will generally make the home of the birds in the military service noticeable at a long distance, it is suggested that when it is possible the flagstaff be surmounted by a large spherical reflector, or a large white ball. That their arrival from a voyage may be quickly known, they should announce themselves. This could be arranged by connecting, by means of a light wire, the door of their house or loft through which they enter with a bell in a room that is to be habitually occupied. The wire need only be attached when messengers are expected. It therefore appears the Medical Department at posts should have charge of the pigeons in the military service, and that their loft be near the hospital. Not only will they then be most likely to receive constant care, but judicious attention; and in return may be expected to interest and to be a direct benefit to the patients in hospital. Although it is important to send the same message by several birds, they should not be sent off together, but tossed up at intervals of five or ten minutes. When thrown off together, especially if in good condition, they sometimes play and loiter. See *Carrier-pigeon*.

HOMME D'ARMES.—A military phrase among the French, signifying a gentlemen or cavalier who belonged to one of the old companies, who was armed *Cap-a-pie*, and always fought on horseback. In ancient times, every man of this description was accompanied by two horsemen independently of his servants. One of the mounted attendants was armed with the cross-bow, and the other with a common bow or a battle-axe; so that 100 *Hommes d'Armes* composed a body of 300 horse. It was a species of cavalry which existed from the reign of Louis XI., until the reign of Henry II.

HOMOGENEOUS. A term applied to various substances to denote that they consist of similar parts, or of parts of the same nature and kind; thus, the substance of a solid shot may be said to be homogeneous when the metal is of the same density and texture throughout. In any perfectly homogeneous shot, the center of figure and the center of gravity of the mass are coincident.

HONES.—A particular class of stones used for the purpose of sharpening all edge-tools and weapons. They are usually cut into pieces about a foot in length, and from an inch to two inches thick, and either left square or rounded, according to their intended uses. The finest kind of hones are those called oil-stones: these are hard, compact, and so very silicious that they readily wear down the hardest steel; they are varieties of slate, derived from the argillaceous schists of the paleozoic period. The best are those brought from Turkey; Bohemia is also celebrated for its hones; and very excellent ones are discovered in Persia, in the Hartz Mountains, in Syria, in America, Spain, Peru, and in Siberia. In Great Britain several localities yield hone-stones of excellent quality, and none better than the celebrated Water-of-Ayr stone, which is much used for polishing copper-plates, as well as for hones. The Welsh oil-stone or Idwall stone, and the cutler's greenstone, are obtained from Snowdon in Wales: and in the neighborhood of Tavistock the Devonshire oil-stones are procured. The hones used for sharpening scythes, etc., are usually made of coarse-grained sandstone.

HONEYCOMBS.—Flaws or defects in guns resembling the cells made by bees, worked in the metal through the action of exploded gun powder. They spread rapidly, and with continuous firing, soon eat into the metal to such an extent as to render the further use of the gun dangerous.

HONORABLE ARTILLERY COMPANY.—The oldest existing volunteer corps in Britain. Four military bodies—the *Artillery Company*, the *Sergeant-at-Arms*, the *Yeomen of the Guard*, and the *Gentlemen Pensioners*, were established as far back as the time of the Tudors; all these organizations still exist, but under greatly altered circumstances. In 1537, Henry VIII. granted a patent to three persons, appointing them "Overseers of the Science of Artillery," for long-bows, cross-bows, and hand-guns. They were to constitute a guild or a fraternity for this purpose, with power to appoint assistants and successors, to purchase lands, and to use a common seal; and their formal official name became "The Masters, Rulers, and Commonalty of the Fraternity or Guild of Artillery of Long-bows, Cross-bows, and Hand-guns." The freemen of the guild or company were empowered to keep arms, and exercise themselves in shooting. In 1605 a patent was granted by James I., intended chiefly to effect the preservation of the shooting and practicing grounds around London for the Artillery Company. In 1633 a Commission was appointed by Charles I., still further to insure this object. In 1638 the Corporation of the City of London presented to the company the plot of ground ever since called the Artillery Ground, near Moorfields, as a field for military exercise. Royal Princes frequently enrolled themselves as members of the Company, usually as "Captain General." In 1719, George I. issued an order that all commission and staff officers of the City Train-bands (a metropolitan militia) should become members of the Artillery Company, and exercise with the other members at all convenient times. The word "artillery" had heretofore been considered as applying to bows and arrows as well as to firearms; but the members of the Company, like other marksmen, had also abandoned archery, without, however, making any change in their designation. In a summons to the Company to meet for exercise on a particular day in 1682, it is said: "Those gentlemen that on that day handle muskets are desired to take care that their arms are clean and well fixed, and that they bring with them fine dry powder, and even match." The Company, like many other city guilds, has nearly outlived its original purpose. In 1780, when the "Lord George Gordon riots" afflicted the metropolis, the members of the Artillery Company effectually protected the Bank of England; in 1848, when Chartist riots were apprehended, the Company was on the alert to render good service if needed; and in the spring of 1859, when an uneasy feeling prevailed in England concerning the designs of France, the members polished their arms and looked forward to eventualities; but the Company has never been engaged in an actual warfare with an enemy. The Artillery Company consists of members elected by ballot, who pay one guinea annual subscription, and supply themselves with dress, arms, and accouterments. These payments, together with the rental received from a small amount of real property, constitute the fund out of which the expenses are defrayed. The members learn rifle-shooting as well as artillery practice; there are certain days of meeting at Moorfields; and every summer there are certain days of drill and practice at Seaford. The Corps comprises six infantry companies, a grenadier company, a light-infantry company, a rifle company, and an artillery company. Until 1849, the members elected their own officers; but since that year the Crown has appointed them on the nomination of the Lieutenancy of the City of London. The Lieutenant-colonel appoints the Non-commissioned Officers. See *Artillery Corps.*

HONORS OF WAR.—The term employed to express the privileges allowed to a garrison surrendering, either in consideration of a brave defense, or from some other cause. Many degrees of honor may be paid to a vanquished enemy, according to the generosity or judgment of the victorious Commander-in-Chief. In some cases, the garrison is allowed to march out with all its arms, drums beating, colors flying, etc.: at another time, the conquered force will only be permitted to advance silently to the front of their works, there to ground or pile arms, and then, facing about, to return to their lines as prisoners of war. Occasionally, the capitulation will provide that the garrison shall deposit their arms and warlike stores at some specified spot, and then march on to their own territory on parole of not serving during the existing war against the victors or their allies.

HONORS PAID BY TROOPS.—The following officers are received with standards and colors dropping, the officers and troops saluting, and the bands, trumpets, or field-music playing, as is indicated in each case: 1. The President. Music: "The President's March." 2. The General Commanding-in-Chief. Music: "The General's March." 3. The Lieutenant-general. Trumpets sounding the flourishes, or drums beating the ruffles. 4. A Major-general. Two flourishes, or two ruffles. 5. A Brigadier-general. One flourish, or one ruffle. Officers of the Navy are received with the honors due their assimilated rank, which is as follows: Admiral, General; Vice admiral, Lieutenant-General; Rear admiral, Major-general; Commodore, Brigadier-general; Captain, Colonel; Commander, Lieutenant-colonel; Lieutenant-commander, Major; Lieutenant, Captain: Master, First Lieutenant, : Ensign, Second Lieutenant. Officers of Marines, and Officers of Volunteers and Militia in the service of the United States, receive the honors due to their relative rank. To the Vice President, the members of the Cabinet, the Chief Justice, the President of the Senate, the Speaker of the House of Representatives of the United States, and to Governors, within their respective States and Territories, the same honors are paid as to a General Commanding-in-Chief. American and Foreign Envoys or Ministers are received with the compliments due to a Lieutenant-general. Officers of a foreign service are complimented with the honors due to their rank. The national or regimental colors passing a guard or other armed body are saluted, the trumpets sounding, and the drums beating a march. No honors are paid when troops are *en route*, on marches, or in trenches; and no salute is rendered when marching in double time, at trot or gallop. The Commanding Officer is saluted by all Commissioned Officers in command of troops or detachments. Courtesy among military men is indispensable to discipline; respect to superiors is not confined to obedience on duty, but extended on all occasions.

All officers salute each other on meeting, and in making or receiving official reports. When under arms, the salute is made with the sword or saber, if drawn; otherwise with the hand. A mounted officer dismounts before addressing a superior not mounted. In all cases the junior first salutes. On official occasions officers when under arms indoors, do not uncover, but they salute with the sword or hand, according as the sword is drawn or in the scabbard; when indoors and not under arms they uncover and stand at attention, but do not salute. A Non-commissioned Officer or private in command of a detachment without arms salutes all officers with the hand. If the detachment be on foot, and armed with the rifle or carbine, he brings the pieces to a carry, and salutes as prescribed for a Sergeant. The Commanding Officer is saluted by all Commissioned Officers in command of troops or detachments. The *Sergeant's Salute* is also used by privates out of ranks armed with the musket, and by sentinels in saluting all officers not entitled to a present. Whenever a Non-commissioned Officer or soldier without arms passes an officer, he salutes him, using the hand farthest from the officer. A Non-commissioned Officer or soldier being seated, and without particular occupation, rises on the approach of an officer, faces toward him and salutes; if standing, he faces toward the officer for the same purpose. If the parties remain in the same place or on the same ground, such compliments are not repeated. If actually at work, soldiers do not cease it to salute an officer unless addressed by him. A Non-commissoned Officer, or soldier, with musket or drawn sword, makes the prescribed salute with the musket or sword before addressing an officer; he also makes the same salute after receiving the reply. A Non-commissioned Officer, or soldier, with sword or bayonet in the scabbard, and when unarmed, salutes with the hand. Indoors, a Non-commissioned Officer or soldier, when unarmed, uncovers and stands at attention, but does not salute; in all other cases, he salutes as just prescribed, without uncovering. A mounted soldier dismounts before addressing an officer not mounted. An officer mounted dismounts before addressing a superior officer not mounted. When an officer enters a room where there are soldiers, the word "*attention*" is given by some one who perceives him, when all rise, remain standing in the position of the soldier, and preserve silence until the officer leaves the room: if at meals, they do not rise. Soldiers at all times, and in all situations, pay the same compliments to officers of the Army, Navy, and Marines, and to all officers of tha Volunteers and Militia in the service of the United States, as to officers of their own particular regiments and corps. Officers in citizens' dress are saluted in the same manner as when in uniform. Officers will at all times acknowledge the courtesies of enlisted men. When returning the salute of the enlisted men, officers salute as prescribed in the tactics. When several officers in company are saluted, all who are entitled to the salute return it.

Officers arriving at Head-quarters of a Military Geographical Division, or Department, or of any organized Military Command, or at a Military Post, as soon thereafter as may be practicable, call upon the Commander thereof, and, if there be time, register their names in the office of the Assistant Adjutant-general or Adjutant of the command. If the visiting officer be senior to the Commander the former may send a card, when it will become the duty of the Commander to make the first call.

HOOD.—A term applied to the leather cover for the stirrup of a saddle. It is the same as the Spanish *Tapadera*.

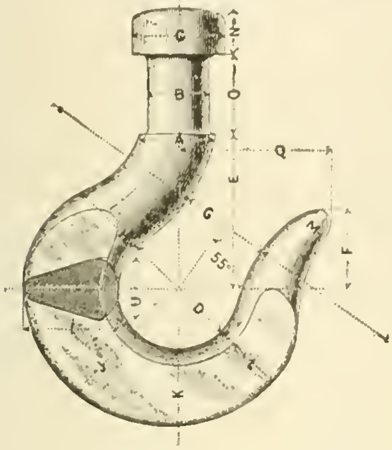
HOOF-PAD.—A device attached to the hoof of a horse to keep the foot, or the shoe of the foot to which it is attached, from cutting the fellow foot or the fetlock. A device to prevent *interfering*.

HOOFS.—The healthy soundness of the horse's foot is mainly preserved by permitting it to grow uninjured by the rasp and knife (see Horse-shoeing), whilst its toughness is secured, and undue dryness and evaporation is prevented, by smearing daily the crust, sole, and frog with a little glycerine, or a mixture made by melting together a quarter of a pound each of tar, honey, beeswax, and glycerine, with a pound of lard. Softness and brittleness of the hoof, which are fruitful sources of cracks and corns, may be remedied by the regular use of such dressings, by placing the feet for several hours daily in thick woolen swabs, kept cool and moist by frequent applications of cold water, and by encouraging a more healthy growth of horn by occasional mild blisters round the coronary band. Cracks, or sand-cracks, as they are termed, mostly occur amongst horses much upon the road, cause lameness and constitute unsoundness. When serious and recent, poulticing, thinning away of the crust about the crack, and perfect rest are essential. After the earlier heat and tenderness are removed, a hot iron should be drawn at right angles to the crack, both above and below, so as to separate the diseased from the sound horn. Waxed thread or fine wire should be wound round the hoof, and a sound growth of horn stimulated by a blister round the coronet.

HOOKS.—A small but important element of the suspending apparatus of a crane or hoisting-machine is the hook which terminates it, and by which the hoisting mechanism is attached to or is connected with the load to be lifted. Investigation has shown that the strains developed in hooks are of an exceedingly complex character, and the determination of the correct proportions of the several parts was only reached, after much study and discussion, by means of mathematical calculations of much intricacy and based upon the results of numerous experiments. Without undertaking here to disclose the intermediate steps of the investigation, we will simply give the final results in the form of the working formulæ. The drawing represents, to a scale of one-sixth natural size, a 5-ton hook of the dimensions and shape determined by the following formulæ, which give the dimensions of the several parts of hooks of capacities from 250 lbs. (or one-eighth of a ton) up to 20,000 lbs. (or 10 tons). For hooks of larger sizes the formulæ become slightly different, the general proportions, however, remaining the same. For economy of manufacture each size of hook is made from some regular commercial size of round-iron. The basis, or initial point, in each case is, therefore, the size of iron of which the hook is to be made, which is indicated by the dimension, A, in the diagram. The dimension, D, is arbitrarily assumed. The other dimensions, as given by the formulæ, are those which, while preserving a proper bearing-face on the interior of the hook for the ropes or chains which may be passed through it, give the greatest resistance to spreading and to ultimate rupture, which the amount of material in the original bar admits of. The symbol Δ is used in the formulæ to indicate the *nominal capacity* of the hook in tons of 2,000 pounds. The formulæ which determine the lines of the other parts of the hooks of the different sizes are as follows, the measurements being all expressed in inches:

$D = .5\,\Delta + 1.25$, $E = .64\,\Delta + 1.60$, $F = .33\,\Delta + .85$, $H = 1.08A$, $I = 1.33A$, $J = 1.20A$, $K = 1.13A$, $G = .75\,D$, $O = .363\,\Delta + .66$, $Q = .64\,\Delta + 1.60$, $L = 1.05A$, $M = .50A$, $N = .85B - .16$, $U = .866A$.

The dimensions, A, are necessarily based upon the ordinary merchant sizes of round-iron. The sizes which it has been found best to select are the following: Capacity of Hook, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, 3, 4, 5,



6, 8, 10 tons; Dimension A. $\frac{5}{8}$, $\frac{11}{16}$, $\frac{3}{4}$, $1\frac{1}{16}$, $1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$, $3\frac{1}{4}$ inches. The formulæ which give the sections of the hook at the several points are all expressed in terms of A and can therefore be readily ascertained by reference to the foregoing scale.

Experiment has shown that hooks made according to the above formulæ will give way first by opening of the jaw, which, however, would not occur except with a load much in excess of the nominal capacity of the hook. This yielding of the hook when loaded to excess becomes a source of safety, as it constitutes a signal of danger which cannot very readily be over-looked, and which must proceed to some considerable distance before rupture will occur and the load be dropped. A comparison of these hooks with most of those in ordinary use will show that the latter are, as a rule, badly proportioned, and frequently dangerously weak. Hooks proportioned by the above formulæ are used in all the Weston cranes. See *Cranes*.

HOOK-SWIVEL.—A device intended for dispensing with the necessity of the triangular bayonet in stacking arms. It is of great value in connection with the trowel-bayonet, the use of which in digging, would deprive the muskets of the means of stacking them when necessarily set aside for this purpose. The swivels are so attached to the upper bands, that it is easy to insert each hook into the swivels of the two remaining guns necessary to complete the stack. The process of stacking is very simple. The men being at *order arms*, bayonets unfixed, the Instructor commands:

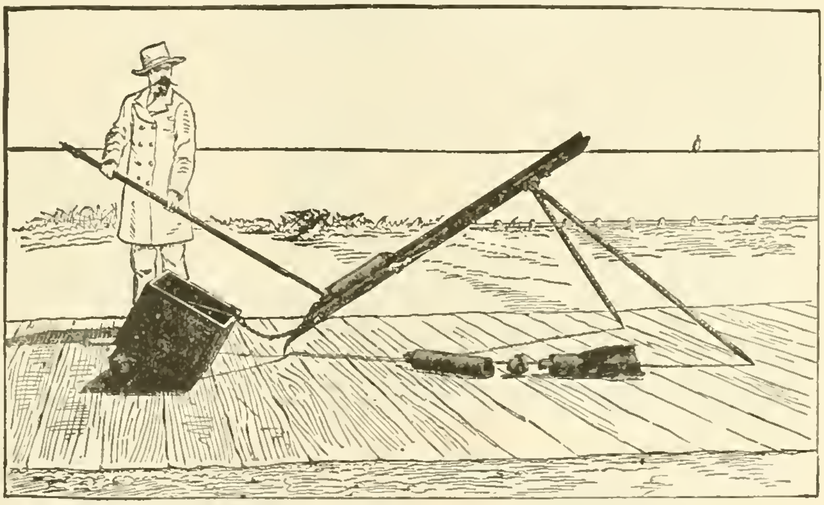
1. Stack, 2. Arms.

At the command *stack*, each even number of the front rank turns his piece, barrel to the front (the barrel turning to the left), and inclines his piece slightly forward, grasping it with the left hand at the upper band, the thumb and forefinger raising the hook-swivel; each even number of the rear-rank then passes his piece to his file-leader who grasps it between the bands with his right hand and throws it, barrel to the rear, two feet in front of his own piece, the right hand slipping to the upper band, the thumb and forefinger raising the hook-swivel, which he engages with that of his own piece, and inclines both to the right. Each odd number of the front rank grasps his piece with the right hand between the bands, the left hand guiding the hook-swivel, which he holds near the hook-swivels of the other pieces.

At the command *arms*, each odd number of the front rank engages the hook of his piece with the free hook of the piece of the even number of the rear rank. He then turns the barrel downward and to the right between the other two—so that it shall rest upon their intersection—and rests the butt about fifteen inches in front of his right foot.

If in single rank, number two of each four makes the stack, using the piece of number three as explained for the even numbered rear-rank man; number one using his own piece as explained for the odd numbered front-rank man, and the loose pieces are passed and laid on as before. In breaking the stack the loose pieces are passed as before, and the stack is broken as when in two ranks, number two taking his own piece in his right hand and that of number three in his left, which he passes to him on breaking the stack. Number one grasps his own piece with his right hand.

HOOKUM.—An Indian word, signifying order or command. *Hookummaumeh* signifies a letter of instructions, or the paper that contains orders.



HOOPER LIFE-SAVING ROCKET.—This rocket is a modification of the Hale rocket. The body is cylindrical in form, and is of sheet-metal 0″.165 thick. The point of the rocket or head is ogival in form, made of wood, and has a cylindrical tenon 1″.1 in length, which is inserted into the front end of the body. The head is held in position by several screws passing through the rocket-case into the tenon. The rear end of the case is closed by a metallic base carrying a double-swivel and perforated with five vents or gas escapes, each one-half an inch in diameter. On one side of these vents are fluted projections extending 2″.3 towards the rear, so curved as to leave the opposite sides open for the unimpeded escape of the gases evolved by combustion. The object of this arrangement is to produce a motion of rotation about the longer axis of the rocket, and thus secure greater steadiness of flight. This cast-iron base is held in position by pins passing through the case. To the swivel is attached a chain a little over 3 feet long, to which the line is made fast. The rocket is fired by breaking the paper covering of one or more of the vents, and inserting a piece of slow match and igniting the outer end.

The following are the principal dimensions and weights of the rocket:

			Inches.	Centimeters.
Length of body			14.5	36.82
Diameter of body	Exterior		3.75	9.40
	Interior		3.42	8.64
Head	Total length		3.6	9.14
	Length of ogival part		2.5	6.35
	Diameter		3.75	9.40
	Tenon:	Length	1.1	2.79
		Diameter	3.42	8.64
Length of base outside of case			2.7	6.86
Total length of rocket			19.7	50.03
Length filled with composition			12.0	30.48
Diameter of vents			0.5	1.27
Number of vents			Five.	
Length of chain and swivel			38".5	96.65
			Lbs.	Kilos.
Average weight of rocket and chain			19.25	8.73

The following directions should be observed when using this rocket and its stand. 1. The elevation required for the stand to be ascertained by means of a small quadrant; 25° will carry the line 300 yards with ease. 2. It is suggested, in order to save time, that every rocket-line should be spliced to a spring-swivel that it might *at once* be attached to the end of the rocket-chain. 3. In all cases three fathoms of the rocket-line to be wetted before being attached to the chain. 4. Place the rocket in the trough or stand with its shoulder against the small iron projection at its base, and have the chain hanging down through the slot. 5. To fire the rocket: With a pointed stick break the oil-paper covering each of the flange-holes, insert into one of them a slow match, light and retire to an angle of 45° to the rear of the stand. See *Life-saving Rockets*.

HOPLITAL.—Foot-soldiers among the Greeks, who bore heavy armor, and engaged with broad shields and long spears. These took precedence of all other foot-soldiers, and never went into action except in their own proper positions in the phalanx.

HOPPER.—A device, employed in machine-guns, very nearly of the form of a cartridge, and tapered downward. Its sides serve to guide the cartridges into the carrier singly, so that they can be removed one by one. The front end of the aperture is projected downward nearly into the carrier next the barrels, and thus serves to cut off the entrance to that particular barrel which is in front of it while in this position, and the cartridge which lies upon the one already in the groove from sliding forward and prematurely entering the opposite barrel. See *Gatling Gun*.

HOPPER-PLATE.—A component part of most ma-

chine-guns. It is a brass-curved plate, *I*, hinged to the frame-work of the gun on the right side, and covering the *carrier-block*. It is provided with a *hopper*, *K*, through which the cartridges descend to their places in the grooves of the carrier-block; whereupon they are instantly taken possession of by the locks, forced into the barrels, and fired. A short distance in front of the hopper is an upright pin, *I'*, on which the *feed-drum* rests and revolves. The upper side of the plate is flat and circular. See *Gatling Gun*.

HORDE.—A wandering troop or gang; especially a clan or tribe of a nomadic people possessing no fixed habitations but migrating from place to place for the sake of pasturage, plunder, or like cause.

HORDEARIUM.—The money which the Romans gave their cavalry for the sustenance of their horses.

HORION.—A term which formerly signified a helmet, and which in the vulgar acceptation of it at the present time among the French, means a blow upon the head.

HORIZON.—The circular line formed by the apparent meeting of the earth and sky: this, in astronomical phrase, is called the *sensible horizon*. The *rational horizon* is the circle formed by the plane passing through the center of the earth, parallel to the sensible horizon, and produced so as to meet the heavens.

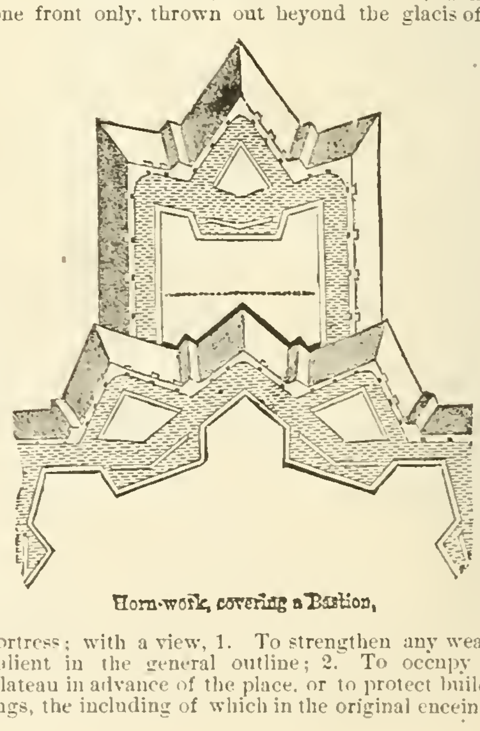
HORIZONTAL FIRE.—In gunnery, the fire of guns and howitzers under low angles of elevation. See *Fire*.

HORIZONTAL RANGE—In gunnery, the distance to which a piece of ordnance will project a ball on a horizontal plane. Supposing no resistance from the atmosphere, the greatest range would be when the piece is elevated at an angle of 45°, and in all other positions the *horizontal range* would be as the sine of twice the angle of elevation. In a resisting medium the maximum horizontal range requires the elevation to be less than 45°. It is found by experience that, with ordinary velocity, a cannon-shot ranges farthest when the elevation of the piece is about 30°.

HORIZONTAL VELOCITY.—A projectile's velocity at any point resolved in the horizontal direction. Thus, if V be the velocity of a projectile moving at an angle E to the horizon,

$$\text{Horizontal Velocity} = V \cos e.$$

HORN-WORK.—That work, in fortification, having one front only, thrown out beyond the glacis of a



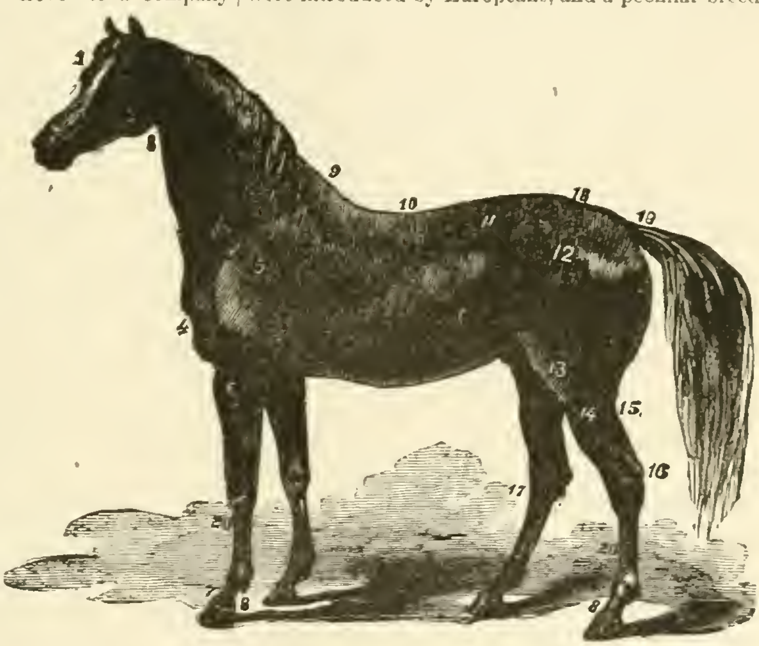
Horn-work, covering a Bastion,

fortress; with a view, 1. To strengthen any weak salient in the general outline; 2. To occupy a plateau in advance of the place, or to protect buildings, the including of which in the original enceinte would have extended it to an inconvenient degree; 3. To occupy a tongue of land protected on its sides; 4. To bar a defile; 5. To cover the head of a bridge; 6. To occupy rising ground, the possession of which would render the enemy more than necessarily dangerous. The front of a horn-work consists of two demi-bastions connected by a curtain, and usually defended in front, as in the fortress itself, by a tenaille, ravelin, and covert-way. The flanks, protected by ditches, run straight upon the ravelin, bastion, or curtain of the main defenses, so that the ditch may be swept by the fire of the latter. The flanks should not be too long for easy musketry range. In most of the earlier works of this nature, the ditch of the horn-work was united with the ditch of the main works by being cut through the glacis and covert-way, but in modern works the horn-work is constructed entirely beyond the glacis. Occasionally, horn-works are very useful; but all modern Engineers generally prefer constructing detached and advanced works. See *Crown-work*.

HORS DE COMBAT.—The French term, literally meaning "beyond the battle," used to signify a combatant, or body of combatants, so completely beaten either by physical force or strategy, as to be incapable of further action in the struggle which is actually under consideration.

HORSE.—1. A military term for a body of Cavalry. 2. We can go back 35 centuries, to Job the afflicted inhabitant of Uz, for the most wonderfully poetical description of the true horse. Solomon, later, does not hesitate to compare his "Love" to a company of horses in Pharaoh's chariots. Homer portrays the horse as a sensitive being, and relates that the steeds of Achilles wept at the death of that hero. Virgil tells us that the charger of Pallas followed the remains of his master to his burial, his eyes filled with tears. Pliny, the naturalist, positively asserts that horses often bewail the loss of their masters. Buffon, a hundred years ago, said: "The noblest conquest achieved by man is that of this proud and mettlesome animal, which shares with him alike the hardships of war and the glory of a conflict. He likewise shares his pleasures in the chase, in tournay, in the race; he glows with brilliancy and ardor." The native country of the horse is uncertain. Some contend for Asia, and some for Africa; some suppose that the horse was first domesticated in Egypt, and quote Scripture in support of their opinion, but to no better purpose than to show that at a very early period it was in use as a domesticated and valued animal among the ancient Egyptians: whilst others adduce arguments not more conclusive to show that it was originally domesticated in the north-east of Asia; some think it not improbable that Europe also, and even Britain, had indigenous horses. Whether certain wild races of Central Asia and the north of Africa are indigenous to the regions in which they are found, or the offspring of animals which have escaped from domestication, like those of America, and whether the origin of the domestic horse is to be referred to one original form, or to several forms somewhat different, and belonging to different countries, are questions also uncertain; and the last of them is very similar to that which is so much agitated respecting the dog, although it must be admitted that the diversities are not so great as in that case. The lips and teeth of a horse adapt it for cropping the short herbage of dry plains or hills, so that it finds abundance where the ox would be very insufficiently supplied. The feet are also adapted to dry rather than to soft or swampy ground. On soft ground, not only is the foot apt to sink, not being very broad, but the horny foot is softened, and a diseased state of the feet is the result, as in the case of a great many dray-horses in London, reared in the alluvial districts of the east of England. The horse, however, requires a liberal supply of water; and during the dry season, in the hot plains of South America, great troops of wild horses often rush furiously to the rivers, and as they approach the drinking-place, trample one another under foot, vast numbers of skeletons remaining to bleach in the sun.

Wild horses are found on the plains of Central Asia. Some also inhabit mountainous or hilly districts both there and in the north of Africa. They abound still more in the grassy plains of North and South America, although they were first introduced into America by Europeans; and certain tribes of Indians, both in North and South America, have become at least as equestrian in their habits as any of the Tartars of the East. Wild horses are also found in the Falkland Islands, into which they were introduced by Europeans, and a peculiar breed has been found in a wild state in the Island of Celebes. The races or varieties of the horse have an evident relation to the climate of the countries in which they occur. Those of cold and stormy regions are comparatively small and rough-haired; those of more favored climates, large and sleek. There are differences, more evidently to be ascribed to domestication, according to which certain breeds of horses are particularly suited to certain kinds of work some excelling in fleetness, some in endurance, some in mere strength for burden or draught. The



NOMENCLATURE.

1. Forehead.	6. Arm.	11. Loin.	16. Point of the Hock.
2. Jaw.	7. Large Pastern.	12. Hip.	17. Hock.
3. Throat.	8. Small Pastern.	13. Stifle.	18. Croup or Rump.
4. Breast.	9. Withers.	14. Thigh.	19. Dock.
5. Shoulder.	10. Back.	15. Hamstring.	20. Cannon-bones.

slender form of the race-horse or hunter contrasts almost as strongly with the ponderous solidity of the dray-horse, as the great size of the latter does with the diminutiveness of the Shetland pony. Wild horses generally congregate in troops, sometimes small in number, but sometimes of many hundreds. The males have fierce contests for the supremacy, and males that have contended unsuccessfully are often driven off to a solitary life. On the appearance of danger, the chief stallion of a small troop seems to direct the movements of all, and even the largest troops seem instinctively to move in a kind of concert, so that when they are assailed, the stronger animals oppose the enemy, and protect the younger and weaker. Wolves, even when in packs, attack with success only weakened stragglers, and even the jaguar is repelled. In fighting, horses either raise themselves on their hind-feet, and bring down the fore-feet with great force on the enemy, or wheeling about, kick violently with the hind-feet.

The *tarpan* of Tartary is one of those races of wild horses which are sometimes regarded as original, and not as descended from domesticated animals. It is of a reddish color, with a very black stripe along the back, and black mane and tail. The eye is small and vicious. Tarpans are sometimes caught by the Tartars, but are with great difficulty reduced to subjection. In some of the steppes of Central Asia, are wild horses of a white or dappled-gray color. The wild horse of South America is there called the *mustang*. It exhibits considerable diversity of color, but bay-brown is the most prevalent. It is strong and active, and is often taken with the lasso, and employed in the service of man. A curious method is practiced by some Indian tribes of promptly subduing its wild nature, and rendering it tractable, by blowing strongly with the mouth into its nostrils. By other tribes, it is subdued more rudely. It is thrown on the ground, and ere it can recover, a man gets upon its back, whom, when it rises, it cannot shake off, and who retains his seat until it is quite submissive. The *koomrah* of North Africa is regarded by Col. Hamilton Smith as a distinct species. It has no forelock, but woolly hair on the forehead, is of reddish-bay color, without stripe on the back or any white about the limbs, has limbs of somewhat ass-like shape, and the tail covered with a short hair for several inches at the root. It is an inhabitant of mountainous regions.

When full mouthed, the horse will have forty teeth, twenty in each jaw. The mare possesses only thirty-six. The age of the horse may be determined by observing the teeth, the times at which they appear, are shed and replaced, and the alterations in their form and markings;—2 years, all milch teeth, which are easily distinguished from the permanent by being smaller, whiter, and by having necks;—3 years, two permanent teeth, central incisors;—4 years, four permanent teeth, central and lateral incisors;—5 years, all are permanent teeth. From this time on, the age of the horse is decided by the marks on the teeth;—6 years, the marks on the central incisors are worn out, and the points of the tushes are blunted;—7 years, the marks on the central and lateral incisors are worn out, those on the corner incisors still showing;—8 years, all the cavities are filled up. Beyond this age the criteria are uncertain. For the military service the horse should possess the general features shown in the above drawing, and should not be less than 14 nor more than 16 hands high; weigh not less than 750, nor more than 1,100 lbs.; age not less than 5 or more than 8 years; head and ears small; forehead broad; eyes large and prominent; the shoulders long and sloping well back; fore-legs straight and standing well under; chest broad and deep; barrel large, and increasing from girdle to flank; withers elevated; back short and straight; loins and haunches broad and muscular; hocks well bent and under the horse; pasterns slanting; and feet small and sound.

In the matter of the treatment and qualities of the horse, we can not do better than remember a few axioms and aphorisms current among a people with whom the raising and training of horses are matters of religion, and to whom the Prophet has said, "Whoever raiseth and traineth a horse for the Lord is counted in the number of those who give alms night and day." "Make your horses work, and make them work again. Inaction and fat are the great peril of a horse, and the main cause of all his vices and disease." "As you would shun the plague so shun a horse with shrunken breast and straight shoulders. But one whose croup is as long as his back and loins together take with closed eyes." "If you would know at a glance the value of a horse, measure him from the last joint of the tail to the middle of the withers, and from the middle of the withers to the tip of the upper lip, on a line between the ears. If the hind measure is the longer, the horse is of little worth; but if the forepart is longer, rest assured the animal has distinguished qualities, and the greater the difference the greater will be his value." "Never run your horse up or down hill if you can avoid it." "To prepare a too fleshy horse for fatigues make him thin by exercise; never by withholding his food." "Do not beat your horses, nor speak to them in a loud tone of voice; do not be angry with them, but kindly reprove their faults; they will do better thereafter, for they understand the language of man and its meaning. If by chance you meet with a horse insensible to kindness, hesitate not to employ the power of your spurs, but in such wise that he never forgets the punishment." "The man who gives not a steady walk to his horse excites pity. The walk is the gallop of always." See *Cavalry-horses*, *Artillery-Horses*, *Pack-animals*, and *Draught-animals*.

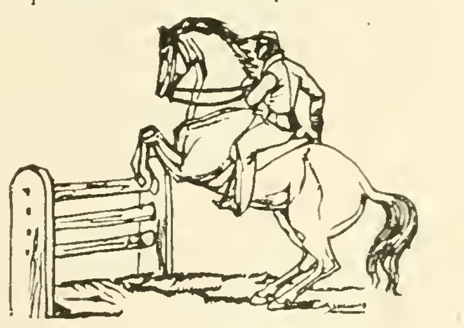
HORSE-ARTILLERY.—A portion of the artillery which generally serves with cavalry. One of the mounted branches of the British service is Horse-artillery. The formation of this branch dates back to the year 1793, when two troops were raised at Woolwich. Each troop consisted of 4 guns, but in November of the same year 2 more troops were added, and each troop had 6 guns. Subsequently it was raised to 12 troops. This branch of the service has been further augmented to the extent, at the present day, of 6 brigades, of 5 batteries each, each battery having 6 guns. The present equipment of the Horse-artillery is made up of 9-pdr. M.L.R. guns. The gun is made of a steel tube with a wrought-iron jacket; caliber, 3 inches; weight, 6 cwt.; length of rifling, 62·3 inches; rifling, three grooves, with a uniform pitch of 1 to 30 calibers; charge, 1.75 lb The carriages for these guns are of wrought-iron.

The Horse-artillery is held in hand for all decisive moments. When launched forth, its arrival and execution should be unexpected and instantaneous. Ready to repair all disasters and partial reverses, it, at one moment, temporarily replaces a battery of foot, and at the next is on another point of the field, to force back an enemy's column. In preparing the attacks of cavalry, this arm is often indispensable and aways invaluable; brought with rapidity in front of a line, or opposite to squares of infantry, within the range of canister, its well-directed fire, in a few discharges, opens a gap, or so shakes the entire mass, that the cavalier finds but a feeble obstacle, where, without this aid, he would in vain have exhausted all his powers.

HORSE-GRENADIERS.—The Flying Grenadiers, who fight both on foot and on horseback. They were first established in France by Louis XIV., in 1676, formed in squadrons, and called *Grenadiers Volans*.

HORSE-GUARDS.—1. The name applied to a large public office in Whitehall, appropriated to the departments under the General Commanding-in-Chief. The word Horse-guards is used conventionally to signify the Military Authorities at the head of Army Affairs, in contradistinction to the Civil Chief, or the Secretary of State for War. 2. The Royal Horse-guards, or Oxford Blues, is the third heavy cavalry regiment of the Household Brigade. The regiment was raised in 1661 from the remnants of the disbanded Army of the late Commonwealth. It has ever proved a loyal corps, although it readily transferred its allegiance from James II. to William III. It took part in Marlborough's campaigns; served under the Duke of Wellington in the Peninsula and at Waterloo, and has always been considered one of the finest heavy cavalry corps in the world. The Guards of State for the Sovereign are taken either from its ranks or from those of the Life-guards. The present uniform consists of a steel helmet, with plume, a steel cuirass over a blue coatee, leather breeches, and knee-boots; the horses are black. The establishment of the regiment consists of 1,302 of all ranks, with 825 horses, exclusive of officers' chargers. See *Cavalry* and *Dragoon*.

HORSEMANSHIP.—Throughout history the art of managing the horse and riding on his back has ranked high among useful and graceful accomplishments. According to Cæsar and Livy, the Numidians and Mauritanians rode their horses without either bit or saddle, and guided them solely by using a small switch, which was applied to either side of the neck, according as they wished to turn. The Persians trained their horses to kneel to receive their riders, and were the first to introduce saddles. Stirrups were used in the 5th century, but were not common even in the 12th. The two essentials for riding are a firm seat and a light hand, as without a combination of the two no one can become a good horseman. In every description of riding, the light or delicate "hand," just feeling the mouth of the horse, and playing the bit in accordance with his movement, will insure success; and it is to this delicacy of wrist that we must attribute the ease and skill with which ladies so often ride the most high-spirited animals, which, in rougher hands would be unmanageable. The first lesson in horsemanship is to learn to mount safely and easily; and the ordinary and on the whole least objectionable way is as follows: Stand at the shoulder of the horse, looking towards his tail, and taking the reins in the right hand, divide them by the middle finger of the left till you feel the horse's



mouth; then take hold with the left hand of a lock of the mane, lift the left foot into the stirrup, and using the mane as a slight hold, spring into the air, taking hold of the back of the saddle to assist in getting the right leg easily over the horse, steadying the fall of the body by the right hand on the pommel, and then arranging the stirrups. In dismounting exactly the reverse of this process is followed, or both feet may be disengaged from the stirrups at once, and the rider may vault from the saddle to the ground with great rapidity, and less risk of falling if the horse chance to move on.

There are four different styles of riding practiced among modern civilized nations—viz., the military, road, hunting, and racing styles. The military style differs in many particulars from the others, as, owing to the long stirrups used, the soldier is obliged to sit well down in his saddle, with his body erect, the seat being preserved more by balance than by a tight hold by the leg or thigh. In rapid movements or when charging over irregular fields, a very firm seat is necessary; the stirrup-leathers are then about two holes shorter, and the feet pressed "home" in the stirrups, which otherwise would be apt to be lost in jumping; the leg from thigh to the knee well forward, and nearly at right angles to the upper part of the body inclined forward; the legs perpendicular, the heel well down, and the toe pointing nearly straightforward. This seat the trooper has in common with all equestrian nations, as the Arabs, Tartars, Persians, Egyptians, Cossacks, Magyars, and Circassians, the last mentioned nation carrying it to such an extreme that the leg assumes the form of the letter V, having the knee for the apex. In riding at the bars or hurdle "collect" the horse into the pace at which he goes with most ease to himself; keep him straight at the fence till he rises; "ease" his mouth by leaning forward; take especial care not to confine it when he is making his effort, or you will pull him into the fence as he descends; lean well back in the saddle, and gently take hold of his mouth to support him when landing. Do not gallop with a loose rein (except down hill, when the horse requires his head free), for the horse will go with a straggling pace, which is very undesirable. For rapid movements, the essentials are a good and powerful seat, good "hands," a great knowledge of pace, and quickness to take advantage of any chances of success.

As the strongest part of a horse, and also the center of action, is situated at a point just behind his shoulder-blades, the nearer we can ride to this the better, and riding rather forward in the saddle is a relief to the horse, while leaning back, as it bears upon his loins—his weakest part—is a cause of fatigue. The grip in riding should be maintained by the knees, the thighs, and the calves slightly. The thigh is the most essential part of a good and strong seat. Few riders whose thighs are short and round, have a good seat; while, on the other hand, jockeys and tall thin men, whose thighs are long, and more or less hollowed on the under side, are generally very firm. No one pretends to horsemanship without a knowledge of the proper action for emergencies. If a horse runs away, do not exhaust yourself by vain pulling, but guide him out of danger, and let him run till he is tired. A Bucephalus noseband is a great security against bolting. If a horse rears, loosen the reins, and lean forward: in hunting, the "art of falling" consists in getting clear of your horse. In case of a horse kicking, keep his head up as much as possible, and sit firm in the saddle. The art of riding teaches and shows the position to be taken on horseback, so as to be there with the greatest security and ease. It at the same time affords the means of leading and directing the horse with the utmost of facility, and of obtaining from him by the simplest method and with the least fatigue the most exact and perfect obedience in everything which his strength and conformation allow. He is the good horseman, therefore, who, firm and easy in his seat, has acquired both the knowledge of what he may ask of his horse and the practice of the best means of enforcing obedience. And that is the well-trained horse which understands the intentions of his rider from the slightest of his movements, according to given principles, and executes them with promptness, agility, and vigor.

HORSE MEDICINES.—In a military point of view, the medicines issued to an army or command for the treatment of diseased or disabled animals. A *Supply Table* is usually authorized for an army, the medicines are all procured on requisition, and the Veterinary Surgeons dispense them. The following

Name of Drug.	Action and Use.	Dose.	Antidote.
Aloes.	Laxative and Tonic.	½ to 1 oz.	
Alum.	Astringent.	2 to 3 drs.	
Anise Seed.	Aromatic and Stomachic.	½ to 2 ozs.	
Aqua Ammonia.	Stimulant and Antacid.	1 to 4 drs.	Vinegar.
Arsenic.	Alterative and tonic, used for Paralysis, Mange, etc.	1 to 5 grs.	Magnesia and oil.
Assafœtida.	Anti-spasmodic, Coughs, etc.	1 to 3 drs.	
Bicarbonate of Potash.	Diuretic and Antacid. Good for Rheumatism.	3 to 5 drs.	Vinegar and raw Linseed-oil.
Bismuth.	For Chronic Diarrhœa, etc.	½ to 1 oz.	
Black Antimony.	Promotes the Secretions.	¼ to ½ dr.	Infusion of oak bark. Give also Lins'd-oil
Blue Vitriol.	Astringent and Tonic.	½ to 1 dr.	Eggs, Milk, etc.
Calomel.	Cathartic.	10 to 40 grs.	Eggs and Milk.
Camphor.	Anti-spasmodic.	½ to 1 dr.	
Cantharides.	Diuretic and Stimulant.	3 to 6 grs.	
Carbolic Acid.	Externally and Disinfectant.		Eggs; soap; gruel.
Castor Oil.	Cathartic.	½ to 1 pt.	
Cayenne.	Stimulant and Carminative.	5 to 25 grs.	
Chlorate of Potash.	Diuretic. Given for bloating, etc.	1 to 2 drs.	
Copperas.	Tonic and Astringent.	½ to 1½ drs.	
Croton-oil.	Powerful purgative.	10 to 15 drops	Opium.
Digitalis leaf.	Sedative and Diuretic.	10 to 20 grs.	Stimulate.
Epsom Salts.	Cathartic and febrifuge.	2 to 8 ozs.	
Ether.	Anti-spasmodic.	½ to 2 ozs.	
Fowler's Solution.	Used for skin diseases. See Arsenic.	1 to 4 drs.	Hydrated peroxide of iron.
Gentian Root.	Tonic.	1 to 2 drs.	
Ginger.	Tonic, Stimulant, and Stomachic. Used for flatulent colic, dyspepsia, etc.	2 to 5 drs.	
Glauber Salts.	Cathartic.	6 to 12 ozs.	
Iodide of Potassium	Diuretic and Alterative. Employed for Rheumatism, Dropsy, Enlarged Glands, etc.	½ to 1½ drs.	Give very freely starch or flour, with water largely.
Linseed-oil, raw.	Cathartic and Nutritive.	1 to 2 pts.	
Magnesia.	For colts as an antacid and laxative.	¼ to 1 oz.	
Mercurial Ointment	Used for Mange, itch, lice, and other parasites.		Whites of eggs with milk given freely.
Nux Vomica.	Nervous stimulant—used for Paralysis.	15 to 25 grs.	Saleratus, followed quickly by copperas, both dissolved in water.
Opium.	Anodyne and Anti-spasmodic. Given in Colic, Inflammation of Bowels, Diarrhœa, etc.	¼ to 1 dr.	Belladonna, strong coffee, brandy and ammonia. Dash very cold water on and keep the horse moving.
Prepared Chalk.	Antacid.	½ to 1 oz.	
Quinine.	Tonic, given during convalescence.	15 to 50 grs	Linseed-oil largely. Raw.
Saltpetre.	Diuretic and Febrifuge.	1 to 3 drs.	
Soda Bicarb.	Similar to Bicarb. Potash.	3 to 8 drs.	
Soda Sulphite.	Antiseptic and Alterative, used for blood diseases.	½ to 1 oz.	
Solution of Lime.	Antacid, used as an antidote to poisoning by acids.	4 to 6 oz.	
Spirits of Chloroform.	Anodyne and Anti-spasmodic.	1 to 2 oz.	
Strychnia.	Tonic and Stimulant. Used for Paralysis.	½ to 1 gr.	Tobacco.
Sulphur.	Alterative and Laxative. Used for Skin diseases and Rheumatism.	½ to 2 ozs.	
Sweet Spirits of Niter.	Diuretic and Diaphoretic.	½ to 1½ ozs.	
Tannic Acid.	Astringent.	20 to 40 grs.	
Tartar Emetic.	Sedative and Alterative.	⅛ to ½ dr.	Tannic Acid.
Tincture of Aconite Root.	Sedative. Used for lung fever, etc.	15 to 35 drops	Give small doses of Nux Vomica, use stimulants largely, and keep moving.
Tincture of Cantharides.	Stimulant and Tonic.	1 to 2 ozs.	
Tincture Ergot.	Parturient.	1 to 2 ozs.	
Tincture Iodine.	Used externally.		
Tincture Iron.	Tonic and Astringent. Used for Typhoid diseases.	½ to 1 oz.	
Tr. Nux Vomica.	Tonic. Stimulant in Paralysis and Dyspepsia.	2 to 4 drs.	See Nux Vomica
Tincture Opium.	Anodyne and Anti-spasmodic.	1 to 2 ozs.	See Opium.
White Vitriol.	Astringent. Used for cuts, wounds, and sores, in solution.	5 to 15 grs.	Milk, eggs, and flour.

For a colt one month old, give one twenty-fourth of the full dose for an adult horse as given above; three months old, one twelfth; six months old, one-sixth; one year old, one-third; two years old, one-half; three years old, three-fourths.

doses for the horse, prescribed by the eminent Veterinarian, Dr. Kendall, are found on all Army Supply Tables, and may be administered by any intelligent soldier, in the absence of the Veterinary Surgeon. See *Veterinary Art*.

HORSE POWER.—A term used in expressing the force of a motive power. It is based upon the assumption that horses in general perform a certain constant amount of work in a specified time; an assumption which is evidently erroneous. The fundamental unit of work is the foot-pound; but in measuring the work of a horse by this unit, the estimates of most celebrated Engineers differ widely from each other; Boulton and Watt, basing their calculations upon the work of London dray-horses (working eight hours a day), estimated it at 33,000 foot-pounds per minute. D'Aubuisson, taking the work done by horses in whims at Freiberg, estimated the work at 16,440 foot-pounds, working eight hours a day; under all similar circumstances, Desaguliers's estimate was 44,000; Smeaton's 22,000; and Tredgold's 27,500 foot-pounds; 17,400 is thought to be near the truth. It matters little, however, what number is assumed, provided the same be always used: and accordingly the original estimate of Watt is still counted a horse-power. In calculating the power of a steam-engine in terms of this unit, the general rule is to multiply together the pressure in pounds on a square inch of the piston, the area of the piston in inches, the length of the stroke in feet, and the number of strokes per minute; the result obtained by this operation, divided by 33,000, will give the horse-power. It is generally necessary to deduct about one-tenth of the whole, as an allowance for friction.

HORSE SHOE.—In fortification, a very small round or oval work, with a parapet; generally made in a ditch, or marsh.

HORSE-SHOEING.—The ordinary system of horse-shoeing is rude and irrational, and is the main cause of most lamenesses and of the majority of falls in riding and driving. Chief amongst its faults are the attempts to fit the foot to the shoe, instead of the shoe to the foot, and the wholesale cutting and rasping, and consequent injury of the several parts of the foot. After the cautious removal of the old shoe, the crust on which it rested generally requires to be pared down with a drawing-knife, and its edge afterwards rounded with the rasp. Any ragged portions of the frog may also be taken off, and this includes the whole of the allowable paring or dressing of the horse's foot. The horny sole intended as a covering and protection of the sensitive parts beneath; the tough elastic frog, an insensible pad which obviates concussion, and preserves the foot wide and free from contraction; the bars, an involution of the crust, which help it to support weight, and give it lateral support, are all too valuable to be ruthlessly cut away, and in all ordinary cases must be scrupulously preserved from both knife and rasp. For sound healthy feet treated as advised, a plain shoe is preferable for saddle or harness horses; the web need not exceed three-fourths of an inch, must fit the crust closely and accurately all the way round to the heels, where its inner edge will rest upon the strong uncut bars. Nowhere must there be any overlapping, which only renders the shoe more apt to cut the opposite limb, and be torn off in heavy ground. To lessen the chances of tripping, and make the shoe wear equally, it should for the fore-feet be turned up very slightly, and its ground surface hollowed out a little at the toe, so as

Fig. 1.

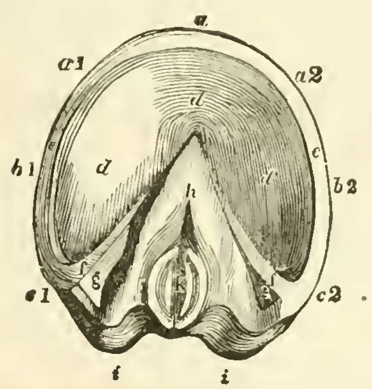


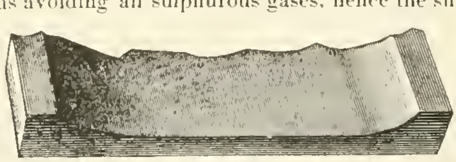
Fig. 2.

to present the appearance of an ordinary shoe which has been worn for a fortnight or three weeks; and which, as every one knows, is therefore rendered more safe and comfortable. By turing up at the toe, these advantages are secured at once. For saddle and light harness work three nails on the out—and two on the inside will firmly secure any well-made, well-fitting shoe. The nail-holes should be countersunk, be nearly in the center of the web, and pass straight through it, thus giving the nails a firmer hold of the stout unrasped crust. The points of the nails when driven home should be broken over and laid down with the hammer, but not touched with the rasp. The rasping of the crust which smiths fondly regard as their finishing and polishing stroke, is very injurious, removes the unctuous protecting portion of the crust, and renders it weak, brittle, and liable to crack. Shoes should be replaced every three weeks or a month at furthest. In shoeing the hind-feet the outside web is generally turned slightly down behind, whilst to give an equal bearing the inside heel is thickened. For heavy draught, both hind and fore shoes should have moderate tips and heels, which enable the horse to exert his entire powers without so much risk of slipping. Instead of the five nails used for the lighter horses, seven or eight are requisite.

Figure 1 shows an excellent form of front shoe and the proper positions of nail-holes; *a,a*, are the heels, of the same thickness as the rest of the shoe; *b,b*, are the points at which the heels of the hoof terminate; *c,c*, show the seating; and *d,e*, the positions of nail-heels. Figure 2 represents the ground surface of the hoof prepared for the shoe; *a*, *a* 1, *a* 2, show the front, inner, and outer toe; *b* 1, *b* 2, the inner and outer quarter; *c* 1, *c* 2, the inner and outer heel; *d,d,d*, the sole; *e,e*, the crust or wall of the hoof; *f,f*, the bars; *g,g*, the commissures; *h,k,l*, the frog (*h* being directly under the navicular joint); and *i,i*, the bulbs of the heels.

Horses with weak, tender, or bruised soles may for a time require leather or water-proof pads, but as the sole grows, these should be discontinued, and are never required in healthy feet, where the sole, which is the best and most natural protection, is allowed to grow undisturbed by the knife. Horses with corns should have their shoes made with a wide inside web, which rests upon the bars, or have for a time a bar-shoe. The last nail on the inside should also be dispensed with, and the seat of the corn or bruise carefully pared out, but without injuring frog or bars. If, from constant cutting, the bars are unfit to aid the crust in carrying the shoe, it will often be advisable to shoe for a time with tips or half-shoes, keeping the horse as much as is possible on soft ground, and waiting the healthy growth of the foot. In troublesome cases of thrush, such tips are also most serviceable, allowing the frog the natural and healthy pressure for which it is intended, and with astringents and cleanliness greatly expediting a cure. Groggy horses should have the toe shortened, and turned up, as already advised: the frog and sole must be untouched, and the shoes made light and nicely fitted. Over-reach, or cutting of the heel of the fore-foot with the shoe of the hind, is remedied by filing round the posterior edge of the offending toe, and keeping that shoe as far back as possible on the foot. For speedy cut, which is common in horses with in-turned knees, the shoe should be carefully fitted and no projecting portions be left; the clinches must also be well hammered down. See *Charlier System of Horse-shoeing*, *Seymour Shoe*, and *Snow-shoe*.

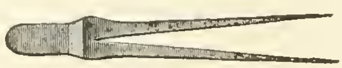
HORSE-SHOE NAILS.—The nail for a horse's foot differs materially from every other kind of nail, not only in shape, but also in the quality of iron from which it is made, as well as the process of manufacture. The slightest deviation from shape and quality of the iron renders the horse-shoe nail comparatively useless. From the days of Tubal Cain to the present time fire has been the only element with which iron could be properly wrought. Every other method has resulted in producing articles of great inferiority where strength and durability are required, and in no place are these two requisites more necessary than in the horse's shoe-nail. The Ancients used only charcoal in the working of iron, thus avoiding all sulphurous gases, hence the supe-



riority of their weapons. The old Damascus blades owe their superiority in part to the use of asphalt when being forged, thus avoiding the presence of sulphur, which is so ruinous to all kinds of iron and

A

steel. Profiting by this knowledge, the manufacturers of the Putnam nail avoid the use of coal and coke in forging, use only pure carbon gas made from petroleum, and thereby obtain a much higher tem-



B

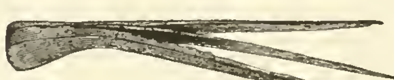
perature in the working of the iron. This hot-forged nail, when made of pure iron, has no equal in the known world.

The first drawing shows a cross-section of iron from which the cold-punched and sheard-nails are

C

made by forcing blanks therefrom by means of a punch. These blanks are put through a series of rollers and drawn into the form of A, with an indentation on the thin end for the *scarfed* points, which conduct the nail out of the hoof. B represents the piece which is removed by shearing the blade of A, so as to leave the nail, C, complete.

D



The rolling of iron *cold* produces lamination, causing the iron to separate in layers, as shown in D. But as the compression of shearing holds the edges together, it does not show itself until driven into the hoof, when the horny fibers cause them to separate while being driven, and one portion is forced *into* the foot and the other *out* through the wall of the hoof, thus causing lameness, lock-jaw, and death, as the records of State courts, as well as the testimony of horse owners, abundantly show.

One of these nails made by the *cold-cut* process, and slivered when being driven in by the shoer, is shown at E. The pain caused by a slight sliver of wood under the finger-nail will give one a slight idea as to how painful such a nail must be in the foot of the horse, there to remain until the shoe is removed. If the shoer is so fortunate as to draw it out without *breaking*, the lameness will disappear, but not until the horse has been laid up for a considerable time. Should the nail break, the result is far more serious.

It requires but little observation and reflection to arrive at the conclusion as to the kind of nails to be used in the horse's foot, whether a mangled piece of

E

iron, rendered dangerous by the *cold-rolling and cutting* process, or one made from the rod at a welding heat, where all the fibers remain intact, and a perfect *oneness* maintained, making it utterly impossible to sliver; likewise a greater amount of tenacity and ductility is obtained, by which the shoes are retained on the feet for a much longer time.

Having selected the best nails, the shoer should drive as small and few nails as will hold the shoe firmly and securely to its place. He should see that the nails fill the holes and the heads the crease, leaving little, if any, to project beyond the ground surface when finished, thus preventing the clinch from rising when brought in contact with stones, and saving the injuring of the ankle. See *Putnam Nail.*

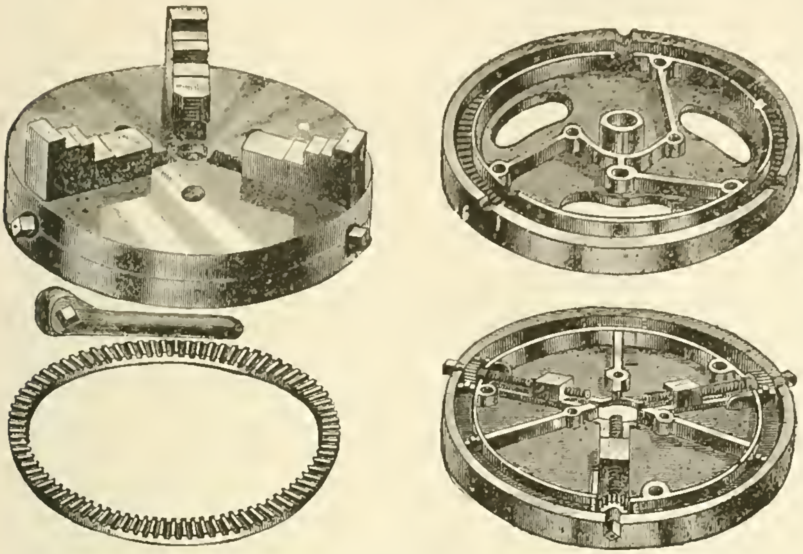
HORSE-TAIL.—Turkish Standard Commanders are distinguished by the number of horse-tails carried before them, or planted in front of their tents. Thus, the Sultan has seven, the Grand Vizier five, and the Pashas three, two, or one.

HORSFALL-GUN.—This gun is a solid forging of wrought-iron, bored out. The trunnions are forged upon a separate ring, which is held in place by a key. The dimensions of the gun are as follows:—Length, 15 ft. 10 in.; the diameter over the chamber, 3 ft. 7 in.; length of bore, 13 ft. 4 in.; diameter of bore, 13.014 in. The weight is 53,846 lbs. The usual windage is $\frac{1}{5}$ of an inch, and the gun is not rifled. The unequal shrinkage of the solid breech of this gun, during its fabrication, caused a crack, which was afterwards covered with a breech-plug, or false bottom in the chamber, to prevent the lodgment of any burning material. This gun is noted for its remarkable endurance, and terrible effect, at short range, in target practice at Shoeburyness.

HORSLEY-POWDER.—An explosive agent, composed of chlorate of potassa and gall-nuts, in proportion by weight of three to one, used principally in charging torpedoes. Its disruptive action in relation to the best gunpowder, volume for volume, is about 15 to 1.

HORTON LATHE-CHUCK.—A chuck of the universal type variously employed in the Arsenal. The drawings present a view of the device together and in its parts. The jaws are moved to and from the center simultaneously by means of the geared screws and the circular rack, which is enclosed in the deep groove or recess in the back-plate, the center faces of the front and back-plates making a perfectly tight casing for the gearing, so that no dirt, chips, etc., can possibly get into them to clog and injure the chuck. When the rack is taken out, especially from the fore-jaw, it makes a superior independent jaw-chuck, making two chucks in one. See *Chuck.*

HOSE-TROUGH.—The hose-trough is a small wooden channel, in which is placed a linen bag termed the *powder-hose*, filled with powder, to fire the charge. The bag should be of close texture, and well sewed. These troughs are made $1\frac{1}{2}$ in. square in the clear. The four pieces of which they are composed, the sill, sides, and top, or cover, are from $\frac{1}{4}$ to $\frac{1}{2}$ in. each in thickness. A trough should penetrate the powder-case about 4 in., and should exactly fit the opening left for it. It is fastened to the floor of the branch by nails, through the sill, which enter small pickets driven to receive them. Sometimes the sides of the trough are confined by pickets to prevent it being disturbed. The different lengths of the trough should be cut to fit exactly. Each portion of the trough should have its cover well fitted and secured with one peg only, in order that it may readily be removed to introduce the powder-hose. The trough is said to make an elbow when it changes its direction. The pieces forming an elbow should be solidly yet simply connected. When several mines are to be fired at the same moment, it is necessary so to



Horton Lathe-chuck.

proportion the trains to explode them, that, starting from the same point, the distances in time from that point to the charges may be all equal. The following cases show the manner of obtaining this result: For two charges place a trough on the shortest line from the one to the other, mark the center of it, and let the principal trough join it at that point. For three charges connect, as above, the two which are nearest. Let a trough lead from the middle point of this to the third charge; bisect the whole length of trough between this third charge and either of the others; then let the principal trough be joined to this last point. For four charges first connect them two and two, then join the central points and proceed as above. The elbows of a trough impede the communication of the fire, for which an allowance must be made when proportioning the trains, each elbow being valued at 3 in. Square elbows impede somewhat more than oblique ones.

HOSPITAL.—The principles of hospital construction were pointed out by a Commission of the French Academy of Sciences in 1778, and improved in several details by Miss Nightingale, Galton, and others, and in the late American and Franco-German wars. The general principles may be gathered from the following directions. The most important part of a hospital is the ward; that is, the special apartment, or system of apartments, for the reception and care of the patients. It should, if large, be arranged in separate pavilions of one, or at most not more than two stories. These buildings should be about 25 feet wide, 14 feet high, and of a length allowing not less than 100 square-feet per bed. In warm climates the height should be greater, and also the floor-space, allowing at least 120 square-feet per bed. No one ward should contain more than 32 beds. The windows should be opposite, reaching from 3 feet above the floor to one foot from the ceiling, and occupy one-third of the wall-space. The floors should be of hard pine or oak (Georgia pine in this country), and perfectly tight. In regard to the walls, there are differences of opinion, but it is probable that a plastering of mortar over laths, whitewashed with milk of lime, is the best, on account of its absorbing power, noxious gases being undoubtedly disposed of in this way by oxidation within the porous spaces. A plan of hospital was not unusual in the armies during the late War of the Rebellion in America, in which the wards or pavilions were disposed in a radiating form around a circular court, from 100 to 150 feet in diameter, according to the size of the hospital. A plan of Hicks Hospital near Baltimore, Md., is sometimes given as a model. This has a mess dining-room in one of the radiating buildings, rather larger than the others, and offices and other administrative buildings in the court. A better plan was carried out in the hospital at Point Lookout, Md., in which the Administration Apartments, Dispensary, Mess rooms, and Surgeons' Quarters were placed in a large building occupying a site among the other radiating buildings. The advantage is apparent in the open court that is unobstructed in regard to currents of air, and in the great cheerfulness of such arrangement, which admits of a free view from one ward to all the others, allowing the convalescent patients who may be sitting in their respective porticoes to greet each other; for wounded and sick soldiers, when they are able to be so, are a very social fraternity. The central court can then be laid out in plats of grass and flower-beds, in the care of which the patients take great pleasure during their often long confinement and absence from family. The plan of the Lincoln Hospital at Washington was the arrangement of the wards in the form of an isosceles triangle, they being placed *en echelon*, with the base of the triangle being left open. The triangular space between the wards was occupied by the various Administration Buildings.

In England there are several grades of hospitals. The smallest is the Regimental Hospital, under the Medical Officers of the Regiment; next, there is the Divisional Hospital, presided over by Staff Medical Officers, for the benefit of all the Corps in the Division; and, lastly, there is the General Hospital, applicable to the whole force. In these hospitals the Medical Officers are responsible directly to the Secretary of State for War for all purely medical functions. With regard to discipline, inspections, and other military duties, the principal Medical Officer is responsible to the Commandant of the Regiment or Division, who in his turn is answerable to the General-in-Chief for the state of the hospitals in his command. Soldiers while in hospital are subjected to a stoppage of 7d. a day from their pay, unless in hospital on account of wounds received in action or on service in the field; but their whole pay is stopped if detention in hospital be certified to have become necessary from their own misconduct. There are some large Military Hospitals at home, such as Netley, Fort Pitt, for lunatic soldiers, Woolwich, etc.

In the French Army the service of the Field Hospitals forms part of the intendance of the Army, the Medical Officers in charge being under the supreme control of the Intendant-general.

HOSPITALERS.—Charitable brotherhoods founded at various times and in different countries for the care of the sick in hospitals. The vow to devote themselves to this work of mercy is, in all these brotherhoods, superadded to the ordinary vows of poverty, chastity, and obedience, which are common to all the religious orders in the Church of Rome. One of the earliest recorded instances of a hospital served by such a brotherhood is that of Constance in the 13th century. The Knights of St. John, of Jerusalem, as also the Teutonic Knights were originally Hospitalers. The Hospitalers of Our Lady of Christian Charity were founded near Chalons in the end of the 13th century by Guy de Joinville; a smaller body at Paris in 1294; and the Hospitalers of Our Lady Della Scala about the same time at Siena. The history of the Brethren of Mercy, founded by St. John of God, will be found interesting. There are many other local institutes or congregations, all of which, however, recognize the same general rules, and follow the same general organization.

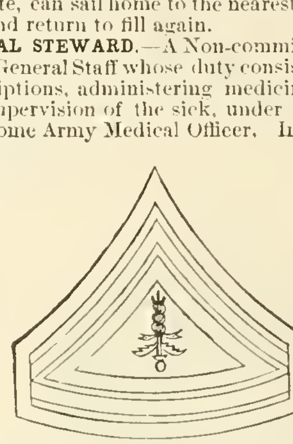
HOSPITAL FLAG.—A flag used to indicate the location of a hospital or ambulance. These flags in the United States Army are as follows: For general hospitals, yellow bunting 9 by 5 ft., with the letter H, 24 in. long, of green bunting, in center. For post and field hospitals, yellow bunting 6 by 4 ft., with letter H, 24 in. long, of green bunting, in center. For ambulance and guidons to mark the way to field hospitals, yellow bunting, 14 by 28 in., with a border, 1 in. deep, of green.

HOSPITAL FOR INSANE SOLDIERS.—The Insane of the military service are sent by Department Commanders, under proper escort, to Washington, where the patients are reported to the Adjutant General of the Army to procure the order of the Secretary of War. The application for admission to the Hospital should be forwarded in time to reach the Adjutant General at least one day before the arrival of the patient in Washington. The application sets forth a full description of the patient, and is accompanied by a certificate from a Medical Officer as to duration of insanity, whether developed before enlistment or employment in the military service, and, if possible, a diagnosis of the case. If the patient be a soldier, his descriptive list and clothing account is also furnished. On the departure of the patient from his station, the Commanding Officer gives such orders to the person in charge as will provide for the transportation of the necessary attendance to the Institution and back again to their posts, and for their subsistence, either in kind or by commutation, during their absence. To obtain the release of a patient when cured, or his delivery to the care of friends, application is made to the Adjutant General, accompanied by the recommendation of the Superintendent of the Hospital. After a soldier has, in the usual manner, been reported a fit subject for admission to the Government Hospital for the Insane, and is ordered to be sent to Washington, his Company Commander forwards, with his "descriptive list," certificates of disability made out and signed in the usual manner. The man is not discharged at the post, nor is the order given for his discharge by the Department Commander, but his discharge is ordered from the Adjutant General's Office, after his arrival at the Hospital.

HOSPITAL FUND.—The saving arising from an economical use of the rations of the sick and attendants in a hospital constitute the Hospital Fund. The amount is paid over to the senior Medical Officer at the station, and is accounted for and expended by him exclusively for the benefit of the men in the hospital, in the purchase of such articles of diet, comfort, or convenience as may be required, according to instructions received from the Surgeon General.

HOSPITAL SHIPS.—Ships fitted out as hospitals in all expeditions beyond the sea, for the care of the sick and wounded; they have been found invaluable in many foreign expeditions. In China, in 1860, four were fitted out, and ships for this purpose formed part of the expedition to the Gold Coast in 1874. They serve either as stationary hospitals or, if sick accumulate, can sail home to the nearest station, discharge, and return to fill again.

HOSPITAL STEWARD.—A Non-commissioned Officer of the General Staff whose duty consists in making up prescriptions, administering medicines, and in a general supervision of the sick, under the instructions of some Army Medical Officer. In the United



States Army, there is one Hospital Steward for each millitary post, and the Secretary of War may appoint from the enlisted men of the Army, or cause to be enlisted, as many Hospital Stewards, as the service may require. They are graded as 1st, 2nd. and 3rd class, are permanently attached to the Medical Corps, under such regulations as the Secretary of War may prescribe. The chevron worn by the Hospital Stewards is shown in the drawing. The senior Medical Officer of a hospital requiring a Steward may recommend a competent Non-commissioned Officer or soldier to be appointed, which recommendation the Commanding Officer forwards to the Adjutant General of the Army, with his remarks thereon, and with the remarks of the Company Commander. And, as the object of these more permanent appointments is to procure the services of a more competent body of Hospital Stewards, no soldier nor citizen must be recommended for appointment who is not *known* to be temperate, honest, and in every way reliable, as well as sufficiently intelligent, and skilled in Pharmacy, for the proper discharge of the responsible duties likely to be devolved upon him.

HOSPITAL TENT.—A large tent used for hospital purposes. It is usually made of heavy cotton-duck. In the United States service it is 14 feet long, 15 feet wide, and 15 feet high (center); with a wall 4½ feet high, and a *fly* of appropriate size. The ridge-pole is made into two sections, and measures 14 feet when joined. This tent accommodates from 8 to 10 persons comfortably.

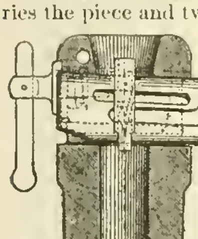
HOSPITAL WAGON.—A carriage on four wheels, having four or six springs, used for carrying the wounded of an Army. The Prussian hospital wagons are fitted up with combination cases, in which are packed everything supposed to be necessary in a hospital for wounded, including bandages, splints, drugs and anæsthetics, blankets, and an amputating-table, besides an assortment of tags, on one of which the surgeon writes his orders as to what is to be done in each case, attaches it to the patient, and leaves him to the care of others. Five ambulances, three supply-wagons (carrying food, bedding, and tents), and two Surgeons' wagons constitute a hospital-train for a division, and will accommodate 200 patients, requiring 13 Surgeons and 74 men for their care.

HOSPODAR.—A Slavonic title once very commonly given to the Governors of Moldavia and Walachia, whereas the Prince of Roumania is now known under the native Romanic title of *Domnu*. Another Slavonic term, *Wojewod*, was also given to the Hospodar, the term Wojewod signifying the right and dignity of leading the Army (being thus identical with Duke), while the Nospodar (Gospodar, Gospod, Gospodin, in the various Slavonic dialects) means simply, Master (Dominus). Formerly, the Lithuanian Princes were likewise called *Hospodars*, and the Polish Kings, down to the time of Sobieski, assumed this title in their diplomatic negotiations with Russia. *Gosudar* (Ruler, Monarch) is even now the title of the Emperor of Russia, and in conversation signifies Master.

HOSTAGE.—A person accepted as a pledge for the performance of conditions. When a town capitulates, victors and vanquished usually give into the custody, one of the other, several officers, as pledges that each party will duly carry out the terms stipulated. When the terms are fulfilled, the hostages are exchanged; but if the terms be evaded, the opposite side holds the right to put to death, or otherwise punish, the hostages in its possession. It is needless, however, to add that, in modern civilized warfare, the circumstances would have to be very remarkable indeed to be held to justify so cruel a measure as the execution of a hostage.

HOSTILITIES.—A rupture between the natives of different countries. The first hostile deed that is committed by either party is considered the commencement of hostilities. Between natives, the first act of hostility presupposes a declaration of war.

HOTCHKISS BREECH-LOADING MOUNTAIN RIFLE.—This gun, having been devised especially with reference to the mountain service, is made as light as practicable. It weighs only 116.6 lbs., and one man is able to place it upon the back of a mule. The weight of the carriage being but 220 lbs., the packing, unpacking, and mounting of the gun and its carriage require only two men. For transportation the material is distributed as follows: One mule carries the piece and two small chests containing accessories; another mule carries the carriage and shaft, and others carry the ammunition-chests. The construction of the Hotchkiss gun is based upon the use of a metallic cartridge, by which the obturation of the breech is accomplished. The extraction of the cartridge-case is effected automatically by the opening of the breech. The gun



is made of Whitworth steel, compressed in the fluid state. The mechanism of the breech consists simply of a prismatic bolt, with a cam, entering a cavity recessed in the breech. It is operated by a lever with handles, by which the bolt is withdrawn, or the reverse. As metallic cartridges are employed, a close fit of the breech-block is unnecessary, and the bolt is adjusted freely to its slot, which is an advantage over other breech-loading systems, which require great nicety in the fit of the breech-mechanism in order to insure a perfect obturation. The cartridge-extractor is a simple prismatic piece of metal, bearing at its forward extremity a hook; it is guided in a cavity in the upper part of the breech, parallel to the axis of the piece; on its lower face is fitted a tenon, which slides in a groove cut in the upper face of the breech-block. The groove is straight on the sides towards the handle, but curved at the other extremity—towards the opening for charging—so that in withdrawing the breech-block the tenon of the extractor slides for a time in the straight part of the groove, but as soon as the block is so far withdrawn that the opening for charging comes against the face of the chamber the tenon becomes engaged in the inclined portion of groove, and is suddenly drawn backwards, by which motion the empty case is thrown out of the gun. The movement of the breech-block is arrested by a stop-screw sliding in the recess upon the upper face of the block. The ammunition is composed of a metallic case which contains the powder, and is united to the projectile—an explosive shell by "choking," in the same manner as the cartridges for modern small-arms. The cartridge is of brass; the head being strengthened by cup-shaped reinforces. It is not primed, but is ignited by the ordinary friction primer. In the base of the cartridge is a valve formed by the cup reinforces; the gas from the primer opens the valve, which closes automatically, after the ignition of the charge, by the pressure of the gas inside, thereby preventing the escape of gas through the vent. The cartridge can be recharged, on an average, about eight times. The projectile is of a cylindro-ogival form, about 3½ calibers in length; it being furnished with a middle band of a soft brass, which takes the rifling. Upon the cast-iron body of the projectile are turned a number of grooves, of little depth and width, between which are narrow and sharp ridges. The band covers this portion of the projectile, and at the moment of firing the pressure of the gas which sursounds the projectile in the chamber molds exactly upon the brass the corresponding grooves and ridges that are on the cast-iron. This method of banding offers the advantage of securing a perfect adherence between the brass band and the projectile, and also permits regulating with great nicety the forcing whereby the friction necessary to produce rotation may be reduced to a minimum. The band of brass obviates the fouling of the bore. The piece can be fired a great many times without any necessity for using the sponge. The shells are fitted with percussion fuses of the Hotchkiss pattern. The following are the principal weights and dimensions:

Caliber	1.65 inches.
Length of bore	24.72 calibers.
Weight of piece	116.60 pounds.
Weight of carriage	220.00 pounds.
Weight of cartridge complete	2 pounds 10 oz.
Effective range	4,200 yards.
Number of helicoidal grooves	10
Twist (to the right)	49.21 inches
Depth of grooves (uniform)	0.12 inches

HOTCHKISS MAGAZINE-GUN.—This gun, invented by Mr. B. B. Hotchkiss, an American, lately residing in Paris, was first brought to this country by him in the spring of 1876, and exhibited at the Centennial, at Philadelphia. It was found necessary to make many changes in the arm originally introduced by Mr. Hotchkiss, and for these improvements patents have since been granted. The gun thus improved has been approved by two Boards of Officers, appointed by the Chief of Ordnance of the Army, for the purpose of examining small-arms. As now offered, it was a second time recommended for trial in the hands of the troops by the Ordnance Board of 1881-82. It embodies the experience of six years' manufacturing, and the valuable suggestions of many experienced officers who have used it in the field. It is a most simple and solid repeating-gun, capable of doing good service under the most disadvantageous circumstances. The drawing shows the working parts, with nomenclature, of the latest improved model of 1883.

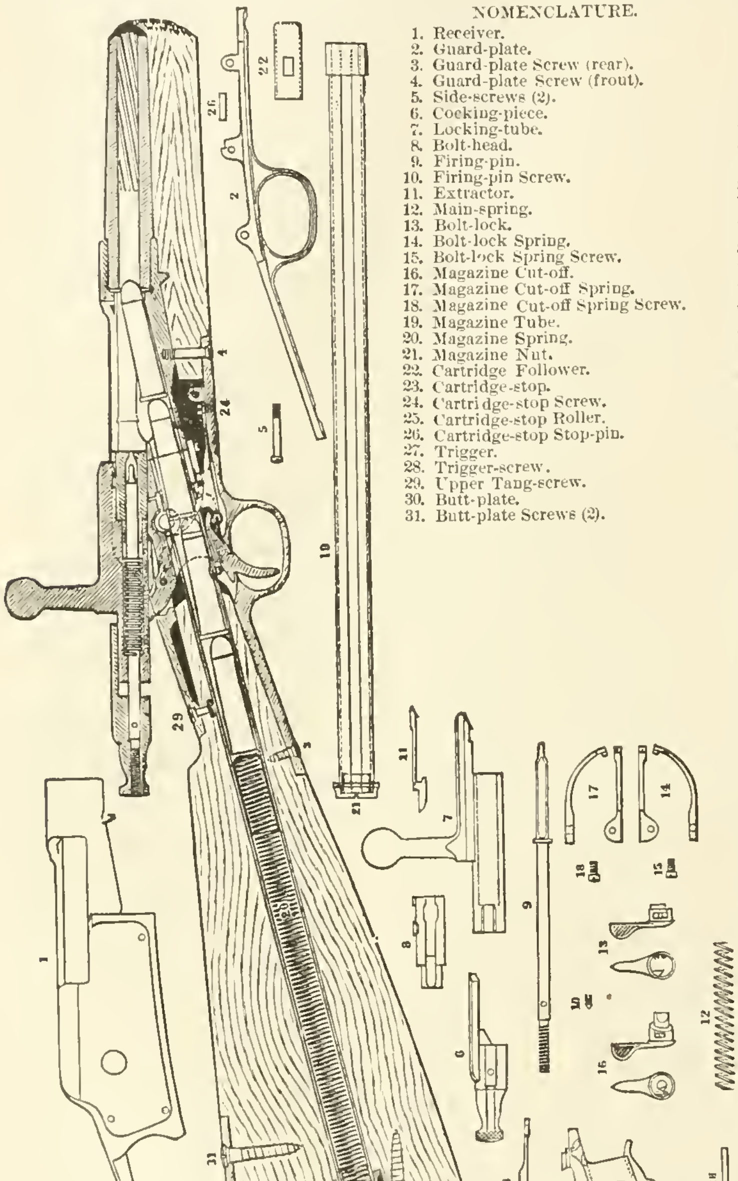
The operation of the gun is very simple. 1. To open the breech-bolt: Hold the stock firmly with the left hand a little in front of the receiver; and with the right hand raise the handle, and draw back the bolt, making but one motion. 2. Close the bolt by an inverse motion. This operation cocks the piece. 3. To cock the piece without withdrawing the bolt: Raise the handle as before, and immediately turn it down. 4. To load the magazine: Raise the handle, and draw back the bolt. Take a cartridge between the thumb and middle finger, placing the point of the fore-finger on the bullet; insert the head of the cartridge in the receiver, just in front of the point at which it narrows down, and press it back in the magazine until a distant click—the head passing the cartridge-stop—is heard. Repeat the operation until five cartridges have been inserted. Another may then be placed in the chamber.

The magazine may be unloaded in two ways:

1. Raise the handle, and draw back the bolt: the cartridge will be then thrown out. Holding the muzzle of the arm well up, push forward the bolt (do not turn it down), the thumb of the right hand pushing the knob of the cocking-piece, and pull the trigger. Draw back the bolt by the knob of the cocking-piece: and the cartridge will be pushed forward, and remain in the receiver. Remove the cartridge, and proceed as before. 2. Raise the handle; place the wrist of the right hand against the handle of the lock-tube, the thumb being extended across the bolt in front of the handle, and the fore-finger resting upon the barrel. Draw back the bolt (keeping the hand in the same position) by pressing the back of the thumb near the wrist against the front of the handle: remove the cartridge with the thumb and fingers, which are thus at liberty to receive it. Push forward the bolt (do not turn it down), and pull the trigger. Withdraw the bolt with the back of the thumb as before, and stop the cartridge coming from the magazine with the fore or index finger. Remove the cartridge, and proceed as before until the magazine is exhausted.

The magazine cut-off is found on the right of the piece, just in the rear of the bolt-handle. It serves to lock the magazine so that the arm may be used as a single loader while the contents of the magazine are held in reserve. When the thumb-piece is pushed forward, however, the arrangement of the mechanism is such that no cartridges can escape from the magazine to the chamber, and the weapon is practically a single loader. The bolt-lock is placed on the left side of the receiver, opposite the magazine cut-off, and serves at the same time to lock the bolt and the trigger in such a manner that the bolt cannot be turned or drawn back, nor the arm fired. To lock the bolt and trigger push forward the thumb-piece of the bolt-lock; this can only be done when the bolt is closed and the gun cocked. To unlock the bolt, push back the thumb-piece of the bolt-lock.

To dismount the gun:—1. Take out the bolt. To do this, raise the handle, and draw back the bolt until the forward end of the cocking-piece just clears the rear end of the receiver; then after letting go the handle, take hold of the cocking-piece, and turn it down to the right until the projection on the bolt-head leaves the groove under the front end of the locking-tube. The latter may then be drawn out at the rear, and the bolt-head removed at the front of the receiver. To return the bolt, the head must be inserted from the front, and the other part from the rear. 2. Take off the butt-plate, by removing the two butt-plate screws. 3. Take out the magazine nut. 4. Take out the magazine spring and follower. 5. Take out all the guard side-screws. 6. Take out the guard-screws and the upper tang-screw. 7. Take off the butt-stock, by drawing it backward from between the guard and upper tang, and off from the magazine tube. 8. Take out the guard. 9. Take out the bolt-lock and magazine cut-off springs. It will aid persons unacquainted with the gun, when endeavoring to replace these parts, to remember that the flat sides of the springs lie next the receiver. 10. Take out the bolt-lock and magazine cut-off. While these parts resemble each other exteriorly, it will be observed that the bolt-lock has a short pivot, and is assembled on the right of the arm, while the magazine cut-off has a much longer pivot, and is assembled on the left. 11. Take out the magazine tube. This is accomplished by drawing back the magazine tube from its seat in the frame, and turning it slightly to the right, so that it may



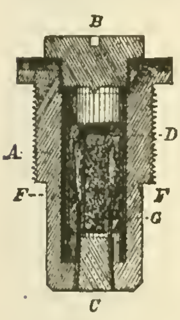
NOMENCLATURE.

1. Receiver.
2. Guard-plate.
3. Guard-plate Screw (rear).
4. Guard-plate Screw (front).
5. Side-screws (2).
6. Cocking-piece.
7. Locking-tube.
8. Bolt-head.
9. Firing-pin.
10. Firing-pin Screw.
11. Extractor.
12. Main-spring.
13. Bolt-lock.
14. Bolt-lock Spring.
15. Bolt-lock Spring Screw.
16. Magazine Cut-off.
17. Magazine Cut-off Spring.
18. Magazine Cut-off Spring Screw.
19. Magazine Tube.
20. Magazine Spring.
21. Magazine Nut.
22. Cartridge Follower.
23. Cartridge-stop.
24. Cartridge-stop Screw.
25. Cartridge-stop Roller.
26. Cartridge-stop Stop-pin.
27. Trigger.
28. Trigger-screw.
29. Upper Tang-screw.
30. Butt-plate.
31. Butt-plate Screws (2).

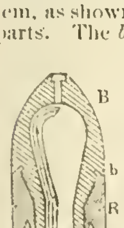
pass the trigger. 12. Take out the wiping-rod. 13. Take of the bands. 14. Remove the tip-stock. This is best done by separating the tip-stock, or fore-arm, from the barrel; first at the forward end of the tip-stock, separating them until the stud on the receiver is withdrawn from the slot in the rear end of the tip-stock. 15. Take out the trigger, by removing the trigger-screw. 16. Take off the barrel. This should be attempted only by persons provided with proper tools, as the barrel and receiver are very firmly assembled together. 17. The cartridge-stop may be dismounted from the guard, by unscrewing the cartridge-stop screw, and driving out, from the left to the right, the stop-pin.

To dismount the breech-bolt :- 1. Remove the bolt-head. To do this, hold the cocking-piece firmly in the left hand, and with the right turn down the handles as in the act of locking the bolt. The head will then slip off. 2. Turn out the firing-pin screw. 3. Slip the bolt-head partly on the projecting end of the firing-pin, and use it as a wrench to unscrew the pin. The main-spring may then be removed. 4. Remove the extractor by tapping gently on its projecting end with a piece of wood. To assemble proceed in the inverse order of the operations given above. See *Magazine-gun*.

HOTCHKISS PERCUSSION FUSE.—This fuse consists of a metal body, *A*, closed at the front end with a screw cap, *B*. It has a conical hole in the rear, which is closed with a lead plug, *C*, (the safety-plug), pressed in very tightly, so that the plug projects a little through the base of the body-case, toward the inside. The plunger, *D*, is composed of lead cast into a brass casing to strengthen it, and to prevent the lead being upset by the shock of discharge. Two brass wires, *F*, cast into the lead on opposite sides of the plunger, hold it suspended in the case, the wires going through the holes in the bottom of the case, and being held securely in position by the safety-plug. The plunger has a nipple cast into the lead, and is primed with an ordinary percussion-cap; in its axis it has a powder-chamber, *G*, which contains the igniting-charge. The operation of the fuse is thus: The safety-plug is dislodged backward into the interior of the projectile by the shock of discharge; the wires then being not held so tight in the hole, the plunger is disengaged and rests on the bottom of the fuse-case, and is free to move in the line of axis. When the flight of the projectile is suddenly retarded by its striking an object, the plunger, in consequence of its inertia, is driven forward, and the primer strikes against the screw-cap, thus igniting the powder in the channel, and so firing the bursting-charge of the projectile. See *Fuse*.



HOTCHKISS PROJECTILES.—Projectiles of this system, as shown in the drawing, are composed of three parts. The *body*, B, and the *cup*, C, are of cast-iron, and the *ring*, R, of lead. The ring is locked into the body and the cup by the grooves (b) and (c), all the parts being thus held securely together. The action of the charge is to drive the cup forward, thereby expanding the soft metal into the rifling of the gun, and at the same time binding the lead so that it cannot revolve upon the projectile; this last is assisted by a few grooves on the cast-iron under the lead. The amount of expansion is controlled by the distance the cup can move before coming in contact with the end of the body. All those projectiles with which time fuses are used have three longitudinal grooves on the outside, to insure the passage of the flame to the fuse. The ring, being placed much nearer the center of gravity of the projectile than if at the base, tends to steady the projectile in the bore, and increase the accuracy of fire. A Hotchkiss projectile, lately introduced for breech-loading guns, is of cast-iron, in one piece; a band of soft brass, about one caliber long, is forced into a recess in the projectile, situated well over the center of gravity; two longitudinal grooves prevent the band from turning. Upon the outside of the band is cut a number of saw-toothed grooves, to reduce the strain due to compression of the brass as the projectile is forced into the bore. See *Expanding Projectiles* and *Projectiles*.



HOTCHKISS REVOLVING CANNON.—The Hotchkiss revolving cannon cannot be classed with mitrailleuses in the ordinary sense of the latter term, as explosive shells are fired with the former, and it has a range equal to that of field-artillery. The system of this gun may be explained as follows; Five barrels, grouped around a common axis, are revolved in front of a solid breech-block, which has in one part an opening to introduce the cartridges, and another opening through which to extract the empty shells, while the cartridges are fired after being revolved and while motionless in front of the solid portion of the breech. Fig. 1. The exterior aspect of this revolving cannon resembles the Gatling mitrailleuse, it being, on the other hand, entirely different in its interior mechanism. The system is composed of two distinct parts, viz., the barrels with their disks and shaft, and the frame and breech containing the mechanism. The five barrels, made of the finest oil-tempered cast-steel, are mounted around a common axis, between two disks, on a central shaft. The series of barrels are in this way placed in a rectangular frame, which is attached to the breech, the near end of the shaft penetrating the same to receive the rotary motion from the driving-gear. Fig. 2. The breech of the revolving cannon is composed of a solid cast-iron breech-block, weighing about 386 lbs. This absorbs the greater part of the recoil. It has a door at the rear end, which can be easily opened, so that the mechanism is freely accessible, and can, if necessary, be dismounted and put back into its place in a few minutes, without the aid of any special tools. A peculiar feature of this gun consists in the barrels remaining *still* during the discharge, so that there is no movement of any kind to impede the accuracy of the fire. This stop or lost motion is obtained by the shaping of the driving-worm, which is so constructed that the inclined driving-thread only covers half its circumference, the other half of the thread being straight. The effect of this is that the barrels only revolve during half a revolution of the worm, and stand still during the other half revolution. The combination of the mechanism is so arranged that the loading, firing, and extracting takes place during this pause. This feature is of great importance for the accuracy of fire and the durability of the system. The worm-shaft projects through the breech on the right side, and has a crank with which the whole system is moved; on the left side of the worm-shaft a small crank is attached, by which the loading and extraction of the cartridge-shells are effected in the following manner: On the interior face of the left side of the breech a cog-wheel is mounted, with two horizontal racks, the one being placed above the other under this cog-wheel, and parallel to the axis of the barrels, so that in moving either of these racks the other is moved by the cog-wheel in the opposite direction. Part of the lower rack forms a vertical slot, in which the small crank on the left side of the worm-shaft works. The rotation of the latter consequently gives an alternating and opposite movement to the two racks, so that while the one is going forward the other moves back, and reciprocally.

The under rack forms the extractor; the upper one moves a piston which drives the cartridge into the barrels, the cartridge being placed before the piston, in the trough in which it moves; and during the time the barrels are motionless it is introduced into the one standing before the trough. The cartridge is not "driven home" entirely, but its head is in view of an inclined plane, cut into the metal of

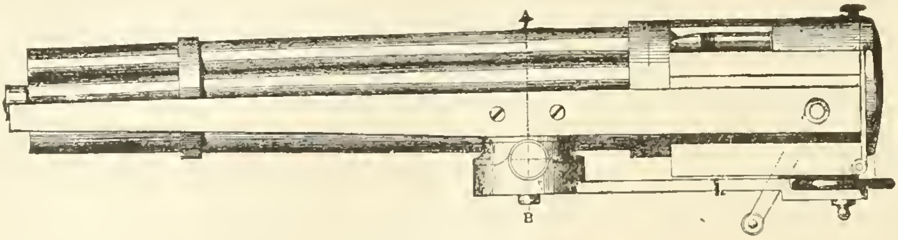


Fig. 1. Side Elevation.

the breech, on which it slides when it is moved by the rotation of the barrels. This completes the introduction of the cartridge into its chamber. The piston itself is a simple cylinder connected with the rack, and running in a slot in the conducting-trough. When the racks are in their extreme positions they

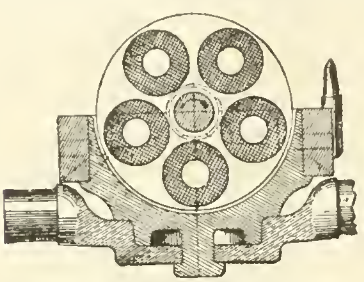


Fig. 2. Vertical Section through AB.

remain still a moment. This stop is obtained by giving the slot in its center part a circular shape concentrically to the shaft of the crank. This is necessary, because at the moment of the barrels arriving at the end of their course the head of the cartridge-case becomes engaged in the hooks of the extractor, which would not be possible if it were in motion at the time. The extractor is a large double hook at the end of the bottom rack; it is very solid,

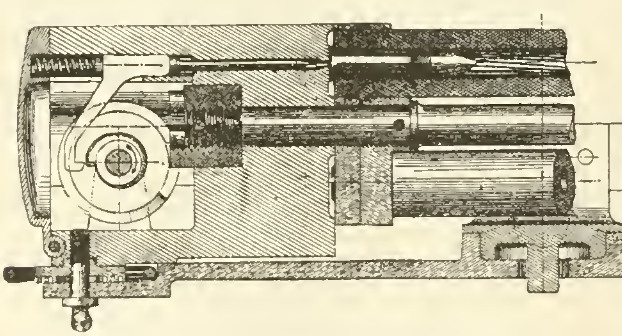


Fig. 3. Longitudinal Section Through the line of Axis.

and its proper working is certain under all circumstances. After the cartridge is extracted from the barrel it strikes against an ejector, which pushes it out of the extractor, and it falls to the ground through an opening in the under part of the breech. The firing-pin has an elongation, pointing downward, which, by the operation of a spring, is pressed against a cam on the worm, and as the worm rotates, the cam drives the firing-pin back and compresses the spring. The moment the firing-pin becomes liberated, it strikes the primer of the cartridge and the discharge takes place. To obviate the difficulties which exist in other systems, when the cartridges are piled one upon the other, the opening of the introduction-trough is closed by a little door, which goes down by the weight of the cartridges, the first of which drops into the trough, and then the piston in moving forward, raises the same door and allows no more cartridges to enter until at the proper time. All parts of the mechanism are very strong and durable, and hardly exceed in number those of an ordinary small-arm, there being, besides the group of barrels, thirteen parts, viz.:—1, 2. The breech-block, with its door for closing the rear end. 3, 4, 5. The crank-shaft, with its worm for moving the barrels, and small crank for working the loader and extractor. 6. The crank. 7, 8. The firing-pin and spiral spring. 9. The extractor. 10, 11. The loading-piston and rack for moving it. 12. The cog-wheel for transmitting the movement of the extractor to the loading-piston. 13. The door for regulating the feed of cartridges.

The operation of the mechanism may be described as follows, supposing the crank to be in continual motion: A cartridge is placed in the introduction-trough, the piston pushes it into the barrel, then the barrels begin to revolve, and the cartridge is carried on till it arrives before the firing-pin, which penetrates the solid part of the breech, and which has in the meantime been retracted by action of the cam. Fig. 3. Then, as soon as the cartridge has arrived into this position, the barrels cease to revolve, and the primer of the cartridge is struck by the firing-pin and discharged; then the revolution of the barrels begins again, and the fired cartridge-shell is carried on until it comes to the extractor; this, in the meantime, has arrived up to the barrels and the cartridge-head rolls into it. As soon as the head is laid hold of by the extractor, the barrels again cease to revolve, and during this period the cartridge-shell is withdrawn and dropped to the ground. As during every stoppage of the barrels the gun is supplied with a new cartridge, and the firing and extraction is also performed, during this time a continuous but slow fire is kept up. By supplying the gun in this manner with single cartridges, about thirty rounds per minute may be fired. Should rapid firing be required, the gun is then supplied, not with single cartridges, but with "feed cases," containing groups of ten cartridges each, and in this manner from sixty to eighty rounds per minute can be fired, with only three men to work the gun; viz.—one man to train the gun and revolve the crank; one man to place the "feed-cases" containing the cartridges into the "feed-trough"; and a third man at the ammunition-chest to charge the "feed-cases" and to hand them to the charger. Attached to the frame is a turn-table which connects the cannon to the "trunnion-saddle," arranged in such manner that without displacing the carriage a certain amount of lateral motion as well as of elevation may be given to the gun. Thus the gun is made to sweep horizontally along a line, by adjustment, between each single shot, or during rapid discharge.

The ammunition for the revolving cannon consists of a center-fire metallic cartridge of special construction, holding in each one the powder, the projectile, and the lubricating-wad, arranged like the similar ammunition generally used for small-arms. Two different kinds of projectiles are used, the one an explosive shell and the other a case-shot. Nothing need be said of the latter, as it does not differ from the common case or canister-shot used in ordinary cannon. The shell is of a novel construction; it is of cast-iron, of a cylindro-ogival shape, slightly rounded at the rear end. The packing consists of a brass coat of about one caliber in length, and placed equidistantly from the center of gravity. This coat is of soft brass tubing, contracted with great pressure over the body of the projectile, it being provided with longitudinal grooves, and two grooves encircling it at the top and bottom ends of the packing. The coating is forced into these grooves, and any disturbance of it on the body at starting is thus jectile, and the rifling is impressed on the ribs only covered by the tubing. Its dimensions and weights are as follows: Length of body, 3.66 inches; entire length with fuse, 4.27 inches; length of brass coating, 1.5 inches.

The cartridge-case is composed of a spirally-rolled tube of sheet-brass, strengthened at the head with an inside and outside cup. The head is punched out of sheet-iron, and is fastened to the cups with three rivets. The primer consists of a case holding the anvil, and is closed at the bottom end by the cap containing fulminate; it is fitted into a hole which penetrates the head and both cups, and it projects through into the inside of the cartridge-case. This cartridge, which can be manufactured with great facility, on account of its simplicity, has proved itself to be of a very durable quality, and it can be used repeatedly. The construction of the body of

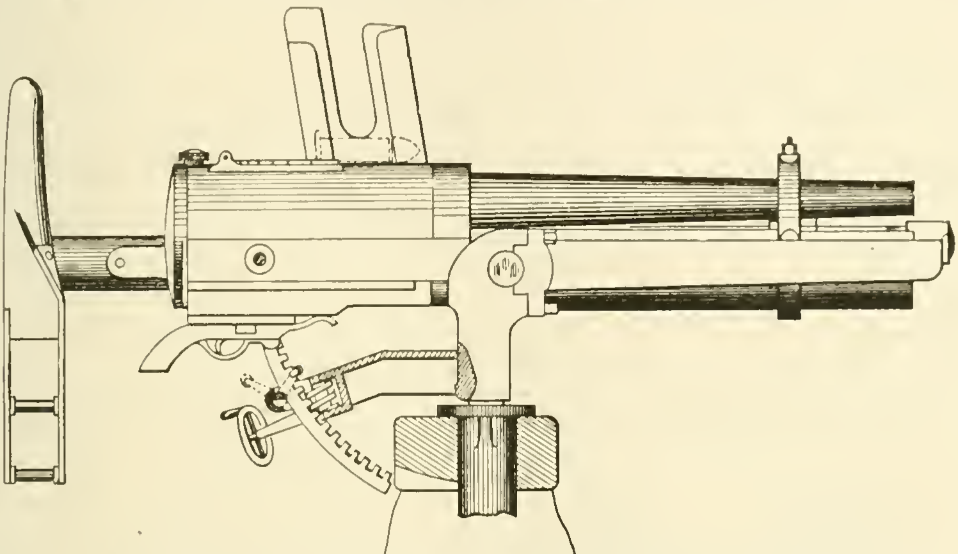


Fig. 4. Hotchkiss Revolving Cannon, with Shoulder-piece, Pistol-grip Stock, and Firing-trigger.

obviated. These grooves serve at the same time as breaking-lines of the shell. After the coating is attached to the projectile, some small saw-tooth-like grooves are cut into it, to reduce the strain while being forced through the rifling of the barrel. These grooves can be filled with a lubricating substance, and this is then carried perfectly between the projectile and the bore of the barrel. The coating of the projectile is conical at its front part, corresponding with the cone in the projectile-chamber, so that it is exactly centered in the bore as soon as the forward movement commences. Its rear end is cylindrical to within about one-third of its length. The shell is turned smooth all over, and is nearly 0″.016 in diameter less than the bore of the barrel. This projectile is made with great care and exactness, with only a very small deviation in dimension.

The fuse employed is that known as the Hotchkiss percussion-fuse, used in large quantities during the last war in America, and described above. The improved Hotchkiss shell is with its fuse a little less than three calibers in length, or about seven-sixteenths inch shorter than the one just described, from which it differs, with the above exception, in the following particulars only: The new shell has four circumferential grooves separated by ribs about one-twentieth inch wide, and longitudinal cuts between ribs. The tubing, about one caliber in length and one-sixteenth of an inch thick, instead of being corrugated on the exterior, as in the old shell, is perfectly smooth, and is contracted into place by a *slight* pressure only. The gas from the discharge presses the packing so firmly into the grooves and cuts that it cannot rotate independently of the pro-

the cartridge allows it to expand to the chamber of the gun without the metal being stretched, so that after the discharge it contracts itself again to its previous diameter, thus leaving the fired case perfectly loose in the chamber for extraction. The lubricator consists of a wad of felt about 0″.236 thick, dipped in a solution of mixed tallow and beeswax. A paper disk is placed between the lubricating-wad and the charge to prevent the powder getting damaged by the greasy surface of the lubricator. The projectile is merely pressed into the neck of the cartridge and is not clenched, as there is enough friction to hold it absolutely secure. Of course the ammunition is, as in the case of all of the modern small-arm ammunition, which it resembles, rendered safe against influences of weather and danger of explosion. The following are the principal dimensions and weights, etc., of the gun.

Caliber	1.457 inches.
Total length of bore	4 feet 2.236 inches.
Length of rifling	3 feet 8.882 inches.
Rifling, one turn in	4 feet 1.212 inches.
(Twist and depth of groove uniform.)	
Number of grooves	12
Width of lands	0.098 inches.
Depth of grooves	0.019 inches.
Number of barrels	5
Diameter of barrel over powder-chamber	3.464 inches.
Diameter of barrel at the muzzle	2.440 inches.
Weight of each barrel	77.166 pounds.
Radius of sights	2′ 3″·047
Vertical distance of the line of sight from the common axis of the barrels	2.0866 inches.
Horizontal distance of the line of sight from the common axis of the barrels	6.496 inches.
Weight of gun	1,047.25 pounds.
Total weight of gun with traversing apparatus	1,157.48 pounds.

For the revolving cannon a special carriage has been constructed. This was found necessary, as the ordinary field-gun carriage is not provided with the means for procuring an excellent and immovable rest for this gun. The trail of the carriage consists of two brackets of steel-plate, connected by three transoms and bolts, the rear end being connected by the trail eye-piece. The brackets diverge against the trunnions. The trunnion-bearings, and the bearings for the axle-tree, are riveted to the outside of the brackets and are fitted in the ordinary manner. The axle-tree is of steel, the arms being slightly conical. The wheels have metallic naves and ring-tires. The nave consists of two parts, the inside flange, with the pipe-box, and the outside flange. The spokes are cut in a conical form at their "hub" ends, so that they fill the nave-flanges, and the two parts of the nave are bolted together with the spokes with six screws. These wheels are very strong, and have been found practical and economical in service, and they allow spokes to be easily substituted for others when broken.

The elevating arrangement consists of a screw working in a gun-metal nut, resting in the oscillating bearing. This nut is revolved by conical gear-wheels from the left side of the trail, the top-end of the screw being attached to the trunnion saddle-plate. The handspike is hinged to the trail so as to fold back in traveling. A tool-box is placed between the trail; this at the same time makes a solid connection of the trail-brackets. The carriage of the revolving cannon is usually provided with a light steel shield for the protection of the gunners from small-arms fire. This shield is of three parts, made to fold together, thus forming seats for two men. It can immediately, when coming into action, be unfolded, and only the muzzles of the barrels and the wheels of the carriage are exposed to the enemy. The steel plates are about 0.236 inch in thickness. Two boxes are attached to the axle-tree, each to carry three feed-cases loaded with ten rounds of ammunition. On the carriages not provided with a shield, these ammunition-boxes are protected by light steel plates in front, and have a lid of steel, which, when raised, forms a small protecting-shield, and when closed they form seats for two gunners, so that with two or three gunners on the limber a sufficient number of men to serve the piece would be taken into action with the gun itself.

The gun shown in Fig. 4 is intended specially for use against torpedo boats, and is mounted on the rail of a ship, as shown in the drawing. The recoil is taken up by the pivot, and the gun is so nicely balanced as to be easily trained by the gunner, who stands with his left shoulder against the "cross" or breech extension, and with his right hand grasping the pistol stock at the right of the gun has as complete control of the weapon as if it were a fowling-piece, or the gun may be held by the rack. See *Machine-gun.*

HOTCHKISS SHELLS.—The first variety has three walls, parallel, or nearly so, with each other, and united to a solid base. In producing it, the middle wall, is first cast by the ordinary process. This wall is then suspended upon a core-piece, whose dimensions are such as will leave a space between its exterior and the interior surface of this wall, equal to the thickness desired for the inner wall. This core and middle wall are then suspended in a mold of the common construction, which mold has an inner contour the shape of the exterior of the complete shell. The metal poured into this mold envelopes the middle wall, and forms the shell as shown in Figure 1. The object of this peculiar form of construction is to produce a shell which will be broken into a larger number of pieces than shells of the ordinary construction. Near the forward and rear ends of the cylindrical portion of the shell cannelures are turned to receive the packing or soft brass bands, which are pressed and crimped into place. The base of the shell is slightly chamfered.

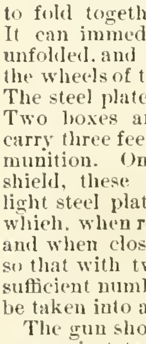


Fig. 1.

The Hotchkiss field-shells of ordinary pattern, as shown in Figure 2, are one inch longer than those described above, and have greater powder capacity. They are cast in the usual way for casting shells, and have the same general shape as the triple-wall shells. The packing as originally made consisted of a soft brass tubing about 4 inches in length, running for nearly two-thirds the length of the cylindrical portion of the shell; it was pressed and crimped into a recess turned on the shell to receive it. Cannelures were turned on the exterior of the tubing to diminish the bearing portion of the packing to be cut through by the rifling of the gun. Before these shells were fired, and to insure suitable rotation, Mr. Hotchkiss had added a smooth brass tubing about $1\frac{1}{4}$ in. long, which was also pressed and crimped into the recess turned for it. In turning this recess two annular rings were left. An examination of the results of a recent experimental firing shows an average of 17.4 hits per shot for the triple-wall against 10.4 for the common shells. The liability to premature explosion or breaking up in the gun seems to be about as great for one as for the other. Experiment fully demonstrates the superior destructive effects of the triple-wall over the common shell. See *Shells.*

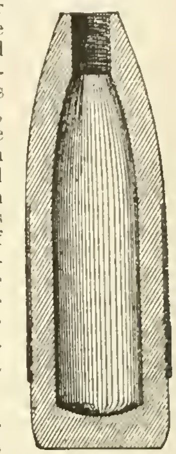


Fig. 2.

HOTEL DES INVALIDES.—An Establishment in Paris, maintained at the expense of the State, where a number of old French soldiers are quartered. Its chapel contains the tomb of the great Napoleon, and is an object of much attraction to all visitors. It was founded by Louis XIV. in 1671, and during his reign and for a long time afterwards was a place of retirement for the aged servants of Court Favorites as well as Invalided Soldiers; but this abuse was put an end to by St. Germain in Louis XV.'s reign. In 1789 the Hôtel had a revenue of £68,000, but during the time of the Republic its property was alienated and the Institution supported from the public revenue. The Hôtel can accommodate 5,000 men, and the actual number of inmates is not much below this. See *Soldiers' Homes.*

HOT-SHOT.—Hot-shot may be fired for the purpose of setting fire to vessels or buildings, though they are rarely used. Shot of low gauge should be chosen for this purpose and with reduced charges. They can be made red-hot in from 15 to 30 minutes, but care must be taken not to bring them beyond a *bright red,* as they are then liable to fuse and become misshapen. The part resting on the furnace-bars heats more quickly than the upper part, so they must frequently be turned. Shot expand $\frac{1}{16}$ of their diameter when brought to a red-heat; therefore, to prevent any accidents, each shot should be passed through a red-hot shot-gauge before being taken from the fire-room. Should the shot jam in the bore it must be cooled by pouring water in at the muzzle; but if that fails, the charge must be drowned before attempting to blow out the shot.

Junk and grommet-wads which have been soaked in water for two or three hours, having the water pressed out of them, are to be used in loading. The junk-wads must be small enough to fit easily when swelled by being soaked. The cartridge must be perfectly tight, so that powder will not be scattered along the bore. Sufficient elevation having been given to enable the shot to roll home, first enter the cartridge, a dry junk-wad, and then a wet junk-wad, and ram them home. Bring the shot in a bearer and enter it, with a wet grommet-wad on top; since it cools rapidly, no time should be lost. Quantities of smoke will come up through the vent, but a red-hot shot does not burn more than the outer yarns of a well-soaked junk-wad, even if left in the gun till it becomes cold. See *Fireworks* and *Projectiles*.

HOT-SHOT FORK.—A fork made of iron, fastened to a wooden handle, and is used to pull the shot out of the furnace. It has two prongs, which curve inwards and upwards, so as to retain the shot between them when once in position.

HOT-SHOT WADS.—Wads for firing hot-shot, and other like purposes, may be made of hay wrapped with rope yarn, and are made in the same way as junk-wads; or they may be made entirely of hay, by twisting from the hay a rope of an inch or an inch and a half in diameter, and then commencing at one end and doubling it up about one caliber in length, and twisting it all the time, until it becomes nearly large enough, when the rope is to be wound around the wad perpendicular to its axis, and fastened with a hitch.

HOTTE.—A sort of hand-basket, which is often made use of in the construction of batteries and other works, and serves to carry earth from one place to another. Hence the word *hod*, a well-known contrivance for carrying bricks.

HOUGINES.—Parts of ancient armor covering the thighs, legs, and arms.

HOUNDS.—1. Pieces of wood used in the construction of limbers for gun-carriages to connect the splinter-bars with the axles. 2. The blood-hounds employed for military purposes. The Russians have strengthened their army by the novel addition to each company of a pack of powerfully and carefully trained dogs. These watchful animals are sent out with the sentinels on picket duty, where their chary ear and still keener scent prove an impregnable barrier to the lurking spies of the enemy. The dogs used are a species of blood-hound from the Ural Mountains. The dog is selected because of its habitual silence. It growls but never barks—a matter of the first importance to soldiers near an enemy's camp. The Ural hound is gifted with an exceedingly fine sense of smell, keen ears, and is ever alert. Most comforting of all to the lonely picket the dog is said to be especially courageous in defending its master. It is curious that, with the example of the King Charles spaniels before us, no one thought before of using these intelligent animals as sentinels. The value of the plan is self-evident. The Muscovites have gone further, and are training swift hounds as well as these same Ural dogs, to act as dispatch bearers, much as the carrier pigeons were employed in 1871. They certainly would be hard messengers to catch, when stealing through the woods at night. See *Blood-hound*.

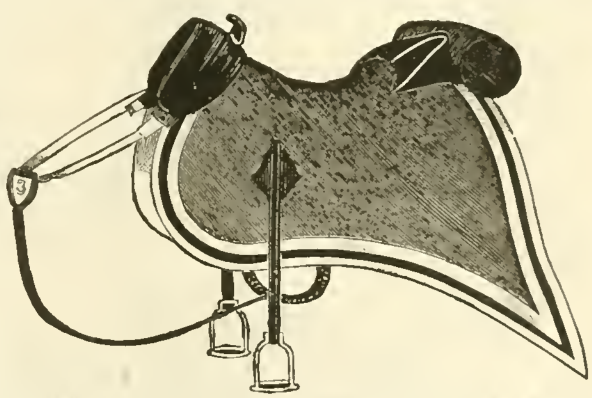
HOURGLASS.—A glass vessel filled with sand, and compressed and attenuated at its center into the shape of the figure 8, whereby the sand can only run through the connecting orifice in a given time. This vessel is contained in a wooden stand. Formerly each English regiment was furnished with this hourglass; and even at the present day native regiments in India use it. A common mode of keeping the time by native guards is by means of a metal bowl having a small hole in the bottom of it, which is allowed to swim on the surface of the water, and to fill in the space of an hour. This rough and ready mode of ascertaining time, though not always correct, gives a near approximation to the lapse of an hour. This nature of time-clock was the first instrument to measure the lapse of time independently of the sunshine. A simple time-keeper is also kept, but the arrangement is inverted, the bowl being filled with water, and the water allowed to escape into a receptacle in the same space of time, through a hole in the bottom of the bowl.

HOURS OF SITTING.—The hours during which a Court-Martial is authorized to hold its sessions. The law provides that the proceedings of trials shall be carried on only between the hours of eight in the morning and three in the afternoon, excepting in cases which, in the opinion of the Officer appointing the Court, require immediate example. In the latter case, the order appointing the Court-Martial must clearly state that "The Court is authorized to sit without regard to hours."

HOUSE.—A term anciently applied to the blocks of wood or frame structures, upon which the early bombards were fixed. See *Fust*.

HOUSEHOLD TROOPS.—Those troops whose especial duty it is to attend the Sovereign, and to guard the Metropolis. These forces comprise three regiments of cavalry—the 1st and 2d Life Guards, and the Royal Horse Guards, and three regiments of Foot Guards (which include seven battalions), the Grenadier, Coldstream, and the Scots Fusilier Guards. The cost of these corps, for pay and allowances only, reaches the sum of £230,000 a year; and they number in all ranks 1,302 cavalry and 5,950 infantry, who are justly held to be the flower of the British Army.

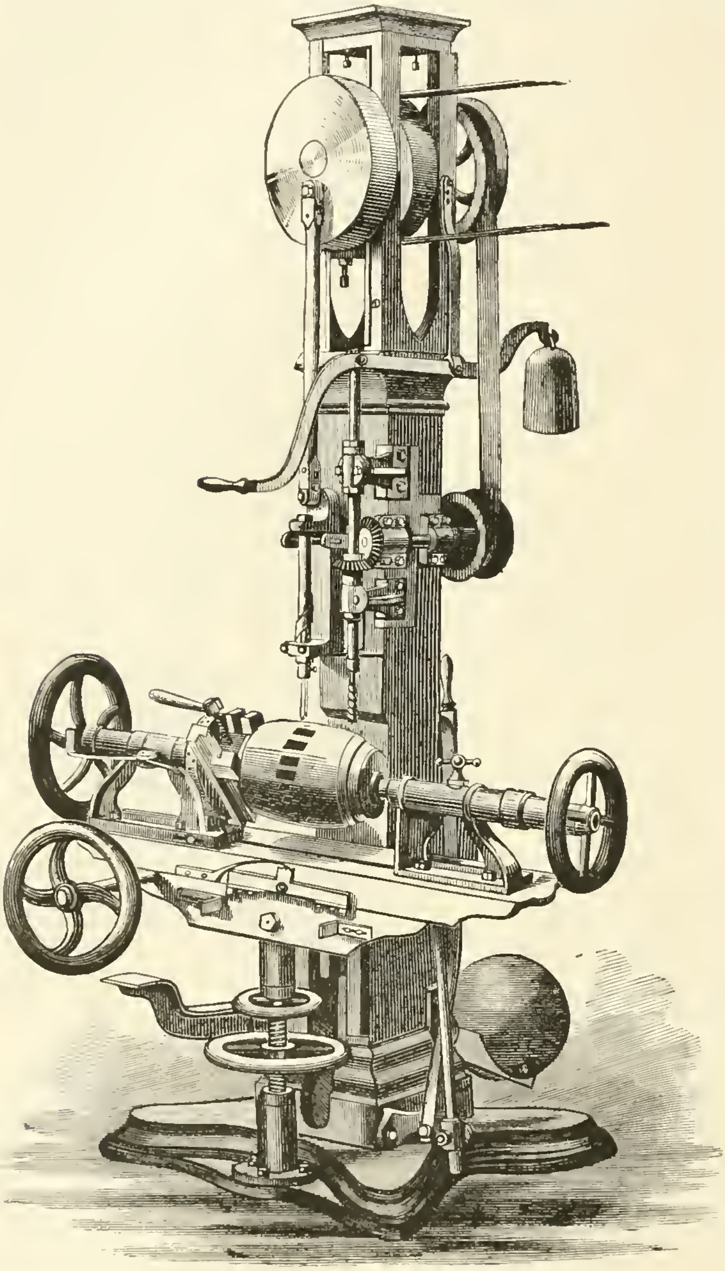
HOUSING.—The cover or cloth over or under a horse's saddle, used for cleanliness or as an ornamental or military appendage. In the United States Army, housing is prescribed as follows: *For General Officers*—To be worn over the saddle; of dark blue cloth, trimmed with two rows of gold lace, the outer row one inch and five-eighths wide, the inner row two inches and one-fourth; to be made full, so as to cover the horse's haunches and to bear on each flank corner the following ornaments, distinctive of rank, to wit: *For the General of the Army*—A gold embroidered spread eagle with two stars and "Arms of the United States" between them; *For Lieutenant General*—A gold embroidered spread eagle and three stars; *For Major Generals*—A gold embroidered spread eagle with two stars; and *For Brigadier Generals*—A gold embroidered spread eagle and one star. See *Saddle-cloth*.



HOWITZER.—From the earliest days of artillery there existed short, chambered pieces, which projected stone balls under great angles of elevation. In 1478, an attempt was made to use in these pieces, hollow projectiles filled with powder, to which was attached a burning match to set the powder on fire; but it is probable that the accidents which accompanied their use caused them to be abandoned for the time. In 1634, however, means were devised to overcome this difficulty; and, thus perfected, these pieces were introduced into the French service as a class of cannon now known as mortars. In the reign of Louis XIV., a great variety of mortars were used;

and some of them, called Comminges, after their inventor, threw bombs weighing 550 pounds. Early attempts were also made to throw hollow projectiles from perrieres and culverins, or guns; but great difficulties were experienced in loading them, and the accidents to which they were liable, as in the case of mortars, caused them to be abandoned. Subsequently, however, the Dutch artillerists conceived the idea of reducing their length, so that the projectile could be inserted in its place by hand; and, thus improved, these cannon rapidly came into use, under the name of howitzers, from the German, *Haubitz*. The howitzer combines in some degree the accuracy of a cannon with the caliber of a mortar; and, while equally effective at short ranges, is far more portable than either. That the powder, on its expansion, may act with full force on the shell, it is confined in a hemispherical chamber of smaller diameter than the rest of the bore, the mouth of which is completely closed by the shell when rammed home. The Coehorn howitzer, much used in India for mountain service, is a small gun, light enough to be borne by a horse up hilly defiles, etc. See *Howitzer*, *Ordnance*, and *Twenty-four-pounder Howitzer*.

HUB MORTISING-MACHINE.—A machine in which a wheel-hub is held upon a mandrel or stake, so disposed that a reciprocating chisel may cut therein the mortises for the spokes. The hub is dogged or clamped so as to prevent rotation while the mortise is being cut, and is then rotated at a determinate number of degrees to present the next spot. The drawing shows a power hub mortising-machine used in making the wheels for gun-carriages and Government wagons. Those hubs to be mortised are held fast in a screw-chuck, one end turning in cups fitted to each size. The chuck has a dial attached to it, accurately spaced for 10, 12, 14, 16, and 18 spokes, thus obviating the necessity for setting out the mortises. The bed also has stops which regulate the length, and is arranged with a lever and stops, to give any required bevel or dish to the mortise. It is supported by a standard, bolted to the base of the machine, making it firm and solid, and is raised and moved for the mortise by hand-wheels. The chisel is reversed by hand, and brought down by the new double lever or treadle, which is very easy for the operator. The bit-shaft has the new arrangement of lever and weight for working it, and is driven direct from the counter-shaft. The machines are complete in every respect, and are made in the best possible manner. This size works hubs 12 by 16 inches and under. It can be fitted with a bed for common mortising, if desired. The counter-shaft has tight and loose pulleys, 12 inch diameter, 4 inch face, and should make 350 revolutions. The counter-shaft should be placed on a level with the pulley in top of machine, and 8 or 10 feet distant. Weight of machine, 2,600 lbs. See *Mortising-machine*.



HUE AND CRY.—In Great Britain, the Official Gazette, which serves to advertise deserters from Her Majesty's service. The phrase is derived from the old process of pursuit with horn and voice, used in English law to describe the pursuit of felons. Whoever arrested the person thus pursued was so far protected that he required no warrant to justify the arrest; and even if the party turned out to be no felon, no action could be brought if the arrest was *bona fide*. But it was not only a ground of action, but an offense subject to fine and imprisonment, to maliciously and wantonly raise the hue and cry against a person. It was the duty of all persons to join in a hue and cry, and if a person who had been robbed, or knew of a robbery, failed to raise the hue and cry, he was liable to fine or imprisonment, or, according to some authors, to indictment. Hue and cry is now substantially abolished.

HUISSIER D'ARMES.—Tipstaff; an officer so-called in France, who was attached to the Royal Household. They were at first distinguished by the name of *Sergens d'Armes*, or Sergeants-at-Arms. Some were directed to bear the mace before the King during the day, and obtained on that account the appellation of *Huissiers d'Armes;* in later times they were called the Huissiers, or Tipstaffs of the King's Chamber. Others kept watch in the King's bed-chamber during the night, and were sworn to expose their lives for the safety of his person, whence they obtained the name of *Archers de la Garde*, which term was changed to *Gardes du Corps*, or the Body-guards.

HULK.—A name given to any old ship unfit for sea-service, which is used in harbor as a depôt of some sort. In the great naval harbors, there are coal-hulks, powder-hulks, convict-hulks, and hulks to which the crew of vessels repairing are turned over.

HUMETTY.—A term in Heraldry, applied to a cross or other ordinary which is cut off, and nowhere reaches the edge of the shield. See *Heraldry*.

HUNS.—The name of a considerable nation of antiquity, which, from time to time, made incursions upon the Roman Dominions, and which eventually, under Attila, the most renowned of all its leaders, brought the Empires of both the East and the West to the very verge of destruction.

The Huns were of Asiatic origin, and, in all probability, of the Mongolian or Tartar stock; therefore akin to, and perhaps to be identified with the Scythians and Turks. According to De Guignes, whose theory has been accepted by Gibbon, the Huns who invaded the Roman Empire were lineally descended from the Hiongnou, whose ancient seat was an extensive but barren tract of country immediately to the North of the great Wall of China. About the year 200 B. C., these people overran the Chinese Empire, defeated the Chinese armies in numerous engagements, and even drove the Emperor Kao-ti himself to an ignominious capitulation and treaty. During the reign of Vou-ti (141-87 B. C.), the power of the Huns was very much broken. Eventually they broke into two distinct camps, one of which, amounting to about 50,000 families, went Southwards, while the other endeavored to maintain itself in its original seat. This, however, was very difficult for them to do: and eventually the most warlike and enterprising went West and North-west in search of new homes. Of those that went North-west, a large number established themselves for a while on the banks of the Volga. Then crossing this river, they advanced into the territories of the Alani, a pastoral people dwelling between the Volga and the Don. At what period this took place is uncertain, but probably early in the 4th century. The Alani, who had long dwelt in these plains, resisted the incursions of the Huns with much bravery and some effect, until at length a bloody and decisive battle was fought on the banks of the Don, in which the Alan King was slain, and his army utterly routed; the vast majority of the survivors joined the invaders.

HUNTING HORN.—The Hunting Horn or Bugle Horn is a frequent bearing in Heraldry. When adorned with rings, it is said to be *garnished*. If the mouth and strings of the instrument are of different tincture from the horn, this must be named in blazon. See *Heraldry*.

HUNT LIFE-SAVING PROJECTILE.—This apparatus consists of a projectile and a tin can known as the shore-can. It is intended for life-saving purposes, to be used in connection with a gun or mortar of suitable dimensions.

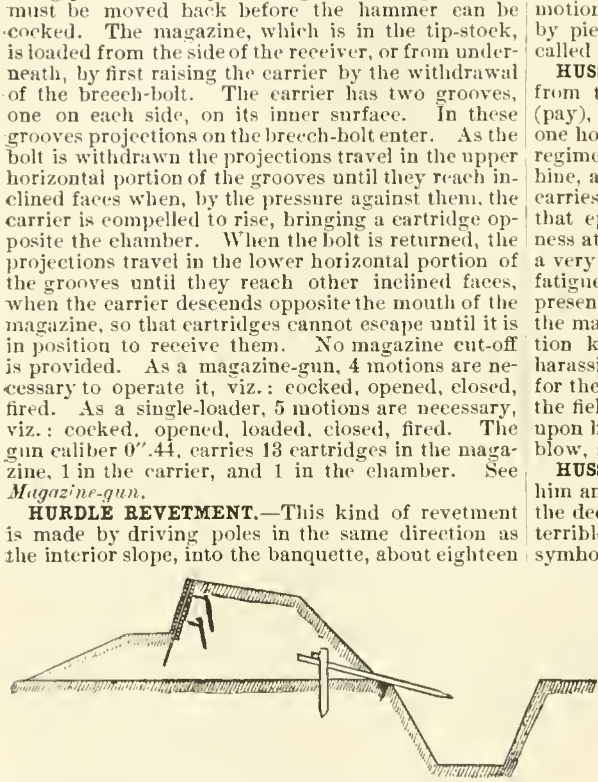
The body of the shot or projectile is composed of a tin tube closed at the front end by a disk of iron. The head or point is made of lead cast upon the end of the tin tube. The lead extends up the sides of the tube, forming a thin coating for a distance of 3″.2 from the plane of the head. The diameter of the flat head is 2.9 inches, but when fired expands to the full size of the bore. The tube is reinforced for 6 inches of its length above the lead with a galvanized sheet-iron tube. The object of this reinforce is to strengthen the tube and prevent upsetting when fired. Near the rear end of the tube four trapeziform pieces of tin, termed "wings," are soldered to the tube at right angles to each other and equidistant circumferentially for the purpose of guiding the projectile in its flight after the manner of the barbs of an arrow. About 250 yards of small line is coiled on a spindle in a lathe, after passing through a saturating solution of paraffine. This coil is wrapped with a thickness of laboratory paper, and as soon as withdrawn from the lathe-spindle is placed in the tin tube. The exterior end of the line is made fast to a wire loop which projects from the rear end of the tube. The wire is soldered to the tube. The rear end of the tube is then closed with a wooden plug one inch in thickness and of the same diameter as the inside of the cylinder. An axial hole one inch in diameter serves for the line to pass through in escaping from the shot. A paper disk is pasted over this end of the projectile, which must be removed before firing in order to secure and withdraw the end of the line.

The shore-can contains the shore-line and is made of tin. It is a short cylindrical tube, of greater diameter than the body of the shot. The lower end is closed by a bottom of the same material as the cylindrical body. To the bottom a ring is attached in which is tied a line, or through which a stake is driven, to prevent the can from being carried off in firing. Holes are punched through the bottom over each side of the ring-seat, through which the end of the line belonging to the outer coil is passed and tied to secure the line to the can. This shore-can contains about 250 yards of small line, coiled in a lathe and saturated with paraffine in the same manner as the line in the shot. After coiling, the line is placed in the can and the tin cover put on. The cover has a central hole 1″.6 in diameter through which the line is paid out. A strip of laboratory paper is pasted around the can so as to overlap the junction of the cover and body of the can and prevent the removal of the former. A paper disk, which must be broken before firing, is pasted over the hole in the top.

The method of using this apparatus is as follows: Suppose the gun, projectiles, and shore-can placed on the firing-ground and the gun in position for firing. Insert the powder-charge, tear the paper cap from the rear end of the projectile, and draw out a couple of feet of the line: place the projectile in the bore with the flat leaden head first. Then tear the paper cap from the hole in the top of the shore-can and pull out about 2 feet of line; tie the ends of the line together and place the shore-can near the gun on the windward side. The proper elevation is then given to the piece, the priming-wire inserted in the vent, a friction-primer put in, and the gun fired. See *Life-saving Rockets*.

HUNT MAGAZINE GUN.—This gun belongs to that system in which a fixed chamber is closed by a bolt, by direct action. The receiver has a slot in its upper surface for the purpose of loading the chamber direct when the piece is used as a single-loader; it is also bored through at the rear for the reception of the breech-bolt. The latter is composed of two parts, the body and the locking-tube, which are connected by a left-hand screw-thread. The bolt is locked by two lugs, turning in corresponding cuts in the receiver. These lugs are so shaped on their rear surfaces as to cam the bolt against the base of the cartridge during the locking. A cam on the inner surface of the rear end of the locking-tube forces the bolt slightly to the rear, starting the shell, during the unlocking. The opening of the joint in the breech-bolt (the thread being left-handed) during the locking aids in the camming forward of the bolt, while the closing, by drawing the forward portion to the rear, aids the starting of the shell. When the bolt is withdrawn the extractor, which is of the spring-hook pattern, pulls on the upper side of the head of the shell while the under side abuts against a forked post. By this means the shell is thrown clear of the gun. In order to insure the ejection of the shell a quick motion of the bolt is necessary. The forked post acts also as a guide for the breech-bolt. A slot in the rear of the bolt receives the nose of the hammer, allowing it to strike the firing-pin only when the piece is locked. A slide prevents the hammer being pulled back by catching of clothing, etc. It must be moved back before the hammer can be cocked. The magazine, which is in the tip-stock, is loaded from the side of the receiver, or from underneath, by first raising the carrier by the withdrawal of the breech-bolt. The carrier has two grooves, one on each side, on its inner surface. In these grooves projections on the breech-bolt enter. As the bolt is withdrawn the projections travel in the upper horizontal portion of the grooves until they reach inclined faces when, by the pressure against them, the carrier is compelled to rise, bringing a cartridge opposite the chamber. When the bolt is returned, the projections travel in the lower horizontal portion of the grooves until they reach other inclined faces, when the carrier descends opposite the mouth of the magazine, so that cartridges cannot escape until it is in position to receive them. No magazine cut-off is provided. As a magazine-gun, 4 motions are necessary to operate it, viz.: cocked, opened, closed, fired. As a single-loader, 5 motions are necessary, viz.: cocked, opened, loaded, closed, fired. The gun caliber 0".44, carries 13 cartridges in the magazine, 1 in the carrier, and 1 in the chamber. See *Magazine-gun.*

HURDLE REVETMENT.—This kind of revetment is made by driving poles in the same direction as the interior slope, into the banquette, about eighteen



inches below the tread, and then forming a wicker-work, by interlacing twigs between them in a similar manner to basket-work. The poles should be nine inches apart, and their diameter about one-and-a-half inches. They should be secured to the parapet by long withes. The drawing shows a hurdle revetment and fraise. See *Revetment.*

HURDLES.—Straight and flat rectangles of strong wicker-work, about 6 feet long, and 2 feet 9 inches high. They are useful in many ways, both in military and civil life, either as fencing, as barriers, or in fortification, in the construction of *hurdle-batteries.* These last were the invention of Sir William Congreve, who devised them as the speediest means of throwing up earthworks; three hurdles are fastened at their ends in the form of a triangle, and the central space is filled in a short time with earth. These triangles can be constructed to any ground-plan, and with their aid, a body of soldiers can intrench themselves in a few minutes. The hurdle is composed of wattles interwoven round stakes or pickets, the latter during the manufacture being fixed upright and firmly in the ground.

HURRAH.—A shout of encouragement and applause, characteristically English. It serves also as a war cry. As an engagement at sea commences, the crews of the English vessels send up deafening hurrahs; in a charge on shore, the English soldiers hurrah when they rush upon the enemy. There is something strangely exciting in this simple sound, and the combatants work themselves, as they shout, into a frenzied forgetfulness of danger.

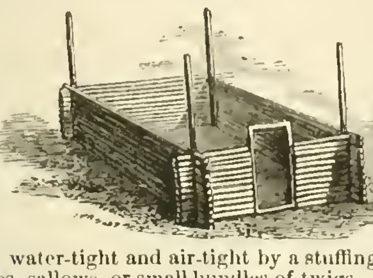
HURST.—A charge in Heraldry employed to represent a small group of trees, generally borne upon a mount in base.

HURTER — HEURTER — HEURTOIR. — A square beam placed at the foot of a parapet where there is an embrasure to prevent the wheels from injuring the interior slope, when the gun is moved in battery. A short fascine or fagot is sometimes used as a substitute for the beam. A hurter is placed on the front part of a siege platform, under the wheels. The motion of gun-carriages is checked, front and rear, by pieces of wood or iron, bolted to the top-rails, called *hurters* and *counter-hurters.*

HUSSARS.—Light cavalry. The name is derived from the Hungarian words *husz* (twenty), and *ar* (pay), because every twenty houses had to provide one horse-soldier. In the British Army there are 13 regiments. The men are armed with a saber, carbine, and pistol. The weight the horse of a hussar carries is about 18 stone. The dashing bold hussar, that epitome of military impudence and recklessness at the tavern, should present those qualities in a very sublimated form on the field. Regardless of fatigue and danger, his imagination should never present to itself an obstacle as insurmountable. On the march, constantly at the enemy's heels; in position keeping him at all moments on the alert, harassing him either with fatigue, or apprehension for the security of his rear and communications: on the field careering with a falcon's speed and glance upon his quarry, however it may seek to elude his blow, such should be the hussar.

HUSSITES.—The followers of Huss. Honoring him and Jerome of Prague as martyrs, they despised the decrees and anathemas of the Council, and took terrible revenge on the Priests and Monks. The symbol of their Confederacy was the cup, the use of which in the Lord's Supper they extended to the Laity, as James de Misa had already done with the approbation of Huss. In 1417 King Wenceslaus was constrained to grant them the use of many churches. After his death, August 13, 1419, the majority of the States refused to acknowledge his brother, the Emperor Sigismund, who had broken his safe conduct to Huss. And the papal instructions to the Cardinal Legate, John Dominico, requiring him to employ violent measures for the conversion of the Hussites, an insurrection ensued, and the war began which is known in history as the Hussite War. Convents and churches were reduced to ashes, and Priests and Monks were slain. The Hussites divided into two parties—the *Calixtine* and the *Taborites.* See *Huss et la Guerre des Hussites,* by Ernest Denis (1879).

HUT.—A structure more or less rough in its details, for the housing of troops. It is substituted very often for the tent, when the sojourn in a camp or cantonment is likely to be of consideration, as, for instance, through a winter—a hut, however rude, which is wind and water-tight, being as superior in comfort to a tent as the latter is to the open air. Huts may be made of almost any size, and are sometimes for one officer; at others for as many as one hundred men. The principal hut encampments in England are Aldershott, Shorncliffe, Colchester, and the Curragh of Kildare; in British North America, hut-camps are situated at intervals of a day's march on the route from New Brunswick to Quebec, and the troops who made that winter-march in 1861 to 1862 found their shelter truly welcome. The quarters occupied by the United States troops on the American frontiers, are very frequently huts made of timber by the troops. A good hut may be readily constructed on suitable ground or hillside by excavating and covering with a roof; but if timber is convenient, it is better to build a *log* hut, covering with bark skins, bushes, reed mats, sea-weeds, or any suitable material procurable. In building the hut four poles are planted in the ground where the corners are to rest. The logs are then piled one above another against these poles, as shown in the drawing, being notched where they cross so as to bring their sides together. The space between the logs is then



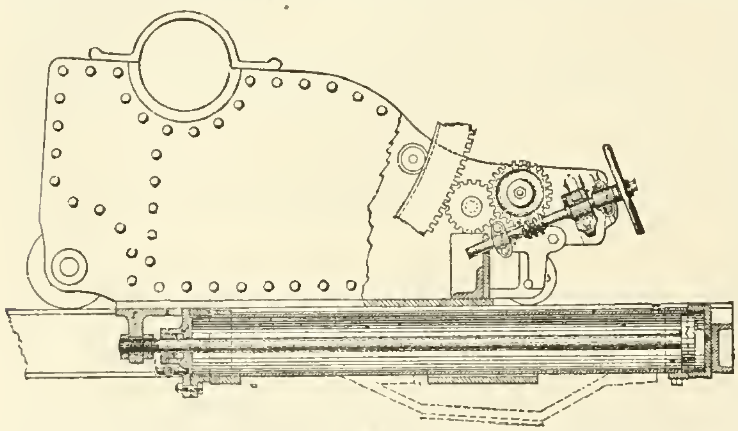
made water-tight and air-tight by a stuffing of clay, wattles, sallows, or small bundles of twigs. Within, the joints should be lined with laths, or the whole be supported by a scantling, and may consist of overlapping boards, or boards laid flush and shingled, or laths and shingles, or even birch-bark alone. The door is usually ledged, and there are one or two windows, with glazed sashes and shutters. A hut thus formed makes a snug habitation, and will last for many years; exclusive of the sashes, two men can erect in about a week, a hut of rough logs which shall be sufficiently large for their residence—that is, with an interior area of about 15 feet. When circumstances permit the logs are occasionally squared, which enables them to be fitted more accurately to each other, and adds, of course, to the solidity and finish of the whole structure, as well as to its durability. In this case the corner logs, instead of crossing each other, are joined by a dovetail, or cutting the end of each to an angle of 45°. The *framed* hut has the advantage over the log hut of allowing more exactness of finish, and from its lightness and portability being easily transported to any place where logs for hut-building may not be forthcoming. It consists of a strong framework of squared wood, properly fitted together, and covered with overlapping planks or weather-boards. The pieces should be sawn to the proper size, fitted to each other, and numbered; then packed together in small compass for conveyance to the intended site, where the structure can soon be erected. It is usually estimated that one of these huts, 30 feet long, 16 broad, and 10 high, makes a good barrack-room for 20 soldiers. The camps at Aldershott and the Curragh are mainly formed of framed huts. Where extra warmth is desired, the spaces between the uprights are built up roughly with bricks, burned or unburned. *Pisé* huts, common in the south of France, and very useful where wood is scarce, as well as very comfortable, are walled with blocks of clayey earth, and rammed with great pressure into wooden molds until they assume the forms of stones. These are laid one above the other much as stones themselves would be by a mason, and the wall so formed is both durable and sightly. The most critical operation for the non-professional hut-builder is roofing. This is usually thatch, shingles, paper, or felt, if lightness be an object; and of stones, bricks, or tiles, if the walls be calculated to bear their pressure. A roof of split logs gouged out in the center, like a long curved gutter, is good. A layer is placed side by side, with the hollow side up, and a second layer is put on them, with the hollow side down. The roof should have a pitch of not less than 45° to keep out the rain. All cracks should be carefully filled with grass, mud, clay, etc. The huts of Indians and all Savages are generally round or approximate to the circular form, probably because of the maximum house for a minimum cover. In building huts, it might be well to remember that logs split better from the crown or small end toward the butt.

HYDER.—The Arabic term for lion. This title is frequently given to men of rank in India.

HYDRAULIC BUFFER.—A recoil check, in construction very similar to the air-cylinder. A liquid is used instead of air, but the principles of operation are similar. This buffer is, at present, furnished only with the converted guns in the United States service. In its usual form it consists of a cast-iron cylinder 78 inches long, with an interior diameter of 8 inches, closed at either end by a cast-iron cap. Near the rear end of the top of the cylinder is a hole for the purpose of filling it with water, or some non-freezing liquid. A hole in the front end, closed with a screw-plug, permits the fluid to be withdrawn. Nine and one-half gallons (precisely) of fluid are required. A wrought-iron piston-rod passes through the rear cap, and is secured to the rear of the top-carriage by a wrought-iron cross-head. The piston-head, of wrought-iron, 15 inches thick, is pierced near its circumference, on opposite sides of the rod, with two holes seven-eighths of an inch in diameter. These holes flare out both ways 25 inches, allowing free passage to the fluid from the rear to the front of the piston, permitting the top-carriage to run back without strain. Upon the top of the rear end of each rail of the chassis of No. 3, is bolted a wedge or incline, having a rise of 2.5 inches in 64 inches; near the rear end of this, is attached a brass angle-plate, to which are secured three rubber counter-hurters. A similar angle-plate with hurters is attached to the front part of the chassis. Water or any other free-flowing liquid answers for filling the cylinder. In cold weather a non-freezing liquid, as a mixture of glycerine and water, methyl and water, or some of the non-freezing oils, must be used. The greatest care must be observed to have in the cylinder the exact amount required. The difficulty of properly regulating all of these matters makes the hydraulic buffer greatly inferior to the air-cylinders.

The recoil of the gun is controlled in all Prussian carriages for the land service by the Hydraulic Buffer. As generally used, it consists of a wrought-iron lap-welded cylinder, with cast-iron cover-cap and flange, and wrought-iron piston-head and rod, a packing-gland and emptying-cock of brass. The cylinder is 77.375 inches long in the clear, and 8.07 inches in diameter, and holds 12 gallons 5 pints. The cap closes the rear end, being screwed on. The flange is screwed on the front end, and the cover is bolted to the flange. Both the flange and cover are flat on top, to allow the top-carriage to pass over them without striking. To secure perfectly tight joints, a mineral composition is spread over the screw-threads of the cylinder before the cap and flange are put on, and the same, mixed with chopped hemp, is laid between the flange and cover before they are bolted together. The packing used to make a tight joint around the piston-rod consists of a piece of tow about 1.25 inches in circumference and 3 feet 7 inches long, greased with tallow, and wound round the rod and pushed into the recess in the cover. It is held in place by the packing-gland, which is made to squeeze the packing by being screwed into the cover until the rod can be just moved by the strength of one man. A zinc pan is suspended from the front end of the cylinder to catch any oil that may drip from the gland in firing.

A filling-hole is bored and tapped in the upper surface of the cylinder near the rear end, and is closed by a wrought-iron screw-plug, which is secured to the chassis by a short chain. An emptying-cock of brass is provided in the lower part of the cover. The piston-head, 8.04 inches in diameter, has four holes drilled in it, each 1.25 inches diameter, for the 7-inch gun: .9 inch for the 9, 11, and 12-inch, and .8 for the 10-inch, and .7 for the 12-inch of 25 tons. The piston-rod screws into the head, and is prevented from turning by a screw. The collar-nut screws on to the rod a few inches from the end, and the connecting-nut on the extreme end. The cross-head is held between the two nuts, with a play of about one-tenth of an inch, and the hole in the cross-head for the piston-rod is made oval, to allow of the top-carriage being thrown on its truck-wheels without bending the piston-rod. The cylinder is secured to the chassis by means of iron bands which pass over the cylinder, and are bolted down to the rear bottom-plate at the rear end, and at the front end to a bearing-plate which is bolted to the diagonal braces. The rear bottom-plate and the lower flange of the rear transom are hollowed out to form a bed for the end of the cylinder. The top flange of the rear transom is cut away from the cap of the cylinder. The cylinder, before being bolted down on the chassis, is brought to bear squarely against the rear transom, with the flat edges of the flange and screwed into a piece to which the cover is held by screws. There is a hole in the bottom piece for filling the cylinder; it is stopped with a screw and a cock in the cover for emptying it. The piston-head, with four holes bored in it, fits the cylinder closely, and to it the piston-rod of cast-steel is fastened, and passes through the cylinder-head, the joint being packed with hemp-packing and bronze packing-box. The end of the piston-rod is fastened to the cross-head, which is bolted to the bottom transom of the top-carriage. The Hydraulic Buffer operates in this manner: The cylinder is filled almost full with glycerine, which is preferable to water in that it does not evaporate or freeze. A certain amount of air is always left in the cylinder. In the recoil of the carriage the piston-head connected to it by the piston-rod and cross-head compresses the glycerine in the



rear end of the cylinder, and causes the liquid to flow rapidly through the holes in the piston-head, gradually bringing the carriage to a state of rest. The air in the cylinder acts as a cushion when the gun is fired, and lessens the shock which is then communicated to the different parts. The resistance of the liquid to a slow motion of the piston-head being very small, no difficulty is experienced in running the gun slowly into battery.

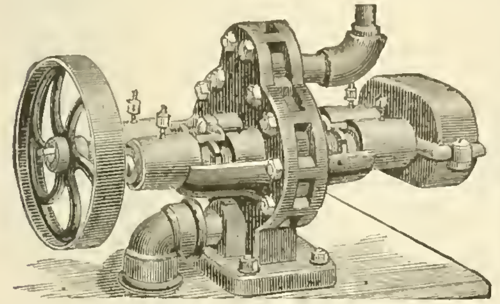
The Hydraulic Buffer should be the object of especial attention, although there is little to do to it after it has been secured in its place in the shops. First, attention should be paid to the preservation of the glycerine in the cylinder at its proper height, which can be discovered at the filling-hole. If the glycerine falls below the prescribed depth, it does not matter from what cause, it must be replenished. For this purpose, take out the filling-hole screw and insert the funnel in the hole. The purest glycerine is always to be preferred, of a density of 1.19, which neither evaporates nor freezes, even with the greatest cold, and has no action on the metals. In cases of emergency the deficiency may be made up with pure water without altering its qualities sensibly, but this addition of water should never exceed one-fourth of the whole. In filling the cylinder the prescribed quantity marked in figures on the end should under no circumstances be exceeded. In some carriages the proper height of the glycerine is marked by a screw. To prevent it from leaking, it is absolutely necessary, in the first place, to keep the filling-hole screw always tight by wrapping it with a hempen thread, with white lead or tallow when necessary; secondly, to tighten the hemp packing whenever the least leaking of the liquid is observed, by screwing up the packing-gland; and, thirdly, to keep the emptying-cock always tight and well closed. It is advisable to close it with a wooden plug. Before the firing, the carriage, and particularly the hydraulic buffer, should, as far as possible, be minutely inspected, the bolts, nuts, etc., which may have got loose tightened up, and the working of the different parts tested. See *Pneumatic Buffer*.

HYDRAULIC CRANES.—Wherever a large number of cranes have to be worked near each other, water-power is by far the most manageable, economical, and convenient method of working them. Sir W. Armstrong & Co., of Newcastle, have taken the lead in introducing this kind of machinery. They have fitted up a great many railway goods stations with complete systems of hydraulic cranes.

The pressure usually employed in working the hydraulic cranes is greatly in excess of the pressure admissible in the case of steam. Six or seven hundred pounds to the square inch is usually employed as the working pressure. It is got up to this great pressure by means of an arrangement called an accumulator, which consists of a large hydraulic ram of 16 or 18 inches in diameter, carrying a wrought-iron cylinder. This cylinder is filled up with stones or gravel to the weight of 60 or 70 tons. A powerful horizontal steam-engine forces water into a cylinder and slowly raises the ram with its enormous load. Pipes lead away from the cylinder to the cranes in the different parts of the station, and are thus supplied with water under the great pressure caused by the load forcing the ram into the cylinder. The load is constantly rising and falling a little as these cranes draw their supplies from the cylinder. If the cranes were supplied direct from the force-pumps of the steam-engine, without the intervention of this accumulator, their action would be jerky and unsteady. The accumulator acts as a reservoir of power, and when it happens that a great number of cranes are drawing off water at the same moment, and in excess of what the engine force-pumps can supply, the ram descends, keeping up the while the full 700 lbs. pressure; and then, when the cranes are demanding less abundant supplies, the engine overtakes its works, and sends the ram up again. When it arrives at the top it touches a lever communicating with the throttle-valve of the engine, and thus slows or stops the engine when the accumulator has mounted to its maximum height. The moment it begins to descend, the lever is relieved, the throttle-valve opens, and the engine goes on again with such speed as the work demands. See *Cranes*.

HYDRAULIC ENGINES.—These engines are frequently used in foundries and arsenals, where water of a high pressure is obtainable. They do not differ in any essential particular from a steam-engine. As the pressure under which they work is from five to ten times greater than that of a steam-engine, they are much smaller. A common form is that of three small cylinders in which three plungers work. The water is admitted into the cylinders by means of valves, and forces the plungers outwards. These plungers are connected with a three-throw crank, and when they have completed their outward travel, or working-stroke, the water is allowed to escape from the cylinder, the plunger then slides inwards, to be again forced outwards by a fresh rush of water admitted at the proper instant into the cylinder by the action of the valve.

Roots Rotary Hydraulic Engine, extensively used in the United States and abroad, is represented in the drawing. In order to realize the full benefits that may be derived from this, or any other Hydraulic Engine, it is of the utmost importance that the supply or feed-pipe be sufficiently large to deliver the water to the engine when running, at the same pressure as at the mains. Anything less than



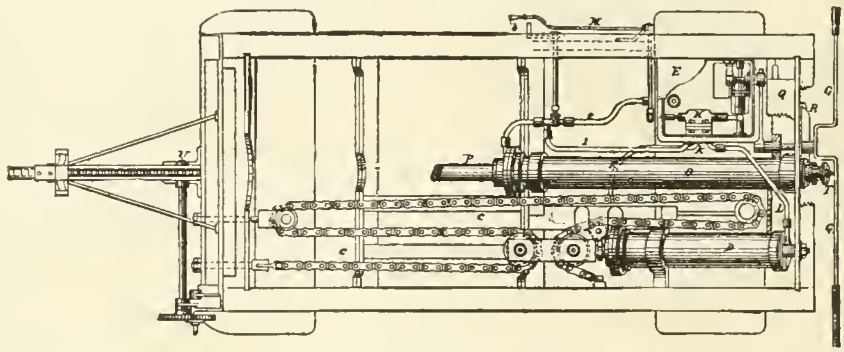
this cripples the engine, and causes it to use an unnecessarily large amount of water. In a long service-pipe of small size the pressure is so reduced by the friction of the water in passing through the pipe, that though it may supply a sufficient volume of water, it would be at such a diminished pressure that it would have but little power; for instance, if an engine used fifty gallons of water per minute, with forty pounds pressure per square inch at the mains, and yet by the use of a small service-pipe, reduced the pressure at the engine when running to ten pounds per square inch (which is often done), it is evident that while the same quantity of water is used, that only one-fourth of the useful effect would be obtained from it, that would be if the same pressure was maintained at the engines as at the main. It is also plain that to do the work that could be done with the 50 gallons at 40 pounds pressure, that four times as much water would be required at 10 pounds pressure, or 200 gallons; thus plainly showing that with a given work to be done, much less water will be required with a large pipe than with a small one, hence the importance and economy of having the feed-pipe amply large. This engine being a pressure-engine, the water is confined and cannot escape until it has exerted its whole force in turning the engine. When the engine does not turn, no water is discharged except from a slight leakage. It can only receive and use a sufficient quantity of water to fill the engine, each revolution. The engine is a water-meter as well as a water-engine, therefore the quantity of water used is not determined by the size of the pipe, but by the number of revolutions of the engine. If the pipes were ten times as large, the engine would not use any more water per revolution than with a very small pipe, but the amount of power resulting from a given amount of water would be in proportion to the difference in pressure, as shown before.

The engine should be placed on a solid foundation perfectly level from end to end, and be firmly secured, so that it will not get out of position from the strain of the belt or other attachment. But care must be taken to have an equal bearing on the foundation; otherwise, when it is fastened down, it will be on a strain and cause it to work hard. Care must also be taken in fitting on the feed and discharge-pipes, and making the connections, that they are not on a strain, for this may also spring the machine and cause it to run hard. The discharge-pipe should always have a syphon or trap between the engine and the sewer-pipe into which it discharges, for the purpose of keeping the discharge-pipe full of water, by keeping out the air. The size of the pulley should be such that, when all the machinery is on that the engine is to drive, and running at full speed, the regulating-valve should be wide open. If the speed is too high, the driving-pulley should be enlarged; if too slow, it should be diminished.

HYDRAULIC FORGING.—Forging with the hydraulic-press instead of the hammer and anvil. The process is analogous to that of rolling. The advantages claimed for the process are that it is, in many operations, more expeditious than the ordinary modes, and also that it produces a better structural condition of the particles of the material, the force being less superficial than the sudden impact of a hammer, and moving the particles of matter near the center to a greater extent, thus rendering the forged bar more homogeneous. Every forger and observant person has noticed that in the ordinary mode of forging a bar of iron there is, when the bar is thick enough, a protrusion of material at the edges, leaving a groove in the middle of the thickness, because of the superficial portions of the iron bar having received the greatest spread. Rolling or forging by pressure avoids this. Forging by hydraulic pressure is practiced in Europe. At Vienna there are several presses in operation, one with a piston 24 inches in diameter transmitting a pressure of 2,400,000 lbs.

HYDRAULIC GUN-CARRIAGE.—The renowned 35-ton Hydraulic Carriage was constructed at Woolwich, under the direction of the Commanding Officer of the Carriage Department. A detailed description of this carriage will suffice for all others. The hydraulic apparatus with which it is provided is used to check the recoil in firing, run the gun into battery or from battery, and also to traverse the carriage to the right or left. These different operations are performed by means of two hydraulic cylinders, O and D, and the double-action pump in the reservoir, E, which contains a mixture of alcohol and water. The pump, worked by means of the brake, G, drives the liquid into the distributing-chest, H, which sends it through the tubes, I K L, either to the front end of the cylinder O, or to one or other end of the cylinder D. The desired position of the valve is given by means of the lever, M, attached to the right side of the chassis. The cylinder, D, has a piston, the rod of which is fastened to the chain *c, c*, which engages a wheel mounted on the same axle as the pinion that drives the bevel wheels, intended to give motion to the rear traverse-wheels. The motion of the piston in either direction carries the chain, *c*, with it, thus causing the pinion to turn, and by its means the traverse-wheels. To traverse the carriage to the right or left it is sufficient to turn the distributing-valve so as to send the liquid on one or the other face of the piston, and then to work the pump by means of the brake, G. The chain moves on the wheel with a velocity four times greater than that of the piston; a slight motion, therefore, of the latter is sufficient to traverse the chassis through a considerable arc. A piston is also fitted to the cylinder, D, which is used to check the recoil in firing, and to run the gun into battery. The piston has a leather packing on either face, and the front end of the rod is fastened to the carriage. The front end of the cylinder is placed in communication with the distributing-chest by a pipe, and the rear end by a passage, R, with a second reservoir, Q. The passage, R, can be contracted more or less by a conical valve, which is regulated by means of the regulator, I. To use the apparatus as a hydraulic buffer, close the communication of the front part of the cylinder, O, with the pump through the distributing-valve, H, and reduce the section of the orifice for the stream according as circumstances may require. When the gun is fired, the carriage as it recoils forces the piston in, and drives the liquid into the reservoir, Q, through the opening around the conical valve: the recoil is checked as in the ordinary hydraulic buffer, by the resistance that the liquid meets with in passing through the narrow orifice. The entire distance through which the valve may be moved is one inch, and the part of the valve-stem that projects is graduated into tenths of an inch. In firing with maximum charges the valve-stem is turned in up to the division of eight-tenths.

To run the gun from battery without firing, it is sufficient to open the communication of the pipe, I, with the pump, and to work the latter. The pressure of the liquid on the front face of the piston forces it into the cylinder, O, and draws the carriage, being attached to the rod, P, back with it. The liquid which is in rear of the piston escapes as before, but without meeting any resistance in its passage around the conical valve on account of the slowness of the motion. To run the gun into battery,



the front of the cylinder, O, and the tube, T, are placed in communication with the discharge-pipe by means of the distributing-valve, H. The carriage then runs into battery of itself by reason of the inclination of the rails of the chassis. Its velocity is checked by the resistance that the liquid meets with in passing through the tube, T. If it be wished that the gun shall run into battery more quickly, a special tube, *c*, is provided, of larger cross-section, which allows the water to pass more quickly; it will be sufficient to open the valve, by means of the handle, to reduce the time of running in to a few seconds. By turning this handle the motion of the carriage may be regulated at pleasure, and it may be even stopped at any point on the chassis by closing the valve altogether. The ordinary position of the valves is that represented in the drawing, the apparatus being arranged for running the gun from battery. The liquid which is forced by the pumps passes into the tube, T, while K, and L, communicate with the discharge-pipe. If the valve be moved farther to the right, L, remains in connection with the discharge-pipe, N. T is closed while one of the orifices of admission comes opposite the outlet, K. If, on the contrary, it is pushed to the left, I, and K, communicate with the discharge-pipe, and L, with the other opening. These two extreme positions of the valve correspond with the traversing of the chassis in one or other direction, and the last also to running the gun into battery automatically. A direction-plate is attached to the chassis on the right side, giving the positions of the lever, M, corresponding to those of the valve for traversing the gun to the left, from battery, gun to the right, and into battery. One man at the valve-lever and two men at the pumps are sufficient to execute all of the maneuvers, though it is preferable to have four men at the pumps. The time required to traverse the gun through an arc of 54° is two minutes, and the same for running the gun from battery 6½ feet. The loading apparatus is decidedly novel. It is composed essentially of a chain with the links constructed like the joint of a carpenter's rule, so that it can turn only in one direction, while it is as stiff as a solid rod in every other. The links of this chain are made as follows: The angles of the links on top are square, while those underneath are rounded; two adjoining links thus abut against each other when an effort is made to bend the chain outward, while it can be readily bent in the opposite direction. It is guided in its motion by a kind of tube inclosed between two sheet-iron plates. A spur-wheel and pinion supply the means of raising the tube out of its bed, and raising the chain up to the bore of the gun. The tube is held at a convenient height by a pawl. A rammer or sponge is fitted to the front end of the chain according as it is wished to load or sponge the piece, and by working the crank-handles the chain is forced down the bore as if it were a rigid staff. The trials with this arrangement have given satisfactory results. A still more original mode of loading, based on the use of a pneumatic apparatus, has been applied to a 65-ton gun in the experimental casemate battery at Woolwich. This arrangement has the advantage of requiring only very little room. See *Sea-coast and Garrison Carriages*.

HYDRAULIC JACK.—A machine which often takes the place of the jack-screw for raising heavy weights. It is simply a form of hydraulic press, which may be placed beneath heavy ordnance, or any great weight which it is desired to raise, and generally consisting of a stout frame furnished with upright grooves, in which a follower may be forced upward by a hydraulic cylinder. By proper appliances the power may be rendered almost immeasurably great. The enormous multiplying power given by this machine has been employed for a great variety of useful purposes such as compressing bales of cotton, paper, etc., expressing oils, bending of iron plates and bars, and raising weights. This was the means employed for launching the *Great Eastern*, at Millwall, and for raising to their position the tubes of the Britannia bridge. The *jacks*, as manufactured by Watson and Stillman, New York, up to 30 tons capacity appear to the eye, when depressed, a simple cylinder with a head; and when elevated, like one cylinder sliding within another. The cylinder is from two to six or more inches in diameter, according to the power desired. The head (which is screwed on to the inner cylinder, called the ram) has a socket for the reception of the lever by which the force-pump is worked. The force-pump is contained inside of the ram, and consequently is not seen in the following drawings. The ram, with the head, contains only as much fluid as is required to fill the vacancy in the cylinder, caused by the raising of the ram in the act of lifting, and when this is accomplished, the fluid is returned into its original reservoir by a valve operated by the lever that works the pump. The lever is detached, and may be put on at pleasure. The claw attachment is an iron tube, screwed into the lower side of the head, and passing down to the bottom of the jack outside of the cylinder, on the lower end of which is a claw that supports the weight to be raised. These jacks are light, portable, and of easy application—a jack to raise 5 tons weighs only 20 lbs., and one to raise 100 tons not more than 375 lbs. They are all worked by the labor of one man only, who is capable of raising 10 tons through a space of one foot in one and a half minutes, or 100 tons the same distance in ten minutes. The horizontal jacks have an enlarged reservoir, containing fluid sufficient to run them out their entire length in a horizontal position. To use the jack, place the head (or if a claw-jack the claw or head) under the weight to be raised, place in the lever with the projection downward, then work it perpendicularly until the weight is at the required height, or the number of inches the jack runs out. To lower the weight, push the lever to the bottom of the stroke, take it out, turn it with the projection upward, and with a slight pressure of the hand, the weight may be lowered as slow as required, or stopped at any point. Sometimes it happens that another stroke of the lever would raise the weight too high; then raise the lever a little, and push it down slowly, by which the stroke will be missed. Should the valve stick to its seat, and prevent the jack working, by striking the lever a few sharp blows up and down, the valve will be released.

Fig. 1 shows the style used when the jack stands upon the ground or light board, and can be placed under the work, or where steadiness is required. Fig. 2 shows the style used when there is not sufficient room to get the head of the jack under the work, and is the pattern used for moving heavy guns, boilers, machinery, etc. Fig. 3 shows a form of lifting-jack used for dry docks, pressing flanges on wagon wheel hubs, etc. The piston is entirely enclosed, thus preventing all grit or foreign material getting into the pump and cutting it or preventing its working. The cylinder and bottom, on which it rests, are made from one piece of steel, thus relieving the reservoir-casing of strain, and dispensing with one very troublesome packing and making a jack stronger and lighter than one having a wrought-iron cylinder. There is nothing difficult of access, or which an ordinary mechanic cannot keep in good order. Fig. 4 shows a double pump-jack, having pumps with pistons $\frac{3}{4}$ inch and $1\frac{1}{4}$ inch diameter, the larger giving about one-third the pressure of the smaller, and working three times as fast. This style of jack is used where there is a variety of work, or where the jack has to work under varying loads. Fig. 5 shows the hydraulic pulling-jack, used for hoisting or pulling heavy weights in engine rooms, or in other circumscribed places, setting up rigging, pile-drawing, etc. This jack appears like a plain cylinder with rings at each end, by which to attach the body to be moved. They are three or more inches in diameter, and one and a half or more feet long, according to the power required, or the distance the weight is to be moved. It has a force-pump on the outside, worked by a lever, which forces the fluid contained in the cylinder to the opposite side of a piston, to the rod of which one of the rings at the end is attached. By this operation the jack is forced together, drawing with it the body to be moved. It will work vertically, horizontally, or at any angle. To use the jack, fill it through the screw in the side of the cylinder with whiskey and a few drops of oil. To pull or lift anything, make it fast to the jack by chains or ropes through the rings at each end, having first extended it as far as it will go. This is done by giving the thumb-screw in the force-pump two or three turns inward, and pulling out the piston, then turn out the thumb-screw until it stops. Put in the lever and pump as much as required. See *Jack-screw*.

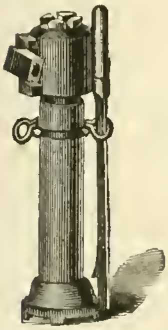


Fig. 1.

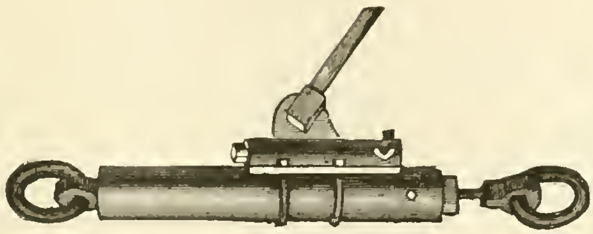


Fig. 5.

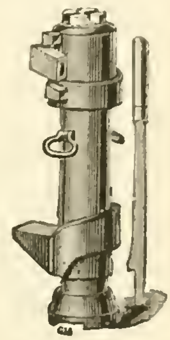


Fig. 2.

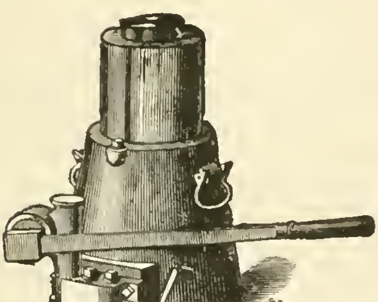


Fig. 3.

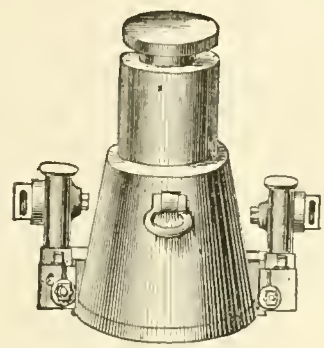


Fig. 4.

HYDRAULIC LOADING APPARATUS.—A system of apparatus used when maneuvering heavy turret-guns. This apparatus was thoroughly tested, in working the 100-ton guns, belonging to the Italian Government, in experiments at Spezzia, 1876. The working of the gun, including all the operations of loading and sponging, is effected by the means of hydraulic pumps, which are all operated by one small steam-engine. The gun is placed with its trunnions resting on two heavy blocks of metal, which, being retained by guides, slide on large beams or girders built in the floor of the turret. In front and rear of the blocks are pistons, working in cylinders in the direction of the floor-beams. These pistons, under the influence of water-pressure, move the gun in and out of battery. The breech is raised and lowered by similar means. When the gun is to be loaded, it is run forward and the muzzle depressed till it is in front of an armored hood, which shields an iron door in the main deck. The door slides back, a sponge appears on the end of a staff, which enters the bore and lengthens itself like a telescope till the bottom is reached, when, in obedience to the touch of a valve, a flood of water is ejected from the sponge to extinguish fire and wash the bore. The shot and cartridge next appear, lifted from below on a small truck, which is run out on a trap-door. The cartridge is lifted in front of the muzzle, the sponge (now converted into a rammer) pushes it a short distance into the gun, is then withdrawn, and when the shot rises pushes both to the bottom of the bore. The sponge is withdrawn below deck and the trap closes. Each of these movements is effected entirely by water-pressure, the course of the water and the corresponding operation being determined by manipulating the proper valve. The only defect in the principle was developed by the bursting of the English 38-ton gun on the *Thunderer*, in 1879.

If the slipping of a shot is to cause the bursting of a gun, anything that tends to produce this slipping is to be deprecated, and as the hydraulic loading-gear requires the gun to be inclined downward at a considerable angle, it would appear that the machinery was open to objection. But a similar difficulty presented itself years ago with broadside guns. These were found to start their projectiles freely, not so much by the rolling of the ship as by the jerk of running the gun out. Wedge wads were employed expressly to prevent this, and guns are generally dependent on the efficiency of these wads for the fixing of their projectiles.

HYDRAULIC POWER.—The use made of hydraulic power is probably greater at Elswick than at any other Establishment in the world. This might naturally be expected, when it is remembered that the world is indebted to Sir William Armstrong for the advance made in this direction. The system of hydraulics at Elswick extends to all parts of the grounds, reaching all the shops, wharves, and water-front. Pumping-engines are established at convenient intervals, only one working at a time, and the connection of pipes being continuous, the uniform working of the system is established by five or six accumulators with 18-inch rams. The working of the pumping-engine is made automatic. The accumulator nearest to it is slightly more heavily loaded than the others to give a lead in rising to the distant one, and is connected with a steam regulating valve to act as a governor for adjusting the speed of the engine to the varying demand of the hydraulic machines. The pressure sustained throughout the system is 750 pounds to the square inch. The pipes are usually 5 inches in diameter, the largest being 6 inches. Hydraulic power is used for the forge and foundry-cranes, also for the movable cranes which operate along the water-front. For the accommodation of these last, pipes are run, in junction with the pressure main, with hydrants from 18 to 36 feet apart, from which connection is made with the cranes by means of telescopic tubes. Two or more cranes can thus be brought into operation on any vessel at the water-front. On the eastern end of the wharf are erected large hydraulic shears, worked by a direct-acting hydraulic cylinder, 40 feet stroke, lifting 120 tons. The back leg moves so as to bring the lifting cylinder about 30 feet out; the foot is moved by a screw 50 feet long, with hydraulic engine and gear. The most notable hydraulic crane that has yet been produced from these works is one erected in the Italian naval arsenal at Spezzia, which is capable of lifting 160 tons through a range of 40 feet. It is carried upon a ring of line rollers supported by a pedestal of masonry, and the slewing is effected by an hydraulic engine applied to a pinion which gears with a circular rack. The rake of the jib or projection from the center of rotation is 65 feet, and its height from the quay-level is 105 feet. The crane is counterbalanced on the side opposite to the load. About the grounds at Elswick, particularly at the approaches to the shops, there are numerous small capstans worked by hydraulic engines, which are of great service in hauling heavy loads into or out of shops, and in transporting them from shop to shop. It is almost unnecessary to add that it is at Elswick that the applications for working heavy guns by hydraulic power have been designed and manufactured. No foundry or gun factory can be considered efficiently equipped without being provided with arrangements for the plentiful supply of hydraulic power.

We can but briefly describe a system of hydraulic supply within the limits of this work, although the subject is a very important one, and is, at present, receiving the attention of the United States authorities in connection with the proposed establishment of a Government foundry, for the manufacture of heavy ordnance adapted to modern warfare. The Holly System of Water Supply, an invention of Birdsill Holly, of Lockport, New York, and the most perfected system of which we have knowledge, is designed not only to supply water for ordinary purposes, at any desired elevation, without the use of a reservoir or stand-pipe, or any other contrivance for calling into requisition the principle of the hydrostatic equilibrium, but also to furnish the means of extinguishing fires at several points at the same time, if necessary, and all this without the use of any movable engine for that purpose. This result is accomplished by placing a set of Holly pumping machinery, which is of peculiar construction, within a suitable building, located at a convenient point where the supply of water is accessible, and from whence by a proper system of mains and pipes the water can be conducted wherever it is needed. The pumping machinery, which may be propelled by either steam or water-power, must be adequate to the service required, having a reserve of power for extraordinary occasions. To guard against contingencies the machinery is duplicated, or so constructed that the breaking of a part does not disable the whole. In order to maintain steady pressure, the operation of the machinery is continuous; but as the demand for water is subject to constant variation, means are provided for the automatic regulation and government of the pumps, so that the amount of water delivered is in exact accordance with the requirements of the moment. The means of regulation which thus forms such an important feature in the Holly system is an exceedingly simple mechanical device depending for its operation upon the degree of pressure in the mains. If this pressure falls, owing to an unusual drain, the regulator instantly acts so as to admit steam for a longer period into the cylinders of the engines, and the pumps are thus at once caused to operate more rapidly and powerfully. When the pressure in the mains increases, owing to but small drafts being made on them, the reverse takes place and less water is pumped. The normal pressure is adjusted by the engineer in accordance with average requirements. The fire protection afforded by the Holly system is of the most efficient character. Water is not merely distributed to hydrants, but sent there under pressure, so all that is required is to couple on the hose and turn on the stream. The adjustment of the engine to give a quick supply under heavy pressure, in response to a sudden alarm of fire, is the work of an instant. The mere opening of a hydrant causes sufficient diminution of pressure in the pipes to operate a valve, which in turn communicates with a whistle, the sounding of which is the alarm for the engineer to turn on the fire pressure.

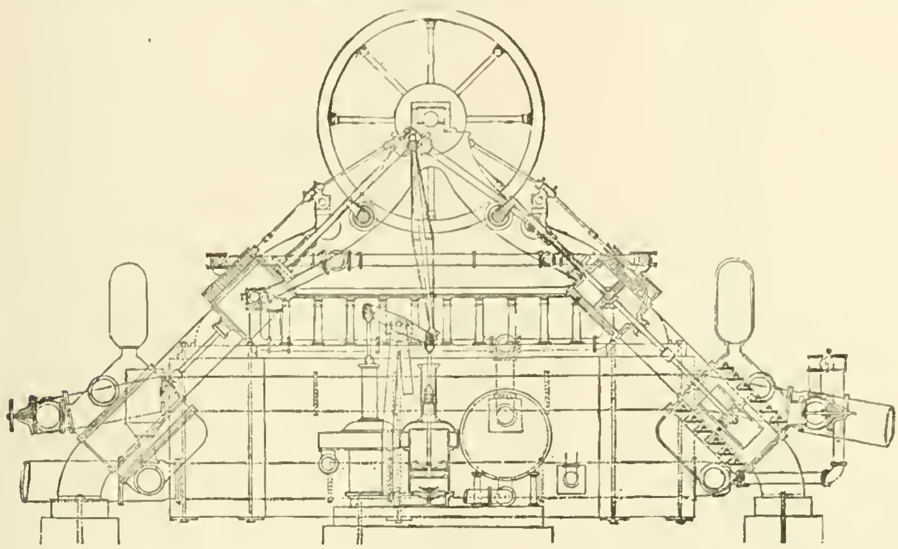


Fig. 1.

The Holly quadruplex pumping-engine is represented in sectional elevation in Fig. 1. It has four steam-cylinders inclined at an angle of forty-five degrees, and four pumps, one of which is in a direct line with each cylinder. The steam-cylinders and their pumps are arranged in pairs on opposite sides of a heavy iron frame, the two cylinders of each pair being connected to a common crank-pin, and the crank for one pair of cylinders being set 135 degrees in advance of that on the opposite side. The engines are of the reciprocating piston form, with guides and connecting rods. A connecting rod affixed to the back crank-pin actuates an air-pump beam, giving motion to two single-acting air-pumps and two boiler feed-pumps, one of which draws water from the hot well, and the other from the steam-jackets which surround the sides of all the steam-cylinders. The steam from the jackets passes through a feed water-heater, so that the temperature of the feed can be raised to any desired point by increasing the amount of steam supplied to the jackets. The connection of the pumps with the steam-cylinders and the steam piston-rods with the pumps, is by means of keys, so that any engine or pump can readily be thrown out of action. The steam-piston is packed by cast-iron rings set out by springs, the set-screw of which projects beyond the face of the piston, and there are bonnets in the lower cylinder-heads, so that the piston rings can be adjusted without opening the cylinder. The pumps are of the piston variety, double-acting, the pump barrel being secured in a chamber containing the valve by a rib which forms a partition between valves on the opposite ends. The pump valves are flat discs of rubber, secured to iron discs having stems working in guides. These iron discs are of sufficient weight to bring the valves to their seats promptly, and no springs are used. The valves seat on metal gratings. The steam and exhaust-pipe of the several steam-cylinders are so arranged that steam from the boilers can be admitted directly into all the cylinders and exhausted into the condenser, or live steam can be admitted to but one cylinder, and exhausted into the other three, then passing the condenser, forming a compound-engine at pleasure. To change from direct to compound, it is only necessary to manipulate three stop-valves, one connecting the steam-pipe of three cylinders with the boilers, one connecting the exhaust-pipe of the fourth cylinder with the condenser, and the third connecting the exhaust-pipe of one cylinder with the steam-pipes of the three. The valve gear of each steam-cylinder consists of a slide valve moved by an eccentric in the usual manner and admitting steam throughout the whole stroke. A double puppet-valve in the steam-chest regulates the point of cut-off, being actuated by a revolving spiral cam which can be moved in an axial direction, and thus vary the periods of admissions from zero to full stroke. The manner in which this cam is moved so as to regulate the speed and power exerted, is an important peculiarity of the Holly pumping-engine. The adjustment is effected by means of a regulator connected with the water-main in such a manner that any change in water pressure is immediately corrected by an adjustment of the cut-off, resulting in a practically uniform water pressure under the most varying conditions of supply. If the water pressure tends to fall, owing to an unusual draft upon the main, the cut-off is immediately lengthened and the engines exert a sufficient power to maintain the original pressure; if the consumption is suddenly lessened so that there is a tendency for the water pressure to increase, the cut-off is at once shortened, diminishing the power of the engine sufficiently to maintain the original pressure under the reduced supply, and if all consumption of water suddenly ceases the engine will immediately stop. The regulator is represented in Fig. 2.

It is evident from the foregoing description that the Holly regulator acts in an essentially different manner from the ordinary governor, which would increase the cut-off as the water pressure augmented, and shorten the cut-off as the same diminished. The details of the regulator are briefly as follows: A small water-cylinder, containing a solid piston, is connected directly with the main, and a weight is attached to the piston so as to counter-balance the water pressure. This is effected by suspending the weight from a strap which passes over a cam that rotates as the pressure changes, thus altering the lever arm of the counter-balance, and keeping it in equilibrium with the water pressure, however much the latter may vary. The cut-off cams of the steam-cylinders are moved axially, either to shorten or to lengthen the cut-off when the regulator throws a friction-clutch into gear, which it does whenever the water pressure varies from a given amount. A weighted lever would maintain this friction-clutch in gear, were it not for the action of the regulator. The shaft on which the counter-balance cam rotates has an index-wheel, and the index can be set at any desired water pressure. So long as the water pressure varies from the figure at which the index is set, the friction-clutch is kept in gear by the weighted

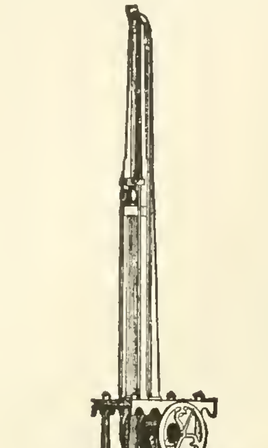


Fig. 2.

lever, and the cut-off is adjusted until the required pressure is reached. At this point the index engages with the weighted lever, and throws the friction-clutch out of gear. Whenever the water pressure varies, the friction-clutch is thrown into gear again, changing the cut-off so as to maintain the water pressure constant. It will be seen that the cut-off is regulated by positive gear driven by the engine, and the only work required of the regulator is to connect or disconnect this gear. Should the pressure rise very suddenly, however, a piston in the safety cylinder raises a lever to which the cut-off gear is connected, and throws the cut-off to zero instantly, if this is requisite.

Following the quadruple engine, the Company has brought out a novel horizontal compound condensing-engine, designed by Mr. Harvey F. Gaskill, Engineer and Superintendent of the Works. It was the purpose of the Company in bringing out this engine to provide one less costly than the quadruplex, and better adapted for pumping larger quantities of water; also to stand in the first rank as to economy. Following is a description of the engine, reference being made to Figures 3 and 4. On a pair of iron bed-plates are mounted the two pumps, and in direct line therewith the two low-pressure steam-cylinders connected to the pump piston-rods. Between the pumps and steam-cylinders are placed beam supports, which are firmly bolted to the bed-plates, and also rigidly stayed by wrought-iron struts to the pumps and steam-cylinders. These beam supports carry the beam shafts and beams, the lower end of the latter being connected to the cross-heads of the low-pressure cylinders by means of links. On the top of the pumps are placed the main shaft bearings, which support the shaft, fly-wheel, and cranks, the latter being keyed to the shaft at right angles to each other. On top of the low-pressure steam-cylinders are mounted the two high-pressure steam-cylinders, with their centers in the same horizontal plane as the center of the main crank shafts. The cross-heads of the high-pressure steam-cylinders are connected by means of connecting rods to the crank-pins. From the high-pressure steam-cylinders heavy cast-iron girders extend to the pillow-blocks. On the inner end of each of the beam centers an arm is keyed, from which the air-pumps are driven. The valves of the steam-cylinders are operated by means of eccentrics on a shaft, which is driven from the main shaft through small bevel gears. The admission-valves to the high-pressure steam-cylinders are of the double-beat puppet pattern, so arranged as to open at the proper time and to close at any desired point of the stroke. The exhaust-valves from the high-pressure cylinder are also the admission-valves to the low-pressure steam-cylinders, and are ordinary slide-valves, remaining open somewhat less than the time required to make one complete stroke. The exhaust-valves from the low-pressure cylinders are also plain slide valves, operating the same as the high-pressure exhaust-valves. The pump-plungers are arranged to work through glands in the center of the pumps, and are accessible from the covers at the end of the machine. The pump-valves are placed on horizontal plates below and above the line of plunger travel. The glands above-mentioned divide the valves of one end of the pump from those of the other end at the center of the valve plates. The operation of the machine is as follows: Steam is admitted through the automatic cut-off valves into the high pressure steam-cylinders, urging the pistons forward under full boiler pressure until the point of cut-off is reached. The valve then closes and the remaining portion of the stroke is accomplished by the elastic force of the steam. When the piston has nearly reached the end of its travel, the exhaust valve between the high and low pressure cylinder opens and the steam remaining in the high pressure cylinder rushes into the low pressure cylinder and against its piston, which at that time is at the end of its travel and at the opposite of the high pressure piston. The low pressure cylinder-piston is then in turn urged forward by the incoming steam, which is expanded to four times the volume it occupied in the high pressure cylinder at the time of its release therefrom. The release from the low pressure cylinders is accomplished by means of the exhaust-valves in the return strokes. This operation is repeated on each side and at each end at proper times. The close connection between the two cylinders reduces the clearance spaces to a minimum, which with thorough jacketing insures the most economical use of steam.

This engine is also built to operate as a non-compound engine, in which case the upper or high pressure steam-cylinders and connections are omitted, and the lower steam-cylinders are provided with automatic cut-off valves. Steam is admitted into these cylinders direct from the boiler and exhausted into the condenser. This mode of construction is adapted to small places, and to cities and villages where the cheapness of fuel renders the first cost

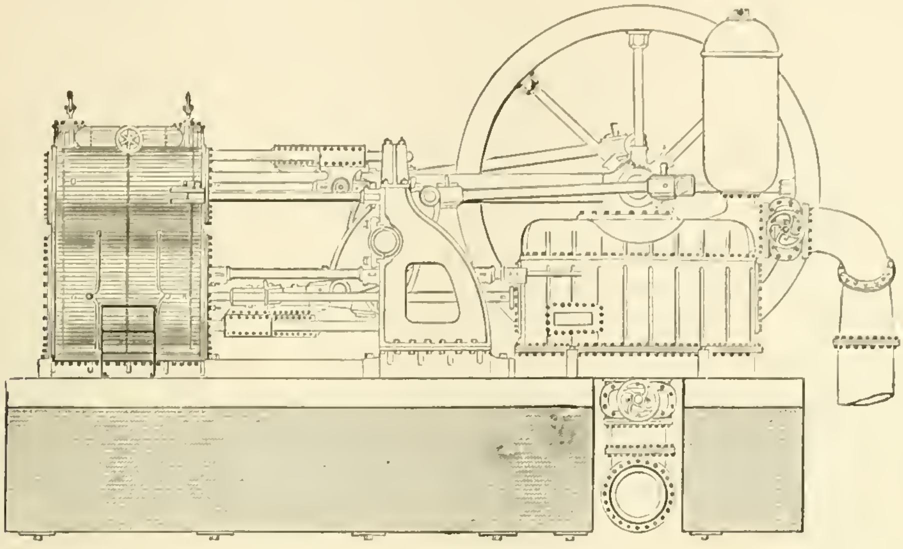


Fig. 3.

of the machine a matter more to be considered than the annual saving in the fuel. Although even when constructed as a non-compound engine, a duty of

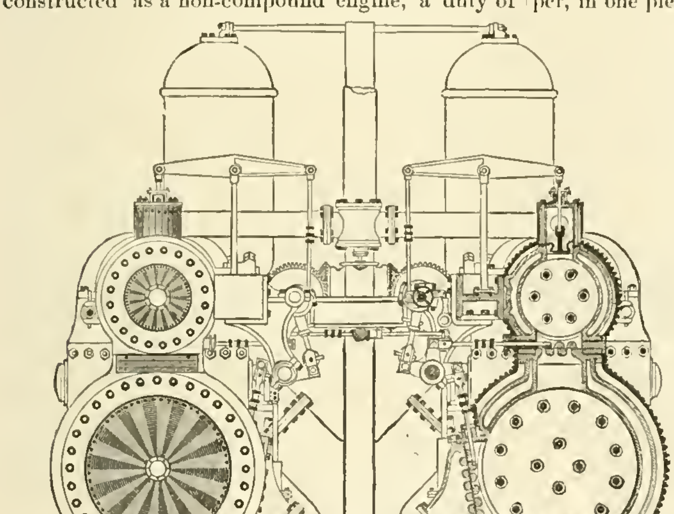


Fig. 4.

50,000,000 foot-pounds of work can be obtained from 100 pounds of coal. See *Steam-engine*, *Turbine*, and *Water-wheels*.

HYDROMETER. An instrument employed to determine specific gravities. The drawing exhibits the form of the instrument used in determining the specific gravity of metals. It is constructed on the principle of Nicholson's hydrometer; having a bulb 7.5 inches diameter and 8 inches high, made of copper, in one piece, without seam. The copper is .03 in. thick, and deposited on a mold, of low fusible metal, by the electro-galvanic process. A handle of brass wire, with broad flanges at the ends, is inserted in the bottom of the mold, before the copper is deposited, the copper covering and uniting with both. The brass cone is bored through its axis, and screw-threads are cut in it. After the bulb is formed, the fusible mold is melted, and withdrawn through the aperture in the brass cone. The aperture is then closed by a small screw and made air-tight by close fitting, and by sealing-wax spread over it. A solid stem of brass is then screwed into the bottom of the bulb. A vertical index-stem, made of steel, is inserted in the upper part of the handle. The upper end of the stem receives the weight-pan, which is supported in its place by a conical socket on its underside. The height of the hydrometer, from the bottom of the ball to the weight pan, is 21 inches. All of the exterior surface is protected by electro-gilding. The weight of the bulb, including the handle and brass cone, is about 15,850 grains; the lower stem and ball weigh about 20,320 grains, and the weight-pan is 660 grains; making the total weight of the hydrometer about 36,830 grains. Its general form, and the distribution of the metal within it, place the centers of gravity and buoyancy so far apart that it readily takes a vertical position when immersed, and will deviate very little from it, however irregularly it may be loaded. The maximum buoyancy of the hydrometer is 14,600 grains, and, when loaded to zero, it displaces 51,430 grains of water. The buoyancy may be reduced one-half by increments of 500 grains each, by placing one or more of the adjusting weights over the ball, at the bottom of the stem. Such a reduction of the buoyancy is found convenient in practice, when weighing small samples, as it prevents the necessity for placing and displacing numerous weights on the pan. The index stem is .071 inch diameter; a length of 1 inch displaces one grain of water. Four points of silver wire, made thin and sloping at the ends, are attached near the stem so as to form a scale of weights, in tenths of a grain. The two nearest opposite points are one-tenth of an inch apart. When the instrument rests with one of these points above, and the other beneath the surface of the water, it is at zero. When either of them touches or is even with the surface, the load is one-tenth of a grain too heavy, or too light, and if either passes through the surface, the error is then two-tenths of a grain. If either of the two points which are more distant from the zero touches the surface of the water, the load is then deficient, or in excess, three-tenths of a grain; and if the heel of either of these points passes the surface, the error is then four-tenths of a grain. Careful observation of the position of these points, when the hydrometer is immersed and at rest, will serve to indicate the true balance, when the zero mark may be above or below the surface of the water, within a given limit. By this method, the inconvenience and delay of bringing the zero to the surface of the water by the decimal parts of the grain weight is thus avoided. The water in which the hydrometer is immersed is contained in a cistern of glass, 25 inches deep, and not less than 12 inches diameter. If the bottom of the cistern is not level a flat plate should be placed over it and supported horizontally on three legs. The height of the water in the cistern should be such that when the bottom of the hydrometer descends to the plate the weight-pan should be one-quarter of an inch above the surface of the water. This will prevent an immersion of the pan when overloaded. The weight-pan is attached to the index stem by an open socket, on its under side, in order that it may be removed with its load from the hydrometer and placed on a table where the weights may be safely and accurately counted. As the weights often consist of many pieces, errors may occur in counting, or in the record of them; it is a good precaution to verify them by a recount after making the record. A thermometer, with a scale of about 5° to the inch, sub-divided in quarters of a degree, is suspended in the water while weighing samples and the temperature should be noted at each weighing. The weighings are made at temperatures varying with the state of the weather at the time, and as the density of water varies with its temperature, the latter is noted in order that the proper corrections may be made. The unit adopted is distilled water at the temperature of 60° Fahr.

The hydrometer may be employed to determine the relative density of distilled and any other kind of water. The weight of the hydrometer, added to its balance-weight in distilled water, at the temperature of 60°, gives the weight of a quantity of pure standard water which is equal in bulk to the immersed part of the instrument. The weight of the hydrometer, with its load, when immersed in like manner in any other kind of water at the same temperature, gives the weight of an equal bulk of the latter; and this weight, divided by the former, gives the multiplier for correcting the density when ascertained in any other than pure distilled water. Rain or river water may be used instead of distilled water, if its relative density be first accurately determined and the proper correction be made. At the foundries, generally, river water is found to be sufficiently pure for use without needing any correction. In using the hydrometer, first load the pan with the grain weights until the instrument rests at zero, and record the sum of these weights as the *Balance of the Hydrometer*. Next, place in the pan the sample, together with as many weights as will again bring the instrument to its zero, and record these weights as the *Sample Balance in Air*. The difference between these balances is equal to the weight of the sample in air. Then place the sample on the bulb of the instrument and immerse both until the hydrometer again rests at zero, and record the weights on the pan as the *Sample Balance in Water*. The difference between this balance and that in air is equal to the weight of the water displaced by the immersed sample. The temperature of the water at the time of weighing is noted, and if it is not at 60° divide the weight displayed by the the sample by that number in the following table which is opposite the noted temperature, and the quotient will give the corrected displacement for the temperature of 60°. Then, the weight of the sample in air, divided by the corrected displacement, gives the density of the sample. The hydrometer may be employed in determining the varying density of the same water at different degrees of temperature. The weight of the water it displaces at any other temperature than 60°, divided by its displacement in the same water at 60°, will give the proportionate weight of water displaced by the same instrument at other temperatures. See *Areometer* and *Specific Gravity*.

HYDRO-PNEUMATIC CARRIAGE.—A hydro-pneumatic carriage has lately been proposed by Major Moncrieff for the use of siege-carriages, somewhat on the system of his counterweight carriages for heavy guns. The object obtained is lightness, the facility of loading the gun when out of sight of the enemy, and raising it *en barbette* without any difficulty, thus obviating the necessity of cutting embrasures in the parapet. The carriage is designed for siege purposes, and it seems not improbable that the development of its principle may altogether revolutionize that branch of military operations. Batteries of attacks have hitherto been protected by embankments hastily thrown up, while the guns have been fired through embrasures. But the deadly precision of improved artillery sends shot after shot into the embrasures, while its penetrating power makes ordinary earthworks but very indifferent protection. Major Moncrieff's idea is to adapt to the attack the system he has been elaborating for coast defenses. He digs a hole and buries his gun in it. The soil, when it is excavated, is carried to the rear, and the enemy has no mark to guide his aim; after each discharge the gun sinks out of sight, and the indication of its precise whereabouts vanishes with the smoke. In the sieges in the late war, the Germans found that they must withdraw their batteries to immense distances, whence the fire was vague and relatively ineffective. Major Moncrieff undertakes to place his guns within 500 yards of the enemy's works. By his very well-known idea of the counterweight he had attained his object of elevating the gun out, and returning it to cover, and so enabling the gunners to work in comparative safety by storing the force of the recoil. But the objection to applying the system to siege operations was the unwieldy weight of carriages fitted with the counterweight, where lightness and facility of movement were primary considerations. The hydro-pneumatic system dispenses with this ponderous counterweight, replacing it very ingeniously with a simple cylinder only containing air and water, which oscillates between the cheeks of the gun-carriage. It is a feature in the carriage that it can be secured on an improvised platform without any heavy and costly appliances. It is fastened by a chain passed loosely round somè balks of timber buried in the ground, and the fastening acts as a rude pivot, on which it revolves. When in position for firing, the gun is raised to a height of some 7 feet upon a pair of arms or elevators which lay hold of the trunnions, and their action is regulated by racks, which are arranged to work in c nnection with a radial connecting-rod. Between these is the head of the piston which works in the hydro-pneumatic cylinder. With the discharge of the gun the head of the cylinder sways backwards, the piston is forced down by the recoil, and, as the piston slowly goes down in this cylinder, the gun descends with it to the normal position for loading. The internal adjustments of the cylinder are, of course, the essence of the invention. The piston descends in a tube of water, communicating at the bottom of the cylinder with a couple of side-chambers which are filled with air. As the water is forced down in the central tube, it necessarily rushes into the side ones, and the elasticity of the air it violently compresses is the motive power that is to be stored for use. There is just sufficient water to fill the central cylinder and to cover all the valves and joints, and there is nothing but strong and solid metal in those parts of the side-chambers in which the compressed air is to be confined. At the bottom of the cylinder, between it and the air-valve, and immediately in rear of the latter, is a "throttle-valve." The throttle-valve consists of a small, circular, perforated cylinder, revolving within a larger one, and its purpose is to neutralize, by the application of water friction, any excess of energy in the recoil. Indeed, next to employing air and water, as light and convenient materials of enormous power to work those heavy siege guns, the idea is to use those elements so as to avoid friction and concussion. Instead of the very violent recoil which threatened to shake the strongest carriage to pieces when it was arrested sharply by the resistance of screws and iron, according to this hydro-pneumatic system the recoil is made to exhaust itself upon air-springs and water-cushions. The first shock is broken upon the mass of water in the middle cylinder, and the throttle-valve disposes, as it were, of any of the subsequent vibrations. Theoretically, therefore, if we may use the expression, the recoil should be all self-contained. It was very nearly so in all practice; the carriage moved slightly to the first shot, as the chain tightened that secured it to the balks; but the shot that followed made no perceptible change in its position. It must be remembered that under the old system, and before Major Moncrieff had invented his counterpoise, or thought of his hydro-pneumatic cylinder, the gun would have wrenched itself away from such a rough-and-ready fastening. When the piece is raised for firing, it is managed by a worm-wheel at the side, which regulates the angle of elevation, and which turns easily to the touch. To sum up the merits of the invention, if it realizes the advantages claimed for it—and as it confessed to be a mechanical success, we can scarcely see how it can fail to do so—it will enable siege-batteries to be established and worked with comparative impunity at an extraordinary short distance from the formidable guns which are mounted on modern fortresses: siege-guns may be secured in position anywhere with materials that are always ready to hand; and carriages on constant service will be exposed to the very *minimum* of strain. Moreover, Major Moncrieff's new apparatus can be easily adapted to ordinary siege-carriages, and a cart and a couple of horses will transport its extra weight. If it proves successful with the heavy 40-pr. siege-guns, *à fortiori* it must succeed with the 46-pr. to be employed for coast batteries, as suggested in Major Moncrieff's pamphlet on defenses.

HYGROMETER.—An instrument for measuring the quantity of moisture in the atmosphere. The earlier forms of hygrometer depended upon the property possessed by some substances of readily absorbing moisture from the air, and being thereby changed in dimensions or in weight. Of this kind was the hair hygrometer of Saussure, in which a hair, which expands and contracts in length according as the air is more or less moist, was made to move an index; a similar instrument was the whalebone instrument of Deluc; but as other causes as well as moisture affect such instruments, they afford no accurate indications. The most perfect hygrometer, theoretically, is that of J. F. Daniell. It consists of two bulbs connected by a very strong bent tube, and enclosing a thermometer, together with some ether and the vapor of ether, the air having been first expelled. This hygrometer was employed at the Royal Observatory, Greenwich, from 1840—the commencement of meteorological observations—till 1847, when it was superseded by the more convenient instrument, the Wet and Dry Bulb Thermometer of usual form. This instrument consists of two ordinary thermometers—one has its bulb bare, and thus shows the temperature of the air; the other has its bulb covered with muslin, which is kept wet by a cotton wick dipping into water. The evaporation from the muslin, and the consequent cooling of the bulb, being in proportion to the dryness of the air, the difference between the readings of the two thermometers is greatest when the air is dryest, and zero when it is completely saturated. The readings of the thermometers then being taken, the elastic force of vapor at the dew-point is calculated by the formula of Dr. Apjohn:

$$(1)\ F = f - \frac{d}{88} . \frac{h}{30};\quad (2)\ F = f - \frac{d}{96} . \frac{h}{30};$$

the first formula is to be used when the wet thermometer is above, and the second whenever it is below, the freezing-point (32°). In these formulæ, F is the elastic force of vapor at the dew-point, which has been determined for different temperatures by Regnault from carefully conducted experiments; *f*, the elastic force at temperature of evaporation (or reading of wet bulb); *d*, the difference between the dry and wet bulbs; and *h*, the height of the barometer. From this the quantity of moisture in one cubic foot of air, etc., can be found as before. To dispense with these troublesome calculations, the *Hygrometric Tables* of Mr. Glashier may be nsed. Mason's hygrometer, represented in Fig. 1, is a very convenient and satisfactory instrument for practical use. It consists of two thermometers, as nearly as possible similar mounted parallel upon a frame and marked respectively "wet" and "dry." The bulb of the one marked *wet* is covered with thin muslin or silk, and kept moist from a fountain which is usually attached. The principle of its action is, that unless the air is saturated with moisture, evaporation is continually going on. And as no evaporation can take place without an expenditure of the heat, the temperature of the wet bulb thermometer, under the evaporation from the moistened bulb, fails until a certain point is reached, intermediate between the dew-point and the temperature of the air, as shown by the thermometer. To find the dew-point, the absolute dryness, and the weight in grains of a cubic foot of air, tables have been constructed empirically from experiments at Greenwich, combined with Regnault's

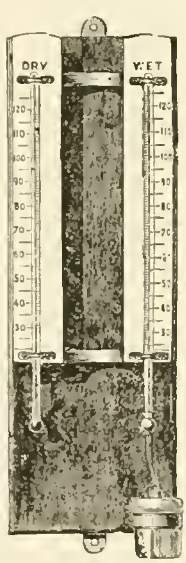


Fig. 1.

Tables of Vapor Tension. When using this instrument, if the air be very dry, the difference between the two thermometers will be great; if moist, less in proportion, and when fully saturated, both will be alike. For different purposes, different degrees of humidity are required, and even in household use, that hygrometrical condition of the atmosphere most beneficial to one person, may frequently be found altogether unsuitable for another. "Dry" bulb 70° and "wet" bulb 62° to 64° indicate average healthful hygrometrical conditions; any other relative condition required may easily be found by experiment, and then, dispensing with calculations, or reference tables, it is only necessary to see that the two thermometers stand in the required relation to each other. The hygrodyke, shown in Fig. 2, is on the principle of Mason's hygrometer, but is arranged with a dial and pointer so that the absolute and also the relative dryness and the dew-point may be read off without calculation. Regnault's hygrometer, with aspirator, is represented in Fig. 3. By means of this instrument instantaneous observations may be readily made. It consists of a thin and highly-polished tubular vessel of silver, A, having one end somewhat longer than the other. A rather delicate thermometer is introduced into the tube at the smaller end, to which end of the tubular vessel, also, a flexible rubber tube with ivory mouth-piece is attached. A sufficient quantity of ether to cover the bulb of the thermometer, being poured into the silver vessel, the ether is agitated by breathing through the flexible tube. A rapid evaporation ensues until at the moment the dew-point is reached, the moisture is seen to condense upon the exterior surface of the polished silver tube. The reading of the thermometer at this precise moment gives the dew-point.

DEW-POINT.

Air temp.	Difference between reading of Wet and Dry-bn .														Air emp.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	
+30°	+30°	+27°	+24°	+21°	+17°	+13°	+ 7°	— 1°	—11°	—30°					+30°
31	**31**	28	25	22	18	14	9	+ 2	— 7	—23					31
32	32	**29**	26	23	20	16	11	5	— 3	—17					32
33	33	30	**27**	24	21	17	13	7	— 1	—12	—32				33
34	34	31	28	**26**	22	19	15	9	+ 2	— 7	—23				34
+35	+35	+32	+29	+26	**+24**	+20	+16	+11	+ 5	— 3	—17				+35
36	36	33	30	27	24	**21**	18	13	8	— 1	—12	—32			36
37	37	34	32	29	25	21	**19**	15	9	+ 3	— 7	—23			37
38	38	35	33	30	26	23	19	**17**	11	6	— 3	—16			38
39	39	36	34	31	28	24	20	16	**14**	8	0	—11	—31		39
+40	+40	+37	+35	+32	+29	+26	+22	+18	+12	**+10**	+ 3	— 6	—22		+40
41	41	39	36	33	30	27	23	19	14	8	**6**	— 2	—15		41
42	42	40	37	34	31	28	25	21	16	10	3	**+ 2**	— 9	—29	42
43	43	41	38	35	33	30	26	22	18	13	6	— 3	**— 5**	—20	43
44	44	42	39	37	34	31	27	24	20	15	9	+ 1	—12	**—13**	44
+45	+45	+43	+40	+38	+35	+32	+29	+25	+21	+17	+11	+ 4	— 7	—27	+45
46	46	44	41	39	36	33	30	27	23	19	14	7	— 2	—18	46
47	47	45	43	40	37	35	32	28	25	21	16	10	+ 2	—11	47
48	48	46	44	41	39	36	33	30	26	22	18	12	5	— 6	48
49	49	47	45	42	40	37	34	31	28	24	20	15	8	— 1	49
+50	+50	+48	+46	+43	+41	+38	+36	+33	+29	+26	+22	+17	+11	+ 3	+50
51	51	49	47	45	42	40	37	34	31	27	23	19	13	6	51
52	52	50	48	46	43	41	38	35	32	29	25	21	16	9	52
53	53	51	49	47	44	42	40	37	34	30	27	23	18	12	53
54	54	52	50	48	46	43	41	38	35	32	28	24	20	15	54
+55	+55	+53	+51	+49	+47	+45	+42	+39	+36	+33	+30	+26	+22	+17	+55
56	56	54	52	50	48	46	43	41	38	35	32	28	24	19	56
57	57	55	53	51	49	47	45	42	39	36	33	30	26	22	57
58	58	56	54	52	50	48	46	43	41	38	35	31	28	24	58
59	59	57	55	53	51	49	47	45	42	39	36	33	29	26	59
+60	+60	+58	+56	+54	+52	+50	+48	+46	+43	+41	+38	+35	+31	+28	+60
61	61	59	57	56	54	52	49	47	45	42	39	36	33	29	61
62	62	60	58	57	55	53	51	48	46	43	41	38	35	31	62
63	63	61	60	58	56	54	52	50	47	45	42	39	36	33	63
64	64	62	61	59	57	55	53	51	49	46	44	41	38	35	64
+65	+65	+63	+62	+60	+58	+56	+54	+52	+50	+48	+45	+42	+39	+36	+65
66	66	64	63	61	59	57	55	53	51	49	46	44	41	38	66
67	67	65	64	62	60	58	56	54	52	50	48	45	43	40	67
68	68	66	65	63	61	59	58	56	54	51	49	47	44	41	68
69	69	67	66	64	62	61	59	57	55	53	50	48	45	43	69
+70	+70	+68	+67	+65	+63	+62	+60	+58	+56	+54	+52	+49	+47	+44	+70
71	71	69	68	66	65	63	61	59	57	55	53	51	48	46	71
72	72	71	69	67	66	64	62	60	58	56	54	52	50	47	72
73	73	72	70	68	67	65	63	61	60	58	56	53	51	49	73
74	74	73	71	69	68	66	64	63	61	59	57	55	52	50	74
+75	+75	+74	+72	+70	+69	+67	+65	+64	+62	+60	+58	+56	+54	+51	+75
76	76	75	73	71	70	68	67	65	63	61	59	57	55	53	76
77	77	76	74	72	71	69	68	66	64	62	60	58	56	54	77
78	78	77	75	74	72	70	69	67	65	64	62	60	58	55	78
79	79	78	76	75	73	71	70	68	66	65	63	61	59	57	79
+80	+80	+79	+77	+76	+74	+73	+71	+69	+68	+66	+64	+62	+60	+58	+80
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	

Lieutenant James Allen, United States Army, has made an ingenious and novel application of the hygrometer, in *foretelling frost* by the determination of the dew-point. Lieutenant Allen uses, in his investigations, a dry and wet-bulb hygrometer of a special construction, consisting of two mercurial thermometers, which, being placed side by side, will indicate the same temperature. The dry-bulb is but a common thermometer, intended to show the temperature of the air. The wet-bulb is also a common thermometer, but having its bulb covered with a piece of thin muslin, from which passes a few threads of darning-cotton or narrow strip of muslin into a small vessel containing rain-water. Water rises by capillary attraction from the vessel and thus keeps the muslin constantly wet. When the air is dry, evaporation from the muslin proceeds rapidly, and on account of the heat lost in this way, the wet-bulb indicates a lower temperature than the dry-bulb; when the air is damp evaporation is slower, and the difference between these two thermometers grows less, and where the air is completely saturated evaporation ceases, and the two thermometers indicate the same temperature. To keep this instrument in working order, several things require special attention. The thermometers must be alike, for if one should be filled with mercury and the other should contain spirit, or if they should be filled with different quantities of the same fluid, the readings will be vitiated. All starch or foreign matter should be washed out of the thin muslin covering and the cotton wicking. The water used should be pure; for if lime or other salts be dissolved in it, the muslin will soon be coated with a calcareous or other incrustation. Rain or distilled water should be used. The muslin ought to be changed when covered with dust or other impurities, and care should be taken not to touch the muslin with the fingers, otherwise it will get slightly greased, and capillary attraction will be thereby interfered with. The bulbs of the thermometers should be made to project 1½ or 2 inches below the scales. The thermometers should also be a little apart from each other, and the vessel containing the water ought to be placed as far removed as possible from the dry-bulb. The thermometers should be exposed to the air where the circulation is unobstructed. They should face the north and be always in the shade. They should be removed at least a foot from the wall of any building, and should be about ten feet from the ground. They should be protected against the heat reflected by the neighboring objects, such as buildings or a sandy soil, and they should be sheltered from the rain. If the dry-bulb should become moistened by rain, the bulb should be carefully dried about five minutes before making the observation: since drops of water, by their evaporation, would lower the temperature of the mercury in the bulb. By means of this contrivance and the foregoing table, the dew-point can be determined with a sufficient degree of nicety. To determine the dew-point, at any time, substract the reading of the wet-bulb from that of the dry-bulb; find the temperature of the dry-bulb in the left hand column of the Table, opposite which in the column that is marked at the top with the difference between the dry and wet-bulb, is to be found the dew-point sought.

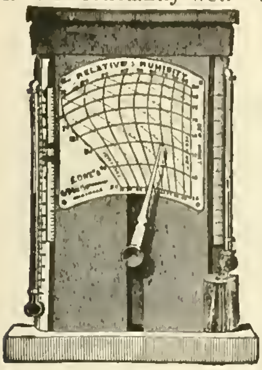


Fig. 2.

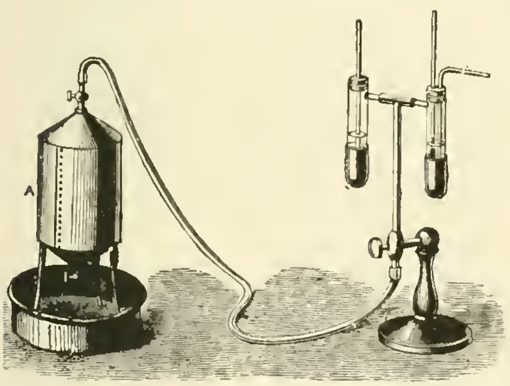


Fig. 3.

Having ascertained the dew-point with certainty, the approach of low temperatures or of frost may be foreseen and provided against. Thus, suppose on a fine clear day, towards evening, that the dry-bulb is 50° and the wet-bulb 40°, the dew-point at the time (per Table) is 22° F. Frost on the ground may then be predicted with certainty, and no time ought to be lost in protecting the tender plants of the garden. If, on the other hand, with a sky quite as clear, the dry-bulb is 50° and the wet-bulb 47°, the dew-point is 43°, and no frost need be feared.

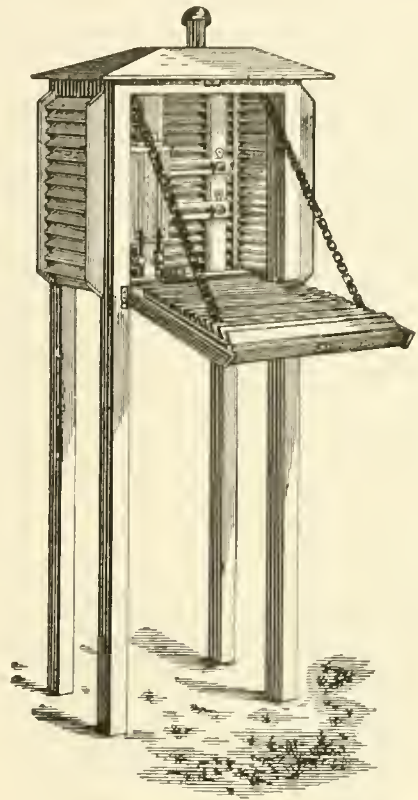
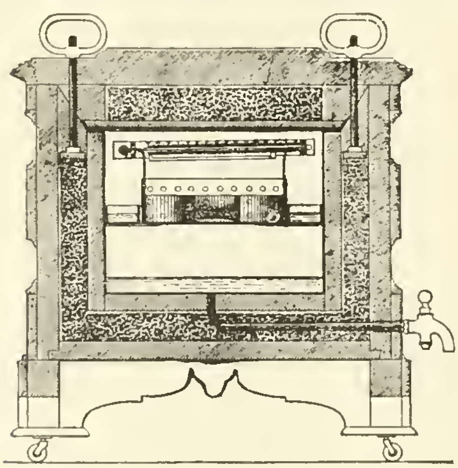


Fig. 4.

Assuming the sky to remain perfectly clear of all haze or clouds, the raising or depressing of the dew-point during the night, (usually with a change of wind), are the only circumstances that can happen to interfere with the predictions founded on the hygrometer. Frequently the presence of any haze at high altitudes during the night prevents the radiation of heat from the earth and thereby the frost which otherwise would have occurred. Hoar-frost is formed under the same circumstances as dew, with the single exception of a lower temperature. When the temperature of the surface of plants falls below 32° the moisture of the air is condensed upon them in the solid state and forms a layer of snow-crystals, like spongy ice. Hoar-frost therefore is not frozen dew, but the moisture of the air is deposited in the solid form, without having passed through the liquid condition. Hoar-frost, however, like dew, is deposited chiefly upon those bodies which radiate best, such as plants and the leaves of vegetables, and the deposit is made principally on those parts which are turned toward the sky. Since plants sometimes become cooled by radiation from 12° to 15° below the temperature of the surrounding air, a frost may occur although a thermometer a few feet above the ground, in an instrument-shelter, may not sink to 32°. During a clear and still night, when a thermometer which is six feet above the ground sinks to 36° or less, a heavy frost may be expected; and a slight frost may occur when the same thermometer sinks only to 47°. Whenever it is practicable, an instrument-shelter should be built. The Stevenson pattern, shown in Fig. 4, is a very suitable one. The louvres are double, sloping in opposite directions, so that while there is access of the air to the inside, the radiant heat and rain are effectually excluded. A single lattice, however, will answer the purpose very well. This screen should be erected on legs four feet high, and should stand over grass on open ground. It should not be under the shadow of trees nor within twenty feet of any wall. See *Thermometer*.

HYGROSCOPE.—The form of hygrometer employed to determine the ability of powder to resist moisture. It is usually an air-tight box in which the powder is subjected to a damp atmosphere at a uniform temperature for 24 hours. It consists of a box lined with copper, with a space of two inches between packed with hair. The lid is double also, like the sides, in construction; an India-rubber gasket covers the edges of the top, which is screwed firmly down with thumb-screws. Inside the box is a movable perforated tray of copper resting on ledges 8.5 inches by 8.5 inches. The intervening spaces have water-tight trays on ledges filled with a solution of niter.

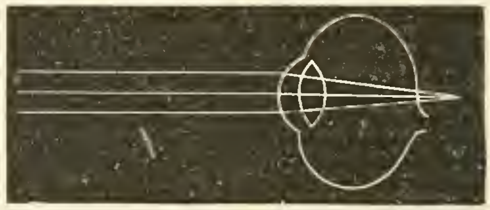
The powder to be tested is placed in circular cups of copper having fine wire-gauze bottoms, affording free access of moisture to all the parts of the sample under test. The percentage of gain is determined by weighing the powder in carefully prepared bottles



on opening the hygroscope. A careful record is kept of the barometer, the hygrometer, external and maximum and minimum internal thermometers. See *Gunpowder* and *Inspection of Gunpowder*.

HYPERMETROPIA.—An anomaly in the refraction of the eye which, by law, disqualifies a recruit for enlistment in the Army. This defect is dependent on a condition of the eye exactly the reverse of myopia. It is the condition in which rays from distant objects come to a focus *behind* the retina. A glance at the drawing will explain this condition. Hypermetropia is due to a formation of the eye, which is present from birth. It is also hereditary, being transmitted through entire families. Hypermetropic eyes are usually flat and shallow in appearance.

Although present from birth, it is often, unless of a high degree, not manifested until the duties of the school-room begin, and, in the slighter grades, it may not be noticed until adolescence or middle-life; neverthelesss the defect has existed all the while, but it has been masked and overcome by the exertions of the little ciliary muscle. Distinct vision is one of the instincts of our senses, and our eyes unconsciously adjust themselves so as best to secure it. Any change of the convexity of the lens is effected by the action of the ciliary muscle; now, since the focus for the rays falls behind the retina, the convex-



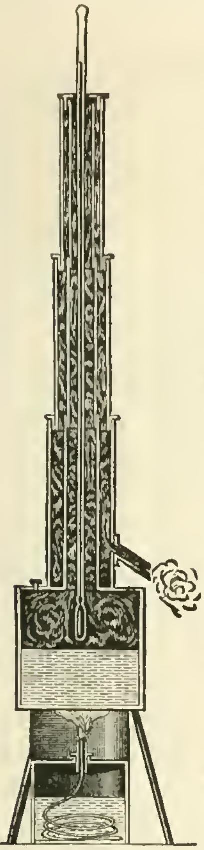
ity of the lens of the eye must be increased in order to bring the focal point on the retina, and hence the little muscle is called upon to do the work; but, since this condition of the eye is permanent, so also this muscular contraction is almost constant while the eyes are employed. Besides this constant exertion, the muscle must also act with vigor enough to give the ordinary power of accommodation for near objects.

In youth the ciliary is in its greatest vigor, and it then overcomes this defect even when of considerable degree, but as age advances, the power of the muscles diminishes and then it is that the defect begins to manifest itself. The great cause of all these symptoms is the overstrain and eventual exhaustion of the ciliary muscle. So long as it is able to accomplish its excessive task, it overcomes, or rather masks the defect, but as soon as its power gives out, the accommodation fails and indistinctness of near objects results, in addition to which we have the long chain of distressing symptoms which arise from the overstrain; many an obstinate headache has its sound in an unrecognized hypermetropia.

Since in this state of the eye the focus falls behind the retina, the remedy is found in a glass which will increase the refractive power of the eye, thus bringing the focus of the rays of light *on* the retina: such a result is obtained by the proper *convex* glass. As, however, the ciliary muscle is able to mask a certain amount of the defect, even after it has become apparent, the convex lens, which most improves distant vision, will correct but the portion of hypermetropia which is "manifest," and, indeed, frequently the patient may reject all convex glasses as failing to improve his distant vision, and yet be hypermetropic to a considerable degree.

The glass which corrects the manifest defect will often greatly conduce to the patient's comfort, yet to select the glass which will correct the entire defect, the accommodation of the eye must be temporarily suspended by putting the ciliary muscle at rest by means of a solution of atropia, when the entire defect becomes apparent and may be carefully measured by the oculist. See *Recruits*.

HYPSOMETRICAL THERMOMETER. It is generally assumed that water boils at 212° Fahrenheit, but this is true only at the sea-level, under a barometric pressure of 29.922, in latitude 45, at a temperature of 32° Fahrenheit, and with chemically pure water. The boiling-point, therefore, varies with the latitude, the height above sea-level, the pressure of the atmosphere and the temperature. Thus, at Philadelphia, under the mean barometic pressure of that locality, of 29.922 at 32° Fahrenheit, water boils at a temperature of 211.994 Fahrenheit. As there is an evident relation between the boiling-point and the elevation of a place, as shown by the decreased barometric pressure as we ascend, it would seem a comparatively simple matter to measure the height of a mountain by the temperature at which the ebullition of water occurs. The barometric pressure, however, for the same place, is continually varying, and with it, the boiling temperature of fluids. It follows, therefore, that in order to determine elevations with any degree of accuracy, by means of a boiling-point thermometer, it is necessary in the first place, that the thermometer employed should be most accurately graduated and compared with the reading of a standard barometer, reduced for temperature and latitude. It is necessary, also, that observations should be made, with as little interval of time between as possible, at the lower point from which the elevation of the higher point is to be determined, as well as at the higher point itself, and that these observations be repeatedly made. In relation to the necessity of a thoroughly acute thermometer, Admiral Fitzroy says, in his "Notes on Meteorology:" "Each degree of the boiling-point thermometer is equivalent to almost 550 ft. of ascent, or one-tenth to 55 ft.; therefore, the smallest error in the graduation of the thermometer itself, will affect the height deduced materially." Having prepared to make observations with accuracy, it will become necessary to ascertain the means of deducing the height from the observations made. The following Table gives very nearly the elevations in feet corresponding to a fall of 1°, in the temperature of boiling-water. When the barometer falls, or when a part of the pressure is in any other way removed, it boils before coming to 212°, and when the pressure is increased the boiling-point rises. An elevation of 105 feet above the sea-level makes a diminution of one degree; at higher levels the difference of elevation corresponding to a degree of temperature in the boiling-point increases. At the City of Mexico, 7,000 feet above the sea, water boils at 200°; at Quito, 9,000 feet above the sea, at 194°; and on Donkia Mountain, in the Himalayas, at the height of 18,000 feet, Dr. Hooker found it to boil at 180°. The knowledge of the effect of diminished pressure is largely turned to account in processes where the substances are apt to be injured by a high temperature.



Ebullition between	Elevation in Feet for each degree.
214 and 210	520
210 " 200	530
200 " 190	550
190 " 180	570

It is assumed that the boiling-point will be diminished 1° for each 520 feet of ascent until the temperature becomes 210°, then 530 feet of elevation will lower it one degree until the water boils at 200°, and so on, the air being at 32° Fahrenheit. As, according to Regnault, the air expands .002036 of its volume at 32° for each degree increase in temperature, it is necessary to find the mean temperature of the air between the two points, and applying the correction due to the difference between that and 32°, the formula will be as follows: Let H represent the vertical height in feet between the stations; B and b the boiling-points of water at the lower and upper stations respectively; and f, the factor found in the above table. Then $H=f$ (B b). Let m be the mean temperature of the stratum of air between the stations. Calling the correction due to the mean temperature of air C, its value will be found from the equation, $C=H\ (m-32)\ .002036$. Calling the corrected height H', it will be found from the formula

$$H'=H+H\ (m-32)\ .002036,$$

that is $H'=H\ [1+(m-32)\ .002036.]$

When an accurately made and carefully compared thermometer is employed in accordance with the foregoing rules and instructions, very accurate and valuable results may be obtained with the hypsometrical apparatus. But it is manifest that with thermometers as ordinarily made, whose freezing-points have been fixed without regard to the condition of a true zero, and with observations which leave entirely out of account many of the factors necessary to even approximate correctness, the results so obtained must often be of little value. See *Barometer* and *Thermometer*.

I

IBERIAN SWORD.—A small sword somewhat resembling a dagger and much worn by the Roman foot-soldiers, on the right side.

ICE.—In high latitudes, during the winter, rivers are frequently covered with ice of sufficient thickness to sustain the heaviest loads. This means of communication should be used with great circumspection. A change of temperature may not only suddenly destroy this natural bridge, but render the river impassable by any method for a considerable time in consequence of the floating ice. When from three to four inches thick, ice will sustain infantry marching in single file. With the thickness of 4.5 inches, cavalry and light guns can pass over it; with six inches, heavy field-pieces; eight inches will support siege-guns, but, for greater security the wheels should be locked and secured upon way-planks which slide upon the ice, the pieces being moved by hand. In very cold weather the thickness of the ice may be increased by covering it with a layer of straw or brush and throwing water over it, or two rows of logs may be laid at a distance apart equal to the width of the roadway; a layer of earth is spread between them and water is thrown on and allowed to freeze. This operation is repeated until a solid roadway is formed. Troops working in concert can accomplish in this manner a very strong crossing in a short while.

Ice, when very thick, and therefore difficult to remove, may be broken up by charges of powder in water-tight cans or bags, fixed underneath or placed in holes bored in it. Charges of from five to ten pounds of the powder placed in ice two feet thick will break up an area twenty feet in diameter. Eight ounces of dynamite will produce the like or even a greater result.

ICENI.—A warlike tribe of ancient Britain, occupying, as is supposed, that part of the country which corresponds nearly with the present counties of Norfolk and Suffolk. Under their Queen Boadicea they rebelled against the Romans.

ICH DIEN.—The motto of the Prince of Wales. According to one theory of its derivation, the phrase was employed by Edward I. on presenting his new-born son, Edward of Carnarvon, to the Welsh, using the expression in its Welsh signification—*Eich dyn*, "Behold the man." Another view attributes it to the occasion of the killing of John, King of Bohemia, by the Black Prince at Cressy, and asserts that the latter found the motto under the plume worn by the dead King, and assumed it to imply that "he served under the King, his father."

ICHNOGRAPHY.—The plan or representation of the length or breadth of a fortification, the distinct parts of which are marked out either on the ground itself, or on paper. A plan upon the correct principles of *ichnography* represents a work as it would appear if it were leveled to its foundations, and shows only the expanse of ground on which it had been erected. The science does not represent either the elevation or the different parts belonging to a fortification. This properly comes under the title PROFILE, which does not, however, include length.

ICICLES.—In Heraldry, charges of the same shape as drops in the bearing called gutté, but reversed. They have also been called clubs, locks of hair, and guttés reversed.

IGNITIBLE EXPLOSIVES.—Substances which on a match, tube, or detonating composition being applied to them, ignite, such as gunpowder, gun-cotton, nitro-glycerine, dynamite, and glyacyline, all of which can be used as explosive agents, for submarine as well as land purposes.

IGNITION.—The act of setting fire to, or of taking fire, as opposed to combustion or burning, which is the consequence of ignition. Gunpowder may be ignited by the electric spark, by contact with an ignited body, or by a sudden heat of 572° Fahrenheit. A gradual heat decomposes powder without explosion by subliming the sulphur. Flame will not ignite gunpowder unless it remains long enough in contact with the grains to heat them to redness. Thus, the blaze from burning paper may be touched to grains of powder without igniting them, owing to the slight density of the flame, and the cooling effect of the grains. It may be ignited by friction, or a shock between two solid bodies, even when these are not very hard. Experiments in France, in 1825, show that powder may be ignited by the shock of copper against copper, copper against iron, lead against lead, and even lead against wood; in handling gunpowder, therefore, violent shocks between all solid bodies should be avoided. The time necessary for the ignition of powder varies according to circumstances. For instance, damp powder requires a longer time for ignition than powder perfectly dry, owing to the loss of heat consequent on the evaporation of the water; a powder the grain of which has an angular shape and rough surface, will be more easily ignited than one of rounded shape and smooth surface; a light powder, more easily than a dense one; and a powder made of a black charcoal, more easily than one made of red, inasmuch as the latter is compelled to give up its volatile ingredients before it is acted on by the niter. See *Explosion* and *Gunpowder*.

IGNORANCE OF THE LAW.—*Ignorantia Juris*, or ignorance of the law, is held to be no excuse for any breach of contract or duty, nor for crime or other offense. It is absolutely necessary to start with this maxim, otherwise it would be quite impossible to administer the law, for if once a contrary maxim were allowed, it would not only be a premium to ignorance, but would lead to endless and abortive inquiries into the interior of a man's mind. Ignorance of a fact, however, is a different thing. Another kindred maxim of the law is that every man intends the consequences of his own acts. Thus, if he shoot at or give poison to a person, it is presumed that he intended to kill such person. So, if he leaves a trap-door open in a street or thoroughfare, it is held that he intended people to fall into it and be injured. There is, however, a doctrine called *bona fides*, which, in the case of petty offenses punishable by Justices, often tempers the strict and rigid application of the maxim *ignorantia juris neminem excusat*; and even in crimes a Court always takes into consideration, when passing judgment, whether the prisoner was an ignorant or intelligent person.

ILIYATES—EELIAUTS.—A nomadic tribe of Persia and Turkistan, and mostly of Turkish, Arabic, or Kurdish descent. They are Mohammedans of the Sunni sect. They have no settled abode, but live in tents, moving from place to place, according to climate or season. They have large flocks and herds, and some tribes live by plunder. Each tribe pays tribute in cattle for the use of grazing ground, money not being known among them. Also written *Eeliauts*.

IMAGINARY QUANTITY.—In the working of gunnery problems, it often happens that the root of a negative quantity must be extracted; if the root is odd, the operation can be performed, but if even, the root can only be *formally* extracted, and is in consequence called an *impossible* or *imaginary* quantity. For instance, the cube root of — 64 is not an imaginary quantity, for $-4 \times -4 \times -4 = -64$, and therefore $\sqrt[3]{-64} = -4$; but the square root of — 64 is an impossible quantity, for no possible quantity (whether it be + or —) multiplied by itself can produce a negative quantity; similarly and *à fortiori*, the fourth root — 64 is an impossible quantity, and the same is true of all even roots. Imaginary quantities are, however, generally reduced to one denomination as multiples of $\sqrt{-1}$, in the following manner: $\sqrt{-64} = \sqrt{64 \times -1} = \sqrt{64} \times \sqrt{-1} = 8\sqrt{-1}$; and again, $\sqrt{-18a^5} = \sqrt{9a^4 \times -2a} = \sqrt{9a^4} \times \sqrt{2a} \times \sqrt{-1} = 3a^2\sqrt{2a}\sqrt{-1}$. These forms very frequently occur in higher algebra.

IMBRUED.—An expression used in Heraldry to signify bloody, or dropping with blood. Weapons thus blazoned are drawn with drops of blood falling from them. Also written *Embrued*.

IMMORTALS.—In antiquity, the name of a body of 10,000 troops, constituting the guard of the King of Persia: so called because they were always of the same number; for as soon as any of them died, the vacancy was immediately filled up. They were distinguished from all the other troops by the richness of their armor, and still more by their bravery. The same term was applied to the life-guards of the Roman Emperors.

IMPACT OF PROJECTILES.—In order to arrive at a clear understanding of what takes place when the motion of a projectile is arrested by any resisting medium, it is necessary to recall some of the elementary principles upon which these phenomena depend. The manner in which a projectile acquires its velocity, is a good illustration of the manner in which its motion is destroyed. If the mean pressure, P, of the gas be multiplied by the space, S, passed over by the projectile while acquiring its velocity, the result will be the measure of the work done by the charge of powder; and it will also be equal to the work of stopping the same projectile, no matter how or by what means it may be brought to rest. The same result is generally arrived at by measuring the velocity imparted to the projectile under the circumstances mentioned, and multiplying the square of the velocity by one-half of the mass of the projectile; or, since the mass is equal to the weight divided by the force of gravity, the expression for the work stored in the projectile, and which must be expended in bringing it to rest, $= \frac{W v^2}{2g}$, where

W = weight of the projectile in pounds, v = velocity of the projectile in feet, and g = the force of gravity in feet, or the velocity which a body will acquire by its own weight in one second of time. This expression involves indirectly the same quantities as that first mentioned; namely, the mean pressure of the gas and the distance passed over by the projectile: assuming this measure for the work stored in the projectile, it remains to consider how this work is expended.

The following are the different effects produced by the impact of a projectile upon any solid body; some of these being so connected as to render their relative importance extremely doubtful.

Compression—The first effort of impact is to compress or drive back those portions of both projectiles and target first coming in contact upon those immediately behind them; the amount of this compression depending upon the material and velocity of impact, as well as upon the form of the projectile.

Elongation—The greater part of the work of the projectile in penetrating wrought-iron and similar materials is expended in overcoming the tenacity of the material, or in elongating the fiber. This is evident when we consider that punching or shearing consists not so much in cutting the fiber, as in bending it, and afterwards pulling it in two lengthwise.

Shearing—This, as just stated, consists chiefly in the two strains already mentioned.

Bending.—This also implies tension and compression; the back of the target being elongated, and the front compressed.

Pulverizing—a portion of the material. This takes place only in case of hard materials, as a stone or cast-iron, and it then absorbs a very great amount of work. Like bending and shearing, it involves compression and elongation, the material being compressed until it yields laterally to a tensile strain.

Motion—While the work is being expended, a certain amount of time is allowed for the force of the projectile to impart motion to the target, especially that portion immediately in front of the projectile.

Friction—The friction is very great, especially in the case of the more pointed form of projectile, and varies inversely with the velocity of the projectile.

Heat—This is due to friction, both external and internal, that is, of the projectile and the fragments against the target, and against each other during the distortion of the material, from compression, bending, etc. The suddenness with which this heat is generated is almost unequalled by any known source of heat. It is well known that the heat developed in the interior of loaded shells, on striking violently a thick iron plate, is sufficient to ignite the powder, and this fact has been utilized in dispensing with fuses for exploding armor-punching shells.

The effect of a projectile on striking a mass or target of any form or material, may be divided into two general portions,—one being entirely local, while the other is distributed over more or less surface according to circumstances. The former is the *penetration*, and the latter may be called *concussion*. See *Penetration of Projectiles*.

IMPALE.—In Heraldry, to arrange any two coats of arms side by side in one shield divided per pale. It is usual thus to exhibit the conjoined coats of husband and wife, the husband's arms occupying the dexter side or place of honor, and the wife's the sinister side of the escutcheon. When a man marries a second wife, heralds say that he may divide the sinister half of the shield per fess into two compartments, placing the family arms of his deceased wife in chief, and of his second wife in base. A husband impaling his wife's coat with his own, is not allowed to surround the former with the collar or the insignia of any order or knighthood to which he may belong. Bishops, Deans, Heads of Colleges, and Kings of Arms impale their arms with their insignia of office, giving the dexter side to the former. In early Heraldry, when two coats were represented in one shield side by side, only half of each was exhibited, an arrangement which has been called *dimidiation*. Sometimes the one coat only was dimidiated. A reminiscence of dimidiation is preserved in the practice of omitting the bordures, orles, and tressures in impaled arms on the side bounded by the line of impalement. See *Heraldry*.

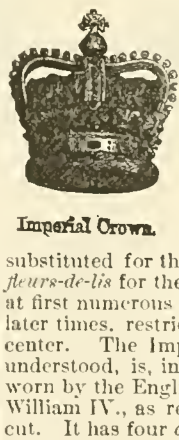
Impale.

IMPEDIMENTA. All the accompaniments to an army received from the Romans the name of *impedimenta*. They consist in a general sense of munitions, equipments, provisions, hospital supplies, tents, engineering tools, bridge equipage, boats, baggage, cooking utensils, etc., necessary for the use of an army moving against an enemy. This requires the use of large numbers of wagons and draught animals, or shipping, and necessarily impedes the movement of an army.

IMPENETRABILITY.—One of the essential properties of matter which implies that no two bodies can at the same time occupy the same space. If a nail be driven into a piece of wood it does not, properly speaking, *penetrate* the wood, since the fibers are driven aside before the nail can enter. If a vessel be filled with fluid, and a solid body be then placed in it, as much water will run over as is equal in bulk to the solid body, in this way making room for it. The lightest gases are really as impenetrable as the densest solid; although, owing to their compressibility, it is not readily made apparent.

IMPERATOR.—An old Roman title signifying Commander, which was applied to the Rulers of Provinces, the Consuls, Pro-Consuls, etc., or to anybody who had an *Imperium* assigned him. After a victory the Roman soldiers frequently saluted their Commander by this title. See *Emperor*.

IMPERIAL CROWN.—Properly the crown borne by the German Emperor; it is in form a circle of gold, adorned with precious stones and *fleurs-de-lis*, bordered and seeded with pearls, and raised in the form of a cap voided at the top like a crescent. From the middle of the cap rises an arched fillet enriched with pearls, and surmounted by a globe, on which is a cross of pearls. The name Imperial Crown is, however, in English Heraldry, applied to the crown worn in times past by the Kings of England. From the 12th century onwards, the Crown of the English Sovereigns underwent repeated changes in form and enrichment. That of Edward II. was formed of four large and four small strawberry leaves, rising in curves from the jewelled circlet, and having eight small flowers alternating with the leaves. In the crown of Henry IV. eight strawberry leaves, and as many *fleurs-de-lis* alternated with sixteen small groups of pearls, three in each. Under Henry V. the enriched circlet was for the first time arched over with jewelled bands of gold, and the apex of the arches were surmounted with a mound and a cross, while *crosses patées* were substituted for the strawberry leaves, and roses or *fleurs-de-lis* for the clusters of pearls. The arches, at first numerous and elevated to a point, became in later times, restricted to four, and depressed in the center. The Imperial Crown of Heraldry, as now understood, is, in point of fact, the form of crown worn by the English Sovereigns from Charles II. to William IV., as represented in the subjoined woodcut. It has four *crosses patées* and four *fleurs-de-lis* set alternately on the circlet, while four pearl-studded arches, rising from within the crosses, carry at their intersection the mound and cross. The State Crown of Queen Victoria differs considerably from this, having a far more enriched character. It is



Imperial Crown.

covered with diamonds and studded with gems, and the arches are wrought into wreaths of rose, thistle, and shamrock formed of brilliants. A charge, crest, or supporter, crowned with a regal crown, is said to be *imperially crowned.*

IMPERIAL GUARDS.—The name of a body of select troops, organized by the French Emperor, Napoleon I., which greatly distinguished themselves at Austerlitz.

IMPERIALISTS.—A designation chiefly applied to the subjects of, or forces employed by the House of Austria, when opposed to the troops of other German Powers.

IMPETUS.—In gunnery, the altitude through which a heavy body must fall to acquire a velocity equal to that with which a ball is discharged from a piece.

IMPLEMENTS.— Artillery implements are employed in loading, pointing, and firing cannon, and in the maneuver of artillery-carriages. The implements for loading cannon are :—1st. The *rammer-head* is a short cylindrical piece of beech or other tough wood, fixed to the end of a long stick of ash, called a *staff*, and is employed to push the charge to its place in the bore or chamber of a cannon. 2d. The *sponge* is a *woollen* brush, Fig. 1, attached to the end of a staff, for the purpose of cleaning the interior of cannon, and extinguishing any burning fragments of the cartridge that may remain after firing. In the field and mountain services, the rammer-head and sponge are attached to the opposite ends of the same staff; in the siege and sea-coast services they are attached to separate staves. To protect the sponge from the weather, it should, when not in use, be enclosed in a *cover* made of canvas and painted. 3d. The *ladle* is a copper scoop attached to the end of a staff for the purpose of withdrawing the projectile of a loaded piece. Ladles are only used for siege and sea-coast cannon, as field and mountain cannon can be unloaded by raising the trail of the carriage, which permits the projectile to slip out by its own weight. 4th. The *worm*, Fig. 2 is a species of double cork-screw, attached to a staff, and is used in field and siege cannon to withdraw a cartridge. 5th. The *gunner's haversack* is made of leather, and suspended to the side of a cannonier by a shoulder-strap. It is used to carry cartridges from the ammunition-chest to the piece, in loading. 6th. The *pass-box* is a wooden box closed with a lid, and carried by a handle attached to one end. It takes the place of the haversack in siege and sea-coast service, where the cartridge is large. 7th. The *tube-pouch* is a small leather pouch attached to the person of a cannonier by a waist-belt. It contains the friction-tubes, lanyard, priming-wire, the thumb-stall, etc. 8th. The *budge-barrel* is an oak barrel bound with copper hoops. To the top is attached a leather cover, which is gathered with a string, after the manner of the mouth of a bag. It is employed to carry cartridges from the magazine to the battery, in siege and sea-coast services. 9th. The *priming-wire* is used to prick a hole in a cartridge for the passage of the flame from the vent. It is a piece of wire, pointed at one end, and the other is formed into a ring which serves as a handle. 10th. The *thumb-stall* is a buckskin cushion, attached to the finger to close the vent in sponging. 11th. The *fuse-setter* is a brass drift for driving a wooden fuse into a shell. 12th. The *fuse-mallet*, Fig. 3 is made of hard wood, and is used in connection with the setter. 13th. The *fuse-saw* is a 10-inch tenon saw for cutting wooden or paper fuses to a proper length. 14th. The *fuse-gimlet* is a common gimlet, which may be employed in place of the saw to open a communication with the fuse composition. 15th. The *fuse-*

Fig. 1.

Fig. 2.

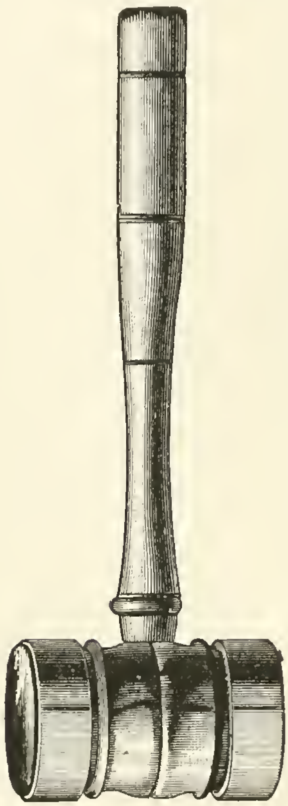


Fig. 3.

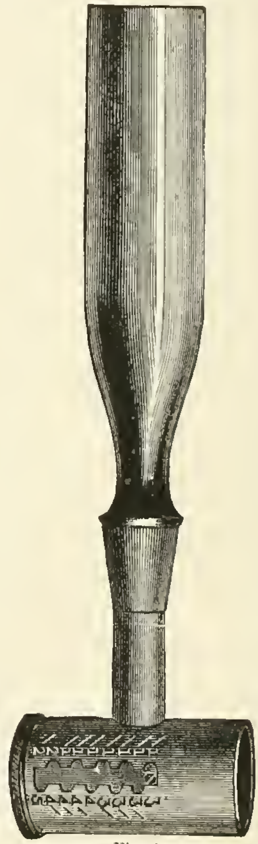


Fig. 4.

auger is an instrument for regulating the time of burning of a fuse, by removing a certain portion of the composition from the exterior. For this purpose it has a movable graduated scale, which regulates the depth to which the auger should penetrate. 16th. The *fuse-rasp* is a coarse file employed in fitting a fuse-plug to a shell. 17th. The *fuse-plug reamer* is used to enlarge the cavity of a fuse-plug, after it has been driven into a projectile, to enable it to receive a paper fuse. 18th. The *shell-plug screw* is a wood screw with a handle; it is used to extract a plug from a fuse-hole. 19th. The *fuse-extractor* is worked by a screw, and is a more powerful instrument than the preceding: it is used for extracting wooden fuses from loaded shells. 20th. The *mortar-scraper* is a slender piece of iron with a spoon at one end, and a scraper at the other, for cleaning the chamber of a mortar. 21st. The *gunner's sleeves* are made of flannel or serge, and are intended to be drawn over the coat-sleeves of the gunner, and prevent them from being soiled while loading a mortar. 22d. The *funnel* is made of copper, and is used in pouring the bursting charge into a shell. 23d. The *powder-measures*, Fig. 4, are made of copper, of a cylindrical form, and of various sizes, for the purpose of determining the charges of shells and cannon, by measurement. 24th. The *lanyard* is a cord, one end of which has a small iron hook, and the other a wooden handle. It is used to explode the friction-tubes with which cannon for the land service are now fired. 25th. The *gunner's pincers, gimlet*, and *vent-punch* are instruments carried in the tube-pouch for removing ordinary obstructions from the vent. 26th. The *shell-hooks* is an instrument constructed to fasten into the ears of a shell, for the purpose of lifting it to the muzzle of the piece.

The implements for pointing are: 1st. The *gunner's level* is an instrument for determining the highest points of the breech and muzzle of a cannon when the carriage-wheels stand on even ground. It is made of a *brass plate*, the lower edge of which is terminated by two *steel points* which rest upon the surface of the piece. A *spirit-level* is attached to the plate with its axis parallel to the line joining the points of contact. When the level is in position, the vertical *slide* is pressed down with the finger to mark the required point. 2d. The *tangent-scale* is a brass plate, the lower edge of which is cut to the curve of the base-ring of the piece, and the upper edge is formed into offsets which correspond to differences of elevation of a quarter of a degree. It is used in pointing, by placing the curved edge on the base-ring, with the radius of the offset corresponding with the highest point of the ring, and sighting over the center of the offset and the highest point of the swell of the muzzle. 3d. The *breech-sight*, is a more accurate form of the tangent-scale. It consists of a *vertical scale* graduated to degrees and eighths of degrees, and a curved *base* which rests upon the breech of the gun. A slide is attached to the vertical piece, which has a small hole or notch cut on its upper edge, through which the aim is taken. The slide is fixed at any point by a thumbscrew. 4th. The *pendulum hausse* is used to point field-pieces, and at the same time to obviate the error which will arise when the wheels of the carriage stand on uneven ground. It is composed of a *scale* arranged like a pendulum, a *suspension-piece*, and a *seat* which is screwed to the breech of the gun. A slot is cut in the suspension-piece into which the scale is inserted, and fastened by a pivot, which allows it to vibrate in a lateral direction. The scale also vibrates in a longitudinal direction, as the journals of the suspension-piece are free to turn in the grooves cut in the seat to receive them, thus assuming a vertical position independently of the surface of the ground on which the carriage stands. 5th. The *gunner's quadrant* is a wooden instrument for measuring the angles of elevation and depression of cannon, and particularly of mortars. The nature of the instrument and its mode of application are very simple. The plumb-line and bob when not in use, are carried in a hole formed in the end of the long branch, and covered with a brass plate.

The principal maneuvering implements are: 1st. The *trail-handspike*, which is made of wood, and attached to the trail of a field-carriage for the purpose of giving direction to the piece when aiming. When the carriage is limbered, the handspike is attached to the cheek by means of a ring and hook. 2d. The *maneuvering-handspike* is likewise made of wood, but it is longer and stouter than the preceding; it is used for siege and sea-coast carriages and gins. 3d. The *shod-handspike* is made of wood, armed with an iron point, which is turned up in a way to prevent slipping on the platform. It is particularly useful in the service of mortars and sea-coast carriages. 4th. The *truck-handspike* is made of iron, and is employed to work the maneuvering wheels of sea-coast carriages, by inserting it in the holes formed in the circumference of the wheels. 5th. The *eccentric-handspike* is used to throw the eccentric axis of the maneuvering wheels of the sea-coast carriages into and out of gear, for this purpose it has a head with a hexagonal hole which fits upon the extremities of the eccentric axle-tree. 6th. The *roller-handspike* supplies the place of rear maneuvering wheels in certain of the new sea-coast gun-carriages. It is operated by inserting the point of the handspike under the heel of the carriage-shoe, and pressing down the long arm of the lever: in this way the weight of the rear portion of the carriage is thrown upon the roller, which moves upon the rail of the chassis. 7th. The *prolonge* is a stout hemp rope, occasionally employed in field-service to connect the lunette of the carriage and pintle-hook of the limber when the piece is fired. It is terminated at one end with a hook, at the other with a toggle, and has two intermediate rings, into which the hook and toggle are fastened whenever it is necessary to shorten the distance between the carriages. 8th. The *sponge-bucket* is made of sheet-iron, and is attached to field-carriages; it is used for washing the bore of the piece. 9th. The *tar-bucket* is also made of sheet-iron, and is used to carry the grease for the wheels. 10th. The *watering-bucket* is made of sole-leather, riveted at the seams, and is used to water the horses. The gutta-percha watering-buckets are sometimes used. 11th. The *water-buckets* are made of wood, and bound with iron hoops. There are two kinds, one for the traveling-forge, and the other for the service of the garrison-batteries. 12th. The *drag-rope* has a hook at one end, a loop at the other, and six wooden handles placed about four feet apart. It is used whenever it may be necessary to employ a number of men in hauling loads, or extricating a carriage from a difficult part of a road. 13th. The *men's-harness* is very similar to the drag-rope, except that the rope is stouter, and the handles are replaced by leather loops which pass over the shoulders of the men, to enable them to exert their strength to advantage. 14th. The *bill-hook*, or hand-bill, is used for cutting twigs. 15th. The *screw-jack* is a lifting-machine, composed of a screw worked by a *movable nut* supported on a *cast-iron stand*. It is useful in greasing carriage-wheels.

IMPREGNABLE.—Not to be stormed or taken by assault; incapable of being reduced by force; able successfully to resist attack; as an impregnable fortress.

IMPRESSION-TAKER.—A device employed for recording impressions of vents and interiors of bores in the inspection of cannon. In its usual form, it consists of a wooden head, one-half of which is cylindrical, and the other half is of the shape of the chamber, both being rather smaller than the parts of the bore for which they are intended. The staff, flattened on its upper side and rounded on its under side to fit the curve of the bore, is mortised into the cylindrical portion of the head. A mortise is cut through the chamber part of the head, extending several inches in the rear and the front of the position of the vent. Into this mortise a loose piece is fitted, capable of free motion upwards and downwards, the top of which is pierced with holes to secure the wax or composition which is spread over its surface. This movable piece rests on a wedge attached to a flat rod running through a slot in this rod about four inches long, a pin passing through it into the staff.

To use the instrument, withdraw the rod as far as the slot will permit, which will allow the movable piece upon which the composition has been spread to drop below the surface of the head, and protect it. Push the head to the bottom of the chamber and arrange the position of the staff, so that the movable piece will cover the vent, then press the end of the rod home. This motion will throw out the composition, and a distinct impression of the vent and of *fire-cracks* (should there be any) will be left on the surface; draw the rod back as far as the slot will allow, and withdraw the instrument; the impression, being protected thereby, will come out uninjured. Impressions of injuries or cavities in the bore may easily be taken by a similar contrivance. See *Gutta-percha Impressions*, *Inspection of Ordnance*, and *Vent Impressions*.

IMPRISONMENT.—Officers may be sentenced to imprisonment by a general Court-Martial in any case where the Court may have discretionary authority. General, Garrison, or Regimental Courts-Martial may sentence soldiers to imprisonment, solitary or otherwise, with or without hard labor for various offenses enumerated in the Articles of War. A Garrison or Regimental Court-Martial, in awarding imprisonment, is limited to a period not exceeding thirty days. When a Court awards solitary imprisonment as a punishment, it is necessary the words "Solitary Confinement" should be expresed in the sentence. The legal imprisonment in the United States is confinement, solitary confinement, and a confinement on bread and water; the latter does not extend over 14 days at a time, with intervals between the periods of such confinement not less than such periods, and not exceeding 84 days in any one year.

IN BATTERY.—A command in heavy artillery service for moving the gun forward into position, prior to aiming and firing. For instance, at the siege-battery, as soon as the piece is loaded, Nos. 1 and 2 unchock the wheels (if they have been chocked), and with Nos. 3, 4, 5, and 6, all facing towards the epaulment, embar; Nos. 1 and 2 through the front spokes of the wheels, near the fellies, under and perpendicular to the cheeks; Nos. 3 and 4 under the rear of the wheels, and Nos. 5 and 6 under and perpendicular to the stock, near the trail. All being ready, the gunner commands: HEAVE, and the piece is run into battery, Nos. 5 and 6 being careful to guide the muzzle into the middle of the embrasure. As soon as the wheels touch the hurter, he commands: HALT. All unbar, and Nos. 1, 2, 3, and 4 resume their posts.

INCAPABLE.—A term of disgrace, frequently annexed to military sentences, when an officer has been cashiered by the sentence of a General Court-Martial, and rendered incapable of ever serving his country in either a civil or military capacity.

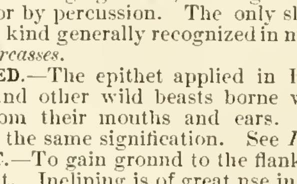
INCENDIARY MATCH.—A preparation in pyrotechny, made by boiling slow-match in a saturated solution of niter, drying it, cutting it into pieces, and plunging it into melted fire-stone. It is principally used in loaded shells. See *Fireworks*.

INCENDIARY SHELL.—A hollow projectile charged with incendiary composition, and designed for setting fire to buildings, ships, and other objects. Hollow balls filled with fire, appear to be among the earliest projectiles used in warfare after the introduction of the Greek-fire, though these were not fired from cannon; but descriptions are given of balls of fire used by the Saracens in Spain, which seem to correspond closely with modern incendiary-shells. The use of incendiary compounds appears to have gradually become obsolete, as we hear little or nothing of their employment until toward the close of the 18th century, hot shot being used as a substitute. About 1797, Chevallier, in France, invented an incendiary compound, which seems to have been tried to a limited extent by the French Government, for filling shells. Since then, many inventors have exercised their ingenuity upon this subject, the principal object being to obtain an inextinguishable composition for charging shells, to be ignited either by time-fuse or by percussion. The only shells of the incendiary kind generally recognized in modern warfare are *carcasses*.

INCENSED.—The epithet applied in Heraldry to panthers and other wild beasts borne with flames issuing from their mouths and ears. The term *Ammé* has the same signification. See *Heraldry*.

INCLINE.—To gain ground to the flank, as well as to the front. Inclining is of great use in the marching of the line in front, to correct any irregularities that may happen. It is equivalent to the quarter facing and to the oblique marching of the infantry. It enables us to gain the enemy's flank without exposing our own, or without wheeling or altering the parallel front of the company.

INCLINED PLANE.—The inclined plane is reckoned as one of the mechanical powers, because, by rolling it up a plane, a man may raise a weight which he could not lift. This principle is extensively made use of, chiefly in the raising of weights and in road-making. It is here unnecessary to go into a mathematical investigation of the theory of the inclined plane, as it may be seen in the common books on mechanics, but the result is as follows: The force required to lift a body (viz., its weight) bears to the force required to keep it from rolling down an in-

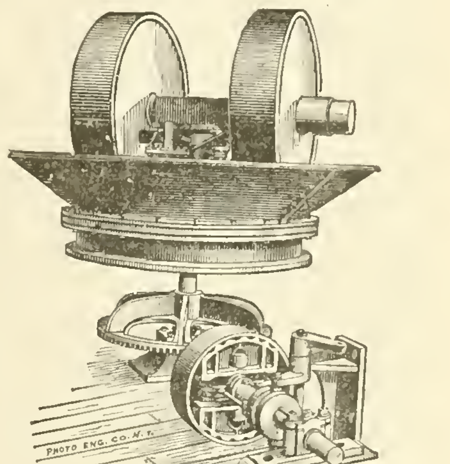


clined plane, the same proportion that the length of the inclined plane bears to its height; also the weight of the body bears to the weight which tends to bend or break the inclined plane, the same proportion that the length of the plane bears to its base. Let us suppose a plane, whose length, AB, is thirteen feet; base, AC, twelve feet; and height, BC, five feet; and let the weight be 780 pounds. Then the force, P, which can sustain 780 pounds on the inclined plane, is $\frac{5}{13}$ths of 780, or 300 pounds (*i. e.*, a force which could just lift 300 pounds); also the force, R, which presses perpendicularly on the plane, is $\frac{12}{13}$ths of 780, or 720 pounds. When the weight has not only to be sustained on the plane but drawn up to it, the resistance of friction has to be added to the power necessary to sustain the weight. In common roads, Engineers are agreed that the height of an incline should not exceed $\frac{1}{20}$th of the length, or, as they phrase it, the *gradient* should not be greater than one in twenty. It may here be mentioned that knives, chisels, axes, wedges, and screws, are mere modifications of the inclined plane, but the last two being generally classed as distinct mechanical powers, will be treated each under its own head. See *Mechanical Powers*.

INCLOSED WORKS.—Inclosed works are assailable on all sides, and must, for security, present an unbroken line to the assault. They are usually divided into three classes, viz.: 1st. Polygonal works or redoubts; 2d. Tenailled works or star forts; 3d. Bastioned works. The redoubts may be inclosed on all sides of a square, polygonal, or circular figure. The latter form is rarely used, being unsuitable to ground in general, and from the impossibility of giving any flanking defense to the ditch. Redoubts on level ground are generally square or pentagonal. On a hill or rising ground their outline will, in most cases, follow the contour of the summit of the hill. The dimensions of all inclosed works should be proportioned to the number of men they are to contain. One file, that is, two men, are required for the defense of every lineal yard of parapet; the number of yards in the crest line of any redoubt should not, therefore, exceed half the number of men to be contained in it. Again, as every man in an inclosed work requires 10 square feet of the interior space, that space clear of the banquette must not contain less than ten times as many square feet as the number of men to be contained in it. From these considerations it follows: 1st. To find the least number of men sufficient to man the parapet of an inclosed work, multiply the number of yards in the crest line by two. 2d. To find the greatest number of men that an inclosed work can contain, find the area, clear of the banquette, in square feet, and divide this number by 10. When the work contains guns, 324 square feet must be allowed for each gun, and this quantity, multiplied by the number of guns, must be subtracted from the whole interior space. The remaining number of square feet, divided by 10, will give the number of men which the redoubt can hold. The side of a square redoubt should, under no circumstances, be less than 50 feet. The great objections to small inclosed works are: 1st, the liability of their faces to be enfiladed from without; 2d, the difficulty of providing an effective flanking defense for their ditches; 3d, the weakness of their salient angles, the ground in front of them being undefended by a direct fire. In tracing redoubts and all inclosed field works, care must be taken to direct as much as possible their faces upon inaccessible ground, so as to reduce to a minimum the effects of an enemy's enfilade, while approach on the salients must be rendered difficult by abatis, trous-de-loup, and obstacles of all available descriptions. It will henceforward be very difficult to guard the interior of inclosed works from the effects of distant musketry. Well-trained troops from a distance of 900 yards could throw with certainty every shot into the interior of even a small redoubt; while the angle at which they fall, some 15° to 20°, would enable them to sweep the whole interior and make every part of the redoubt too hot. It seems to be a question whether such a work can be protected by traverses from such a plunging fire. See *Bastioned Forts*, *Field Fortification*, *Redoubt*, and *Star Forts*.

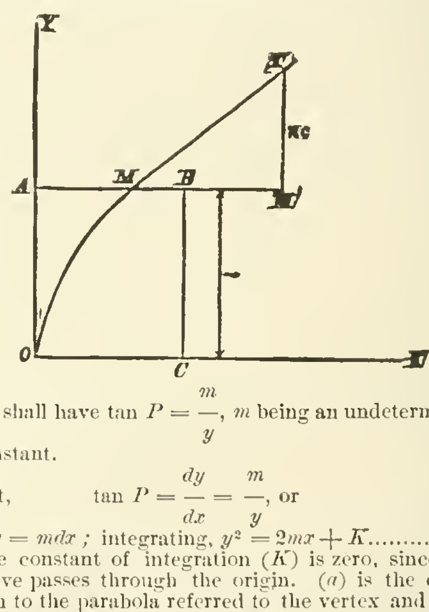
INCOMMODER L'ENNEMI.—To get possession of a fort, eminence, etc., from which the enemy may be harassed, or which is necessary to his security.

INCORPORATING MILL.—The incorporation, or grinding together, of the three ingredients that form gunpowder is by far the most important process in the whole manufacture, for unless the minute particles of the three ingredients be thoroughly blended and brought into the closest contact with each other, all subsequent operations—however well performed—will not compensate for the error. The incorporating mill, which is shown in the drawing, consists of two large and heavy "hard chill" cast-iron edge runners, revolving on a circular cast-iron bed; the peculiar action of these runners or rollers is well adapted for thoroughly grinding and incorporating the several ingredients; their great weight is for crushing the ingredients; which are also ground together by the twisting action produced by the rollers traveling round in so small a circle. Each roller travels over the bed in a separate track, and is assisted by the plough (hereafter described), which mixes the material, so that it is subjected to crushing, grinding, and mixing by the one operation. Incorporating mills in a gunpowder factory are usually grouped together, and the motive power may either be water or steam; in either case the power provided should be capable of driving four or more pairs of runners. Each pair is so arranged that it can be disengaged or put in gear at pleasure by means of a friction-clutch, without interfering with the steady working of the engine or water-wheel. When the latter is employed, the speed is regulated by a governor in connection with the sluice; by this means the flow of water is caused to immediately increase or diminish as a pair of runners is put into motion or stopped, and thus a regular speed is always maintained. The runners travel round the bed at the rate of 8 revolutions per minute; they are 6′ 6″ in diameter by 15″ broad on the face, and they each weigh four tons. As already stated, the two travel on different paths, the one being near to the outside rim or curb of the bed, while the other travels near to the inside curb or "cheese." A horizontal shaft or spindle common to both runners passes through their centers, and between them is a crosshead, fixed on a vertical shaft driven by means of a bevel wheel and pinion, the latter being secured on the main driving-shaft that passes underneath the bed of each mill, and is common to all. The vertical shaft passes through



the crosshead, and is provided with brass bushes, which allow the runners to rise or fall according to the irregularity in the thickness of the material under them. On each side of the crosshead and projecting outwards is an iron bracket, having a plough (made of a wedge-shaped piece of wood shod with felt and leather) fitted to it, and so arranged as to sweep the bed and to keep the composition under the runners. The one plough sweeps against the outside curb, immediately in front of the runner that travels round the larger circle, and the other against the cheese or inside curb, immediately in front of the runner that travels round the smaller circle. The inside of the outer curb, as well as the outside of the cheese where the ploughs work and rub against them, are covered with copper or gun-metal. The composition attains a body in about one hour after the runners are set in motion, and the action of the ploughs in moving the whole of the material on and across the bed thoroughly mixes it, and subjects every particle to the same amount of pressure. Each pair of runners is provided with a tell-tale dial, which shows the attendant the time that the mill has to run, and enables him to judge the condition of the cake from time to time. From three to four hours is the period a charge should be on the mill, providing the engine or water-wheel is maintained at its proper speed. This timing of a charge is a very important point in the manufacture where powder of an equal quality is required, and the attendant has to watch for any change in the atmosphere, so that he may work the charge dry or moist, as the humidity of the air leads him to determine. The ingredients, or charge, as it comes from the mixing-machine—50 lbs. in weight—is spread equally over the bed of the mill, and moistened with from 4 to 8 pints of distilled water by means of a rose-ended watering-pot, the quantity being regulated according to the state of the atmosphere, and as the experience of the attendant shows him to be necessary. The cake should be of a blackish-gray color, and, when broken, of a uniform appearance, without any white or yellow specks in it; the presence of these would indicate insufficient incorporation or grinding. Further, it should not be more than half an inch in thickness, in order to be thoroughly incorporated, nor should it be less than a quarter of an inch thick to insure safety, because if the runners are allowed to come in contact with the bed, the friction caused by their twisting action is so great that an explosion would almost certainly be the result. At the expiration of three or four hours under the before mentioned conditions, a charge will have attained all the properties of gunpowder, nor will the powder be improved by heavier runners or an increase of speed. For fine sporting gunpowder, however, the operation of incorporating is continued in some cases for as long as 8 hours, and with heavier rollers, but it is doubtful whether the powder is much, if at all, improved thereby; the purity of the ingredients is of more consequence, inasmuch that on this the quality of powder depends much more than upon a long or short period of incorporation, for if regularity be observed and the runners are of one size and weight, and the charges are worked for an equal length of time and under the same conditions, a fairly uniform powder will be the result. A method used by some for testing whether the incorporation has been well performed, is to take half an ounce of the cake granulated by hand and flash it off on a glass plate; if a slight residue only is left on the surface it is a sign that the attendant has done his work thoroughly. It has already been stated that incorporating-mills are generally in groups: it becomes necessary, therefore, to prevent explosions spreading amongst these mills. This is very effectually done by the use of a drenching apparatus, which consists of a large board acting as a flapper, and placed horizontally over each pair of runners. This flapper is attached to a shaft running throughout the entire group of mills, and in connexion with it, and immediately over each set of runners, is a copper cistern holding about 40 gallons of water, so arranged and poised that when the flapper is raised by an explosion the catch is disengaged, and the cistern overbalancing empties its contents upon the mill. This, of course does not prevent damage being done to the mill in which the explosion first occurs, but as the whole are connected to each other by means of the shaft referred to, all the cisterns of the group are emptied at the same time, thereby drenching the charges in the other mills, and thus confining the damage to that mill wherein it originated. In addition to this, an arrangement is provided whereby the attendant can, in case of an explosion in any part of the works or in his immediate neighborhood, upset the cisterns of water from the outside, and thus prevent the explosion spreading. In a well-constructed incorporating mill all the movable parts, such as bolts, nuts, etc., are fitted with the greatest care, and at each end of the runner-shaft, and also over and under the cross-head between the runners, large gun-metal discs or drip-pans are fitted: these not only prevent any oil or greasy matter dropping into the charge, but likewise any bolt, nut, or pin that may have become loose in the vicinity of these parts, falling down into the charge, and possibly producing an explosion, if the mill is at work. Further, where steam is employed as the motive-power in a gunpowder works, care must be taken at all times to prevent sparks being emitted from the boiler chimney; this may be effected in several ways, either by using anthracite coal, or coal and coke, for the boiler furnace, or by having a spark-catcher or arrester fitted inside the flue near the base of the chimney, or a number of baffle-plates being placed in the chimney itself in a zig-zag manner. If proper precautions are taken, and the flues are regularly cleaned out, there will be no risk whatever in using steam-power. See *Gunpowder*.

INCREASING TWIST.—For an increasing twist, the edges of the angle-board must be curved accordingly, and as it is the property of the parabola to increase uniformly, it has been adopted as the curve of the rifling for those guns having an increased twist. When this system is adopted, the grooves start in a direction parallel to the axis of the bore, and the twist increases uniformly towards the muzzle. In the drawing, ABCO denotes the development of the bore, and OM that of a groove. The origin of the co-ordinate axes is taken at the commencement of the groove at the bottom of the bore; the axis of Y is parallel to the axis of the bore. The curve OM is tangent to OA at O, since the projectile starts in the direction OA. Let P denote the variable angle between OX and the direction of the curve OM. If the twist increases uniformly, tan P will *decrease* uniformly as the ordinate *increases*, and



we shall have $\tan P = \dfrac{m}{y}$, m being an undetermined constant.

But, $$\tan P = \frac{dy}{dx} = \frac{m}{y}, \text{ or}$$

$ydy = mdx$; integrating, $y^2 = 2mx + K$............(a)
The constant of integration (K) is zero, since the curve passes through the origin. (a) is the equation to the parabola referred to the vertex and principal axes. In the figure, MT is the tangent at M, and MM′ equals AB $= \pi c$, c being the caliber of the gun. Also M′T is put equal to nc, n denoting the number of calibers in which the projectile makes one turn after leaving the muzzle. To determine m, putting P', for the value which P has at M we have

$$\tan P' = \frac{m}{l};$$

also,
$$\tan P' = \frac{nc}{\pi c} = \frac{n}{\pi};$$

$$\therefore \quad m = \frac{ln}{\pi}$$

Whence the equation to the curve is

$$x = \frac{\pi y^2}{2ln} \text{...............................} (b)$$

By means of equation (b) the curve is easily traced. The advantages claimed for this method of rifling are, that the projectile, not being forced to take the whole twist of the rifling at once, moves more readily from its seat, and thus the initial strain upon the breech of the gun is reduced, thereby prolonging its life; also that the bearings on the projectile are not liable to be torn off. Theoretically it would seem that a system of rifling which permits the projectile to move directly from its seat, at the moment of ignition of the charge, must be more favorable to endurance than one which, by impeding the first movement of the projectile in the bore, narrows the space for the expanding gas, and consequently brings a greater pressure on the breech of the gun. But practically this method does not appear to be successful in the enormous cannon of recent construction. The greatest objection to the increasing twist is that it cannot be used with a long bearing of projectile. Indeed, the theoretical bearing, whether it is a soft metal ring, a strip, or a stud, is infinitely short a mere line—and practically, length of bearing only obtained by a constant molding of the projectile to the new angle of rifling, so that the portion of the projectile intended to take the grooves, must be short and also soft, for if it cannot obtain, by changing its figure, more bearing on the grooves than on a mere line, it will undoubtedly cut the grooves, thus increasing friction, and soon ruining the bore. In the absence of further experiments, it would hardly be safe to conclude that long bearings will not prove indispensable to the heavy projectiles and high velocities that are now required. A projectile, if balanced on weakening studs in each groove, is liable to break up through the stud-holes, thereby injuring the gun. To rapidly rotate an iron cylinder, say twelve inches in diameter and three calibers in length, weighing nearly a third of a ton, by a ring of such points, is very likely to produce a *wabbling* motion and unsteady movements in flight, with reduced range. Very rapid twist, although it conduces to steadiness of motion, cannot be given because small bearings will not endure the great effort necessary. See *Grooves*, *Rifling*, and *Twist*.

INDEMNIFICATION.—In the French and English Armies, there is an indemnification established for losses in the military service, and other allowances are also made in the nature of indemnifications; as for *furniture; fuel* and *light; forage; expenses of divine worship; command money* to General and Field Officers; *quarters; expenses upon routes*; *provisions; gratuity at the beginning of a campaign; field allowances; mess; carriage of baggage; blood-money; permanent pensions; temporary pensions*, or *gratuities* in lieu thereof; *rewards* for meritorious conduct; and *pensions* to widows and children of officers.

In the United States service, the law provides that if a horse be lost in battle, an officer may receive not exceeding two hundred dollars for his horse, and allowances are made for quarters, fuel, forage, provision and transportation of baggage, and command money in certain cases.

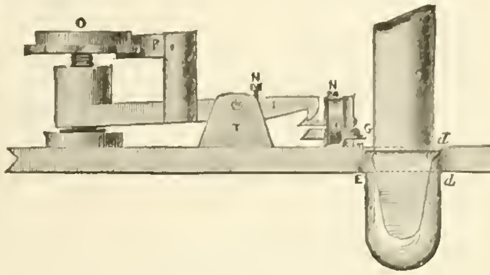
INDENT.—A word particularly made use of in India for the dispatch of military business. It is of the same import and meaning as *to draw upon*. It likewise means an order for military stores, arms, etc., as an indent for new supplies, etc.

INDENTED.—In Heraldry, one of the partition lines of the shield, similarly notched to dancetté, but with the notches much smaller, and not limited in number. See *Heraldry*.

INDENTED LINE.—In fortification, a serrated line, forming several angles, so that the one side defends another. The faces are longer than the flanks. Indented lines are used on the banks of rivers, where they enter a town. The parapet of the covered-way is also often indented.

INDENTER.—This active element of the chronoscope, as shown in the drawing in section, consists of the circular knife, G, fixed in the mainspring, H, which can be cocked by means of the catch on the lever, I. On the breaking of the first circuit, the chronometer falls vertically; on the rupture of the second the registrar falls in its turn, depresses the free end of the lever, I, and thus releases the mainspring; the knife juts forward, strikes the falling chronometer, and indents the upper recorder. As shown below, a very simple relation holds between the dent thus obtained and the velocity of the projectile which caused it. A moment's thought will show that the lower the velocity the higher up shall the recorder be indented.

The chronometer is used in leveling the chronoscope; for this purpose attach it to its magnet, *having previously cocked the indenter*; then, by means of the tripod-screws, bring it to its normal position. In



leveling from front to rear, let the beveled shoulder of the bob, opposite the numbered face, rest lightly against the projecting edge, *e e*, of the triangular base; in leveling laterally, align the right face with the edge *d d*, of the salient angle of the above projection. In cocking the indenter, be careful not to disturb the level of the instrument; the left hand alone is therefore used; the fingers grasp the tube, L, while the thumb pulls pack the spring until it catches in the lever, I. The screw, M, which is tapped through the lever and rests on the fulcrum-mortise will regulate the hold of the catch, which should be as light as possible. The knife is a circular rowel of tempered cast-steel fastened in a slot of the mainspring by the axial screw, N, the loosening of which permits the presentation of a new edge, should the old one be blunted. See *Le Boulengé Chronograph*.

INDENTING FORCE.—The comparative softness or hardness of metal is determined by the bulk of the cavities or indentations made by equal pressure: the softness being as the bulk directly, and the hardness as the bulk inversely. Of the different forms of cavity made by indenting-tools that of the pyramid is preferred, because of its simplicity and the ease with which its volume may be computed. The indenting part of the tool is in the form of a pyramid, having a rhombus for its base, the diagonals of which are, respectively, one inch and two-tenths of an inch, the height of the pyramid one-tenth of an inch. In late experiments the form of the pyramid has been changed and improved somewhat by causing it to make a longer line and mark minute differences more accurately. See *Rodman Cutter*.

INDENTING PISTONS.—The indenting-pistons that are used in the service are found to vary in their diameters. The pressure of the gas is exerted upon their inner ends, and varies directly with the area pressed. It is desirable to have a series of pistons adopted which shall have the same area of cross-section. In practice, the area of these pistons has generally been assumed to be one-tenth of one square inch. The following Table gives the diameters, areas, and pressures upon those pistons of which the dimensions are known, neglecting friction, and supposing the pressure per square inch to be 100,000 pounds.

Little is known in regard to the effect of friction upon these short pistons. The friction of the gas-check against the walls of the hole would render the indicated, less than the actual pressures. A uniform system of pistons and cutters should be established in order to render the results obtained comparable. The more nearly the conditions are assimilated the greater will be the approximation of the relative pressures to an agreement. At the present time each piston necessitates a separate Table of Pressures, and when the length of the cuts is required to determine the pressures, a Table must be constructed for each cutter. See *Circular Cutter* and *Pressure-gauge.*

Pistons.	Diameter of pistons.	Area of pistons.	Pressure upon pistons.	Remarks.
	Inches.	Sq. in.	Lbs.	
Ordnance Manual, 1861	.37	.107521	10752.1	0'' .37 given here because this number has sometimes been used in calculating pressures.
Frankford Arsenal, (musket)	.369	.106940	10694.0	Made for National Armory.
Rodman	.368	.106362	10636.2	Vide "Experiments on Metals for Cannon," and similar writings.
Metcalfe	.357	.100098	10009.8	Made for use with "spiral cutters."
Theoretical	.3568+	.100000	10000.0	True diameter=0''.356824743746.
National Armory circular cutter	.356	.099538	9953.8	Also for Adams's cutter.
National Armory circular cutter No. 3	.357	.190098	10009.8	Made at National Armory for Frankford Arsenal.
West Point internal pressure-gauge	.355	.0989798	9897.98	

INDEPENDENT.—In a strict military sense, a term which distinguishes from the rest of the army those companies which have been raised by individuals for rank, and were afterwards drafted into corps that were short of their complement of men. An *Independent Company* or *Troop*, is one that is not incorporated into any regiment.

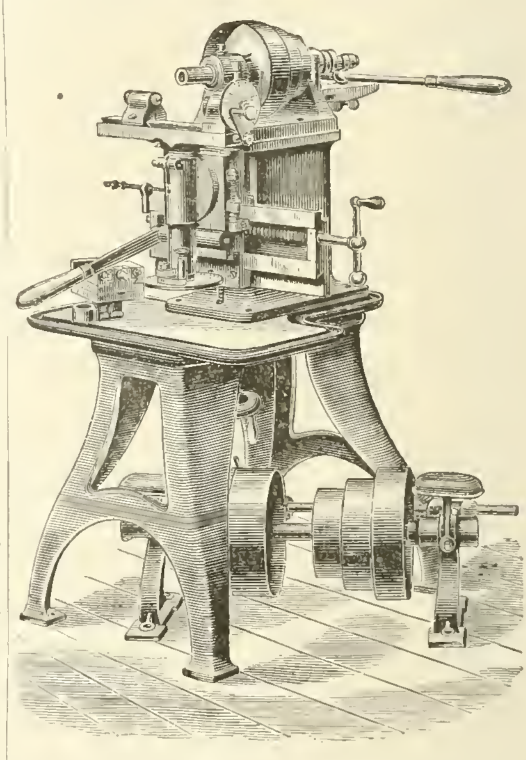
INDEPENDENT SCARP.—A wall 3 feet thick erected at the foot of the exterior slope, and when it is breached the parapet cannot fall. It is loop-holed and provided with a banquette. Its height should not be less than 20 feet.

INDEX MILLING-MACHINE.—A machine adapted to a great variety of work on metals, in the Armory. The small machines of this class, weighing about 600 pounds, mill 10½ inches long and 7½ inches high, and will cut gears up to 8 inches in diameter. The use of the inconvenient counter-shaft, with binder, weight, etc., commonly used with this class of machines, is avoided in the Armory, an ordinary overhead shaft being used, and the compensation for rise and fall of mill-spindle and carrier obtained by a splined shaft passing through the lower gear. When not in use for cutting gears, the index-spindle is solidly clamped, so that when using a vise, centers, or spiral-cutter, no strain or injury can come upon the index-plate or pointer.

The larger machines, weighing about 1,400 pounds, are perfect gear cutters within certain limits of size, cutting fast and smoothly, and, in addition, having provision for using a vise, centers, and spiral cutter without injury to the delicate dividing mechanism, thus practically furnishing two machines. They mill 18 inches in length and 11 inches in height; cut spur-gears up to 21 inches in diameter; also worm and bevel-gears. An adjustable rim-rest supports the gear-blank while being cut, and prevents chattering. The mill-arbor has an outside center support, which can be removed if required. The cutter-head may be worked by the screw in front, or by an adjustable lever, connected with rack and pinion at the back, and is balanced by a weight under the machine.

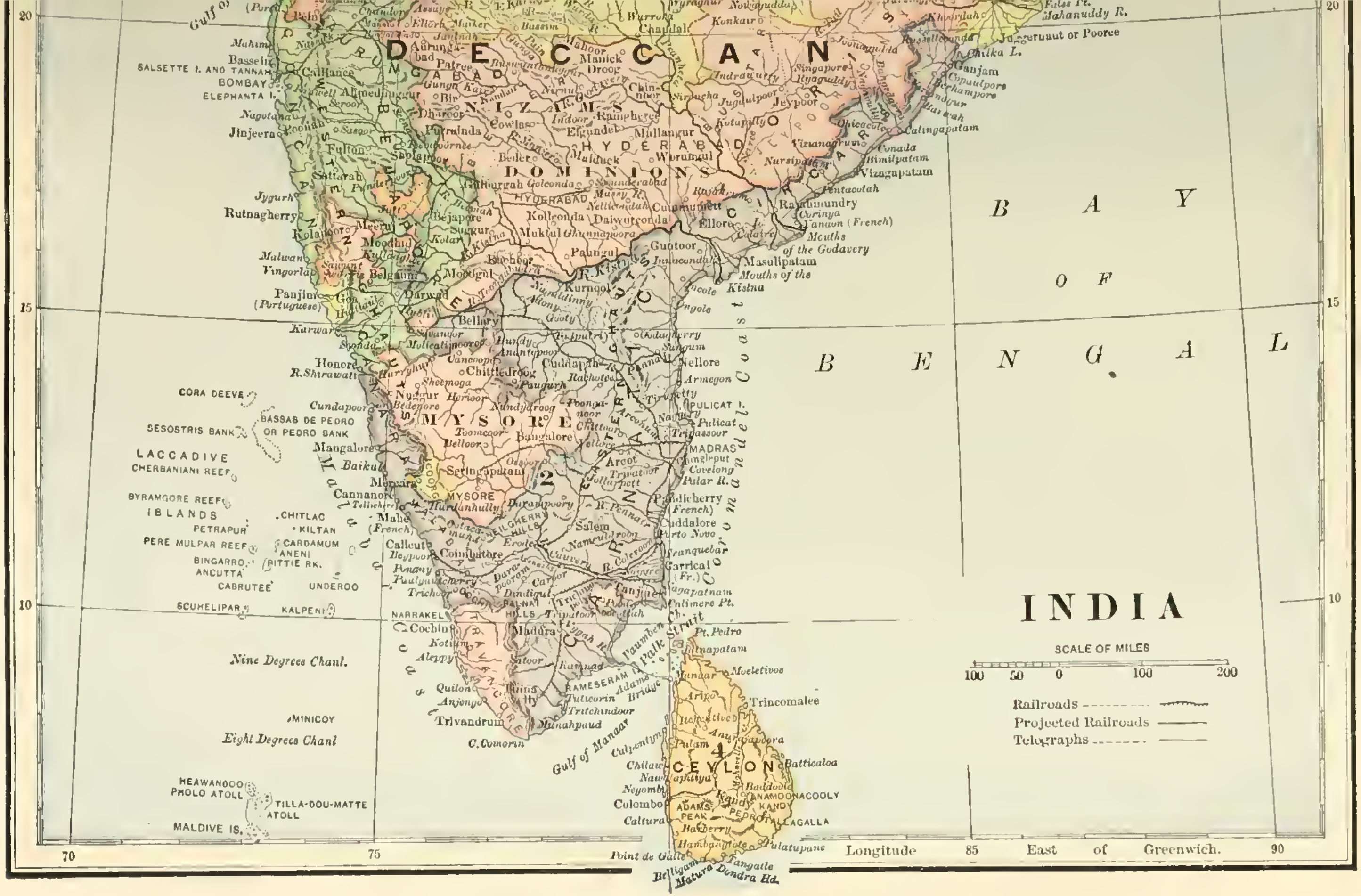
The *index-plate* is 14 inches in diameter, has 3,800 holes, in 25 circles, and divides all numbers to 50, all even numbers to 100, and every fourth number to 200.

The drawing represents the machine most commonly used. It is adapted to cutting mills, spur or bevel-gears, up to 6 inches diameter. The index-plate is attached to the bottom of a hollow spindle having a graduated disc. The spindle is pivoted to a vertical slide, and with its attachments, as vise or centers, may be moved and secured at any angle in a vertical plane of 180°, or 90° on either side of an upright position. This slide, carrying the index-spindle, etc., has a perpendicular movement of two inches. The upward and downward movement of the main slide, to which the vertical is attached, is 6 inches, and its side traverse 12 inches. The centers shown in the engraving as attached to the index-spindle, will receive work 3¼ inches in diameter and 8½ inches in length. The spindle is of steel, and slides in a cast-iron sheath or shell, which runs in cast-iron boxes lined with Babbitt-metal. The horizontal movement of the spindle and the vertical move-



ment of the slides are made by adjustable hand-levers, and limited by check-nuts. The head has a longitudinal adjustment by a screw to the extent of 2½ inches. The machine weighs, with countershaft, vise, and centers, 650 pounds. Speed of countershaft, having 8 and 5 by 2½ inch tight and loose pulleys, 100 revolutions per minute. See *Milling.*

INDIAN ARMY.—The Indian Army in the days of Clive, which was composed of both the British and native troops, was comparatively small, barely sufficient to hold its own; but even in those days it did great deeds of valor, as the battle of Assaye and other battles testify. By degrees, as the East India Company increased its territory, a larger Army was found necessary, and both British and native troops


INDIA
SCALE OF MILES
100 50 0 100 200
Railroads
Projected Railroads
Telegraphs
Longitude East of Greenwich.
DECCAN
NIZAM'S DOMINIONS
HYDERABAD
MYSORE
CEYLON
BAY OF BENGAL
Nine Degrees Chanl.
Eight Degrees Chanl
LACCADIVE
MALDIVE IS.
Gulf of Manaar
Palk Strait
Bombay
Madras
Trincomalee
Colombo
Point de Galle
C. Comorin


REFERENCE TO THE DIVISIONS OF INDIA.
1. PRESIDENCY OF BENGAL
N. W. P. North West Provinces.
C. P. Central Provinces.
Oude
Punjab
B. B. British Burmah.
L. P. Lower Provinces.
2. PRESIDENCY OF MADRAS.
3. PRESIDENCY OF BOMBAY
4. CEYLON
NATIVE STATES UNDER BRITISH PROTECTION
INDEPENDENT STATES—Nepal and Bhotan
CASHMERE
PUNJAB
RAJPOOTANA
CABOOL
SCINDE
CUTCH
NEPAL
BHOTAN
GUNDWANA
CALCUTTA
DELHI
LUCKNOW
BENARES
PATNA

INDIANS, AMERICAN. 1. Menitari warrior, dressed for the dog-dance. 2. Dakota warrior. 3. Mandan cl
boin girl. 7. Buffalo dance among the Mandans. 8. Assiniboin spell-mound.

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ned with his trophies. 4. The same in garments of state. 5. Assiniboins. 6. Dakota squaw and Assini-

were augmented. In 1857 the mutiny of the native Army took place, which necessitated a change in the organization of the Army involving a large increase of the British force. From this date the Army of the East India Company became a part of her Majesty's Army, paid out of the revenues of India.

The Army of India at present consists of 62,850 British troops and 128,500 native troops. More than half the former are stationed in the Bengal Presidency, 38,000 men being in garrison along the valley of the Ganges, Oude, and in the Punjab, while the strength of the native Army for the same Presidency amounts to 49,000. Bengal proper alone requires about 7,000 English troops for its guard, or nearly one-ninth of the total number of the British employed in India. The remainder are distributed amongst the North-west Provinces and in the Presidencies of Madras and Bombay. See *East India Army*.

INDIAN COUNTRY.—"The Indian country," within the meaning of the Trade and Intercourse Acts, may be defined in general as:

1. Indian reservations occupied by Indian tribes.
2. Other districts so occupied to which the Indian title has not been extinguished.

Furthermore, the operation of the said Acts may be retained by treaty or extended by Act of Congress over districts not in other respects Indian country. If any special case shall occur which, in the view of the Department Commander, may not appear to be embraced within the definition above stated, he reports the case, with all its facts and circumstances, to the Secretary of War, in order that the question whether the locality is "Indian country" may be referred to the Secretary of the Interior.

Where lands are secured to the Indians, by treaty, against occupation by the whites, the Military Commanders keep intruders off, by military force, if necessary, until such time as Indian title is extinguished, or the lands are opened by Congress for settlement.

There is no jurisdiction conferred upon State or Territorial Courts to try an Indian charged with the murder of another Indian. Section 2146 of the Revised Statutes of the United States, as amended by the Act of February 18, 1875, entitled "An Act to correct errors and supply omissions in the Revised Statutes of the United States," provides that section 2145 shall not be construed to extend to crimes committed by one Indian against the person or property of another Indian, nor to any Indian committing an offense in the Indian country who has been punished by the local law of the tribe.

When questions arise as to the ownership of animals in possession of Indians, the Commanding Officer of the nearest military post is authorized and directed to act in conjunction with the Indian Agent in charge of the said Indians in the investigation and determination of the ownership.

Whatever may be the rule in the time of war and in the presence of actual hostilities, military officers can no more than civilians protect themselves for wrongs commited in time of peace under orders emanating from a source which is in itself without authority in the premises. Hence a military officer, seizing liquors supposed to be in Indian country, when they are not, is liable to action as trespasser. The difference between the value of the goods so seized, at the place where they were taken and the place where they were returned to the owners, is the proper measure of damages.

Supplies, stores, or property of any kind, procured out of Army appropriations, are not transferred, in any way or under any circumstances, for the use of Indians, except under authority first obtained from the Secretary of War. Any officer violating the terms of this regulation is charged with the money value of the supplies, stores, or property transfered, and in addition is otherwise held accountable, according to circumstances. No issues of arms, ammunition, or any other Ordnance stores are made to Indians not in the employ of the War Department as scouts.

To carry into effect the joint resolution adopted by Congress, August 5, 1876, the sale of fixed ammunition or metallic cartridges, by any trader or other person, in any district of the Indian country occupied by hostile Indians, or over which they roam, is prohibited: and all such ammunition or cartridges introduced into said country, by traders or other persons, and that are liable in any way or manner directly or indirectly, to be received by such hostile Indians, is always deemed contraband of war, and seized by any military officer, and confiscated; and the district of country to which this prohibition shall apply, during the continuance of hostilities, is designated as that which embraces all Indian country, or country occupied by Indians or subject to their visits, lying within the Territories of Montana, Dakota, and Wyoming, and the States of Nebraska and Colorado.

By virtue of authority conferred upon the President of the United States in section 2132, Revised Statutes, the introduction into the Indian country or district occupied by any tribe of hostile Indians, for the purpose of sale or exchange to them of arms or ammunition of any description, and the sale or exchange thereof to or with such Indians, is prohibited. All military commanders are charged with the duty of assisting in the execution of this order, and of Executive Order of November 23, 1876, the provisions of which are extended to include all Indian country within the Territories of Idaho, Utah, and Washington, and the States of Nevada and Oregon. See *Indian Territory*.

INDIAN FILE.—Single file; the arrangement of men in a row following one after another, as is customary among Indians when traversing the woods or mountains.

INDIAN FIRE.—A bright white signal-light, produced by burning a mixture of 7 parts of sulphur, 2 of realgar, and 24 of niter.

INDIAN INK.—The cakes of this substance, which is a mechanical mixture, and not, like the true inks, a chemical compound, are composed of lampblack and size or animal glue, with a little perfume. The lampblack must be remarkably fine, and is said to be made in China by collecting the smoke of the oil of sesame. A little camphor (about 2 per cent.) is also found in the ink made in China, and is thought to improve it. This substance is used in that country with a brush both for writing and for painting upon paper of native manufacture, while in this country, it is extensively employed for designs in black and white, and all intermediate shades of color. Much curious information on this pigment may be found in Merimée's treatise, *De la Peinture*.

INDIAN PONY.—The square-built, large-trunked, and short-legged pony used by the North American Indians and elsewhere. This pony, generally believed to be the result of a cross between the Southern mustang and a small type of the Canadian, is never fed, stabled, combed, shod nor doctored; and when not under the saddle is left to shift for himself. In the winter he is a mere animated skeleton. His proportions vary according to the localities in which he is found, but he seldom exceeds thirteen hands in height. He is wonderfully sagacious and sure-footed. He can climb a steep, rocky hill with assurance and activity, and rush down a precipitous declivity with much indifference. He will get over and through places, which appear utterly impracticable, with ease and rapidity, while the American horse would labor to travel at a walk. He particularly excels in the passage of swamps, marshy places, and sands perforated with gopher holes.

INDIANS.—The collective name now generally given to the various nations and tribes inhabiting North and South America, at the time of their discovery by the Spaniards, and to such of their descendants as survive at the present day. The name of Indians was first given to the natives of America from the mistaken notion of the early voyagers, Columbus himself included, that the newly found Continent was in reality a part of India. This was soon shown to be an error; but the name of Indians, thus wrongly applied to the inhabitants, continued to be used in every narrative of voyage and discovery, and has descended even to our own times, only that we now qualify it in some measure by speaking of them as *American Indians*. In the classification of Blumenbach the American Indians are treated as a distinct variety of the human race; but in the threefold division of mankind laid down by Dr. Latham, they are ranked among the Mongolidæ. Other Ethnologists also regard them as a branch of the great Mongolian family, which, at a remote period of the world's history, found its way from Asia to the American Continent, and there remained for thousands of years separate from the rest of mankind, passing meanwhile through various alternations of barbarism and civilization. Morton, however, the distinguished American Ethnologist, and his disciples Nott and Gliddon, claim for them a distinct origin, one as indegenous to the Continent itself as its fauna and flora. Pritchard, whose views generally differ from those of Morton, acknowledges that "On comparing the American tribes together, we find reasons to believe that they must have subsisted as a separate department of nations from the earliest ages of the world. Hence, in attempting to trace relations between them and the rest of mankind, we cannot expect to discover proofs of their derivation from any particular tribe or nation in the Old Continent. The era of their existence as a distinct and insulated race must probably be dated as far back as that time which separated into nations the inhabitants of the Old World, and gave to each branch of the human family its primitive language and individuality." Dr. Robert Brown, in his "Races of Mankind," the latest authority on the subject, attributes to the American race an Asiatic origin. He says: "Not only are the Western Indians in appearance very like their nearest neighbors, the North-eastern Asiatics, but in language and tradition, it is confidentially affirmed, there is a blending of the people. The Eskimo, on the American, and the Tchuktchis, on the Asiatic side, understand each other perfectly." In fact, modern Anthropologists incline to think that Japan, the Kuriles, and the neighboring regions may be regarded as the original home of the greater part of the American race. It is also admitted by Anthropologists that between these various tribes, from the Arctic Sea to Cape Horn, there is greater uniformity of physical structure and personal characteristic than is seen in any other quarter of the globe. The "Red Men," as they are called, of the United States and Canada, differ in many respects from the Guranis of Paraguay, and both from the wild tribes of California, but all exhibit the clearest evidence of belonging to the same great branch of the human family. Upon this point the testimony of a writer like Humboldt is very important. "The Indians of New Spain," says Humboldt, "bear a general resemblance to those who inhabit Canada, Florida, Peru, and Brazil. We think we can perceive them all to be descended from the same stock, notwithstanding the prodigious diversity of their languages. In the portrait drawn by Volney of the Canadian Indians, we recognize the tribe scattered over the Savannahs of the Apure and the Carony. The same style of features exists in both Americas." The Mongolian cast of features is most marked in the tribes nearest to the Mongol coast, *i. e.*, on the shores of the Pacific, and gets less noticeable as we go Eastward. Their traditions, too, indicate that the tribes on the eastern seaboard came from the West, and the western tribes even came from regions still further west.

Generally the physical characteristics of the American Indians are as follows; a square head, having a low, but broad forehead, the back of the head flattened, full-face, and powerful jaws; cheek-bones prominent; lips full; eyes dark, and deeply set; the hair long, not absolutely straight, but wavy, something like a horse's mane, and like that, of a glossy hue; little or no beard—where it does appear, it is carefully eradicated with tweezers; color of the skin reddish or copper; the height of the men about the average, but looking taller from their erect posture and slender figure; the women rather shorter, and more inclined to obesity, but many of them with symmetrical figure and pleasing countenance; hands and feet of both men and women small. As before said, however, there being some hundreds of tribes among the American Indians, there are many departures from these general characteristics, not only in individuals, but entire septs. "The Americans," says Pritchard, "are not all of the hue denominated *red*, that is, of a copper color; some tribes are as white as many European nations; others brown or yellow; others are black, or, at least, they are described by travelers as very much resembling in color the negroes of Africa. Anatomists have distinguished what they have termed the American form of the human skull; they were led into the mistake by regarding the strongly marked characteristics of some particular tribes as universal. The American nations are spread over a vast space, and live in different climates, and the shape of their heads is different in different parts. Nor will any epithets derived from their habits of life apply to all the tribes of this department. The native Americans are not all hunters; there are many fishing tribes among them; some are nomadic; others cultivate the earth, and live in settled habitations; and of these some part were agriculturists before the arrival of the Europeans; others have learned of their Conquerors to till the soil, and have changed the ancient habits of their race, which, as we may hence infer, were not the necessary result of organization or congenital and instinctive propensity." Dr. Morton's views on this subject substantially agree with those of Pritchard, and both concur in adopting the test of language as a proof of one common origin for the various native tribes of both North and South America. The linguistic conclusion, now generally acquiesced in, is thus briefly stated by Mr. Albert Gallatin: "Amidst the great diversity of the American languages, considered only in reference to their vocabularies, the similarity of their structure and grammatical forms has been observed and pointed out by the American Philologists. The result appears to confirm the opinion already entertained on that subject by Mr. Du Ponceau, Mr. Pickering, and others; and to prove that all the languages, not only of our own Indians, but of the native inhabitants of America, from the Arctic Ocean to Cape Horn, have, as far as they have been investigated, a distinct character common to all, and apparently differing from any of those of the other Continents with which we are most familiar."

The next question that comes under consideration is: Whence does it arise that, with all this similarity of physical conformation and language, there should have been only two nations among so many millions—namely, the Mexicans and Peruvians—who attained to any high degree of civilization? When the Spaniards entered Mexico they found in it a rich, powerful, and warlike nation, living in walled cities, in which were palaces and other sumptous residences. They were ruled over by an Emperor or King whose sway extended over many other nations besides his own. They worshipped the sun, and had an organized Hierarchy; they had also fixed laws, were acquainted with many of the arts and sciences, especially astronomy; they practiced agriculture, worked mines, and displayed considerable skill in manufactures, both industrial and ornamental. The Nation thus discovered was that of the Aztecs, who professed to have among them evidences of antiquity dating as far back as the year 554 of our era. A few

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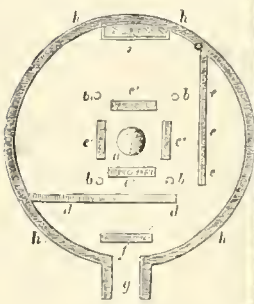

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Mandans and Cherokees. 1. Lodge of a Mandan chief. 2. Scalp of a man; feathers as mementoes (American portable cradle. 6. Cherokee village. 7. Air-burial. 8. Mandan village and canoes. 9. M

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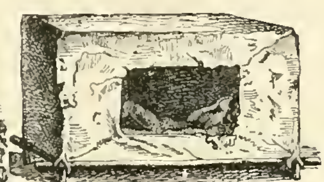

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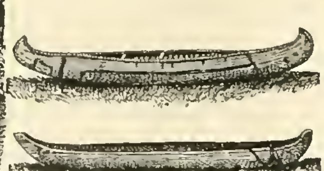

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r deeds. 3. Plan of a North American Indian tepee (hut). 4. Chief's summer wigwam. 5. North
10. North American canoes

years later, in Peru, the Spaniards found another Nation, also exceedingly rich, numerous, and powerful with a civilization fully as much extended as that of the Aztecs, yet differing from that in many essential particulars. This was the Nation of Quichuas, frequently termed Incas (more correctly *Yncas*), associated with whom were the Aymaras, whose country had been subjugated by the Incas two or three centuries before the arrival of Pizarro, in Peru. Each of these Nations—the Mexicans and Peruvians —is supposed to have slowly developed its own civilization during a long process of ages. In every other part of America European settlers and explorers have found only complete or semi-barbarism. Such was the case in Virginia; such in New England, Canada, the Hudson's Bay Territory, California, and Patagonia. In Central America, however, there have been found extensive remains of architecture and other traces of civilization, which would seem to date back to even a more remote period than that of the Mexican or Peruvian Empires. Immense artificial mounds also exist in the valley of the Mississippi and elsewhere throughout America, supposed to be the work of the ancestors of the present wandering tribes. If so, there may be some truth in the theory of Dr. Martius, a distinguished German Ethnologist, "That the nations of the new world are not in a state of primitive barbarism or living in the original simplicity of uncultivated nature, but that they are, on the contrary, the last remains of a people once high in the scale of civilization and mental improvement, now almost worn out and perishing, and sunk into the lowest grade of decline and degradation." Dr. Pritchard appears inclined to the same view, adding: "Attentive observers have been struck with manifestations of greater energy and mental vigor, of more intense and deeper feeling, of a more reflective mind, of greater fortitude, and more consistent perseverance in enterprises and all pursuits when they have compared the natives of the New World with the sensual and volatile, and almost animalized Savages who are still to be found in some quarters of the Old Continent, They have been equally impressed by the sullen and unsocial character, by the proud apathetic endurance, by the feeble influence of social affections, by the intensity of hatred and revenge, and the deep malice-concealing dissimulation so remarkable amid the dark solitudes of the American forests."

Dr. Robert Brown adopts a geographical classification of the American tribes, which is, on the whole, at least unsatisfactory. There are Arctic tribes; North-western tribes inhabiting the region west of the Rocky Mountains between California and Alaska; Californian tribes; Indians of the Central Plains; Prairie tribes; North-eastern Indians; Canadian Indians; and Central American Indians. The chief existing tribes are; Eskimo, Cowichans, Tsongeisths, Nanaimos, Quakwolths, Nuchultaws, Koskeemos, Seshahts, Nittinahts in Vancouver Island; Hydahs (Queen Charlotte Islanders); Tsimpsheans, Bellacoolas, Chilcoatins, Shuswaps in British Columbia; Cayuse, Snakes, Klamaths in Oregon; the Digger or Californian Indians, the most degraded of all the tribes; the Comanches, Apaches, Navajos, Hualpais, Yampas, in the Central Plains; the Moqui, Pueblos, Pimas, Papagos in New Mexico; Utahs, Pahutas, Pahides, Soshones, Loo-coo-rekahs, Goships, Cheyennes, Arrapahoes, Kwivas, Arickarees, Poncas, Yanktons, Gros-Ventres, and Sioux or Dahcotahs, Assiniboines, Blackfeet, Crows, Omahas, Ottoes, Pawnees, etc., are all Prairie tribes; the Delawares, Mo-hee-conneughs (Mohicans), Oneidas, Tuskaroras, Senecas, Shawnees, Cherokees, Choctaws, Creeks, Seminoles, Osages, Kaskias, Weeahs, Potowatomies, Quapaws, Peorias, Kanzans, Sanks, Foxes, Puncas, etc., in the North-eastern States; the Crees, Santeux or Ojebways, Chippewayans, the Sacliss or Shewhapmuch in Canada; Tehuantepecs, Mosquitos, Smoos, Twakas, Toonglas, Payas, Ramas, and Cookras in Central America. Again, M. d'Orbigny has classified all the Indians of South America under three great groups, viz., the Andian group, the Mediterranean group, and the Basilio-Guarani group; and these he subdivides into thirty-nine distinct nations; viz., '1. Quichua; 2. Aymara; 3. Chango; 4. Atacama; 5. Yuracares; 6. Mocetenes; 7. Tacana; 8. Maropa; 9. Apolista; 10. Araucananian; 11. Fuegian; 12. Patagonian; 13. Puelche; 14. Charrua; 15. Mbocobi; 16. Mataguayo; 17. Abipones; 18. Lengua; 19. Samuco; 20. Chiquito; 21. Saraveca; 22. Otuke; 23. Curuminaca; 24. Covareca; 25. Curaves; 26. Tapiis; 27. Curucaneca; 28. Paiconeca; 29. Corabeca; 30. Moxo; 31. Chapacura; 32. Itonama; 33. Canichana; 34. Movima; 35. Cayuvava; 36. Pacaguara; 37. Itenes; 38. Guarani; 39. Botocudo.' Other classifications have been attempted, but all more or less arbitrary. Morton is content with two grand divisions, viz., the 'Toltecan Nations' and the 'Barbarous Tribes,' the former embracing the ancient Mexicans and Peruvians, and the latter all the uncivilized or semi-civilized tribes from the extreme North to the extreme South. The Toltecans are said to be the builders of the remarkable series of mounds found throughout North America.

The Indians are yearly decreasing in numbers. A fair estimate would probably give Alaska 20,000; British Columbia, 20,000; Vancouver's Island, 9,000; Canada, 5,000; California, Oregon, and States north of it, 10,000; Prairie-lands west of the Rocky Mountains, 10,000; other portions of the United States, 2,000; in New Mexico and Central America, 20,000. This would gives us a total of about 110,000 for the whole of North America, exclusive of half-breeds, &c. Some twenty tribes have become partially civilized, and live by agriculture, under the protection of the American Government, on what are called 'Indian Reservations.' There are in these Indian communities many men and women whom education has developed into most valuable, intelligent, and even polished members of a highly civilized community. Two tribes (Choctaws and Cherokees) have become wholly civilized, and have a settled form of government modelled on that of the United States. The Cherokees stand alone amongst modern nations in having produced a second Cadmus, one Sequoyah, or George Guess, who actually invented an alphabet. It must be stated, however, that fully one-half of these civilized tribes are, like Sequoyah, half-breeds. Even the whites marrying Choctaw or Cherokee women are admitted, if they choose, into these tribes.

Both the early English and French settlers of North America were often at war with the Indians, either in self-defence or instigated by a desire for their lands. In Virginia the Indians who had combined to exterminate the Whites were subdued after a ten years' war. In New England (1637) the Colonists of Connecticut and Massachusetts destroyed the warlike Pequods, and in 1643 the Narragansetts. The war of Phillip, king of the Wampanoags, ended, 1676, in the almost total destruction of that tribe. The Dutch in New Amsterdam and the English in North and South Carolina suffered greatly from the Indians. In the Seven Years War between the English and French the Indians were used by both sides and terrible atrocities were committed. In 1763 a number of tribes were united under Pontiac, the Chief of the Ottawas, in a general conspiracy to exterminate their Conquerors, but they were finally subdued. When the American Revolution began the Indians, who were Allies of the English, ravaged on the frontiers. The United States, by the Constitution of 1787, claiming sovereignty over the whole territory, made treaties with the Indians for the purpose of obtaining their lands; but in 1790 the Miamis and other tribes conspired and defeated the army under Gen. Harmar, and the following year under General St. Clair, but were subdued by General Wayne. In 1811 they recommenced hostilities under Tecumseh, but were defeated at Tippecanoe by General Harrison, who also in 1812, defeated the combined forces of the English and Indians, and killed Tecumseh. In the South the Creeks were conquered by Jackson in 1813, and the Seminoles of Florida in 1817. In 1832 the Sacs and Foxes, under their Chief, Black Hawk, harassed the frontier Settlements, and from time to time the Sioux, the Comanches, and Apaches, often joined by other tribes have given the Government great trouble. In 1838 the Cherokees and Creeks were removed from Georgia to the Indian Territory, West of the Mississippi, which the Government had established to be the permanent home for all the Indians. The Seminoles of Florida refusing to remove, a bloody war ensued, which lasted 7 years and cost $15,000,000. After the removal of the Choctaws, Creeks, and other tribes to the Indian Teritory, other reservations were formed in several States. In 1871 there were on reservations 237,478, which, added to 60,000 in Alaska, and about 50,000 others not yet placed in reservations make the total number of Indians in the United States, as estimated by the Indian Department, 350,000. The number in the British Colonies is estimated at 150,000.

The five civilized tribes of the Indian Territory had under cultivation (1879) 237,000 acres, on which they raised over 3,000,000 bushels of cereals, and were engaged largely in the raising of stock. The Indians on other reservations had under cultivation 157,056 acres, and raised over 1,500,000 bushels, and all together about 225,000 tons of hay. The Indians are scattered over a large extent of country, and the difficulty of managing them is increased by the attempts of bold and unscrupulous white men to invade their reservations for trade, which often involves fraud, and for the sake of the mineral deposits known to be there. The Utes in Colorado and Apaches in New Mexico, especially, have given the Government much trouble. The Utes are fierce and warlike, and resist all efforts to induce them to abandon their wandering life and cultivate the soil.

Earnest attempts have been made at different periods by individuals and Societies to Christianize and civilize the Indians, some have been remarkably successful. The French and Spanish in connection with their Colonies, had Missions among the Iroquois, Chippewas, Creeks, and other tribes. In Florida, Texas, New Mexico, and California, they had prosperous Missions. In 1643 Thomas Mayhew labored with success for three years at Martha's Vineyard, Mass., followed in the same work by his father, and by others of the family for five generations. In 1646 the Legislature of Massachusetts passed an Act for the propagation of the Gospel among the Indians, and in the same year John Eliot began his labors at Nonantum, churches were formed, and the Bible and other Christian books translated. The Brainards labored with effect in New Jersey and Pennsylvania. The Moravians and Friends have been active in instructing the Indians. The various Protestant Denominations, through organized Societies have had for many years Missions among the Cherokees, Choctaws, Ottawas, Chickasaws, Creeks, Dacotahs, and some other tribes, instructing them not only in religion, but also in the arts of civilized life. The Indian problem, always troublesome to the U. S. Government is now seen to involve grave, moral, and political issues not at first recognized. The governmental policy has been one of expediency rather than of justice. Treaties have been made with the tribes as with sovereign nations, but have been set aside on easy pretexts. Indians have not been considered as citizens under the law; their ownership of property, as recognized, has been tribal and not individual. They have been allowed to be the pray of rapacious speculators in land, and thievish traders. Of late years the Government has sought to apply a better policy, but the evil has been found too vast and deep for easy reform; and a wave of popular feeling is now rising, bearing in upon the Government with strong demands in different directions. There are signs that the discussions will result in better processes of dealing with the Indians, and that the Government will find or make its way to a system that shall be wise and just. See *Indian Territory.*

INDIAN TERRITORY.—The home of civilized or partially civilized remnants of once powerful aboriginal tribes, removed by the Government from time to time from differen' parts of the Union, and which, upon separate reservations and under forms of government established by themselves, are living at peace with each other and with the United States. In June, 1830, Congress passed an Act setting apart "All that part of the United States west of the Mississippi, and not within the States of Missouri and Louisiana or the Territory of Arkansas," to be known as the Indian Country. The region thus described formed a part of the Louisiana purchase of 1803 from France. Portions thereof have since been organized into new States and Territories, and only a remnant of the original Indian Country now remains. To it has been added, however, a narrow adjoining strip of land west of the 100th meridian which was ceded to the United States by Texas. The Territory contains 20 reservations, the names of which, with the extent of each in square miles are as follows:—Arrapahoe and Cheyenne, 6,715; Cherokee, 7,861; Chickasaw, 7,267; Choctaw, 10,450; Creek, 5,024; Kansas, 154½; Kiowa and Comanche, 4,369; Modoc, 6; Osage, 2,291; Ottawa, 28½; Pawnee, 442; Peoria, 78½; Pottawatamie, 900; Quapaw, 88½; Sac and Fox, 750; Seminole, 312⅜; Senaca, 81; Shawnee, 21; Wichita, 1,162; Wyandotte, 38½; total area appropriated, 47,039 square miles; unassigned, about 22,000 square miles. White speculators and adventurers have often attempted to enter the Territory and appropriate the lands not included in the reservations, but the Government of the United States, in fulfillment of its treaty stipulations to the Indians, has prevented them. A late movement of this kind was made in 1879, when the President issued his proclamation warning those engaged therein to desist, and informing them that if they should enter the Territory they would be expelled, if necessary, by an armed force. A Bill was lately introduced in Congress to erect the Indian Country into a regular Territory of the United States, thus, opening its unsettled lands to the whites and subjecting the Indians to the very encroachments to avoid which they consented to go upon the reservations. It has been proposed in some quarters to make the Indians citizens, to place them under Territorial Government, and finally to admit them as a State to the Union. But to this plan there are some serious obstacles, not the least of which is the unwillingness of the Indians themselves to sacrifice the autonomy of their respective tribes and the Governments of their own already existing. Though this may ultimately be arrived at, it is not easy to see how the Government of the United States could suddenly force such a change upon them without violating the most solemn treaty obligations. The population of the Territory, exclusive of white residents, is reported to number 74,140. The number of whites legally there is about 12,000, and besides them there are 3,000 others who would be excluded if the law was strictly enforced. Agents representing the United States live among the various tribes, exercising a paternal oversight of their affairs, and protecting them from encroachments. They are appointed by the President with the consent of the Senate, and, under the existing regulations of the Indian Bureau, are nominated by the Religious Denominations which have Missions among the tribes. Each tribe has its own inner government, but the United States Courts have jurisdiction in civil actions where a white man is a party, in cases of crime against a white man, and of violations of the laws regulating trade and intercourse with the Indians. See *Indian Country.*

INDICATOR.—1. An invention of General George W. Wingate, of the New York Militia, for instructing men in aiming the musket. A steel rod, passing through a brass tompion in the muzzle, is projected forwards by the firing-pin. The rod carries a sharp point in the line of the sights, which punctures a miniature target a foot or so in front of the muzzle.

2. In connection with the testing-machine it has been found desirable to have an instrument which would give a continuous curve representing the elongations and corresponding tensile strains for specimens of various kinds, in order to arrive at the exact dynamical value of the metal. An instrument has been devised for this purpose, as represented in Fig 1. It consists of a brass frame, AB, supporting a vertical cylinder, C, revolved by the endless screw, S; this screw being turned by the tape, T, which draws around the pulley, P, as the weight,

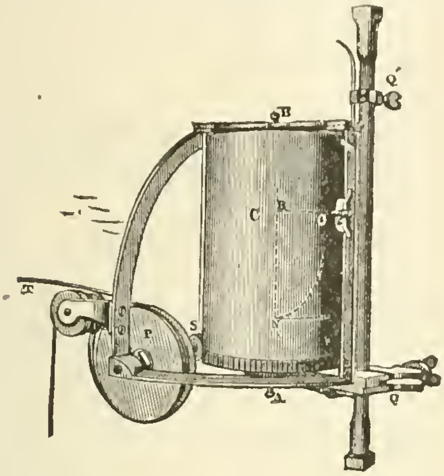


Fig. 1.

W, is wound along the scale-beam. When the chain was used as a weight, the cylinder revolved as the chain was paid into the scale. This arrangement causes the cylinder to revolve as the weight or strain upon the specimen increases or diminishes, and if the marker M, remains stationary, it will describe a horizontal circle upon the paper with which the cylinder is covered. Starting from the zero-point of the scale, the length of any arc of the circle will represent the strain upon the specimen at the instant the marker has arrived at the end of the arc. If now the elongation of a given portion of the specimen carries the marker in a direction parallel to the axis of the cylinder, it is clear that the curve, NO, described upon the paper, will accurately and continuously represent the relation between the elongation of the specimen and the corresponding strain upon it. In order to move the marker in this manner, it is connected with one end of the specimen by the clamp Q', which fits into a center-punch-mark on the specimen, while the frame and cylinder are attached to the other end, Q, of the specimen in a similar manner. The portion of the specimen between the two center-punch-marks is evidently the only portion whose elongation will move the marker along the paper, and the space passed over by the marker divided by the original length of this portion will give the elongation per unit of length of the specimen, or the per cent. of elongation; and the area bounded by the curve, NO, and the co-ordinates, NR and RO, measures the *work* of breaking the specimen.

3. A steam-engine indicator is an instrument used to draw a diagram, showing, upon a reduced scale, the motion of the piston and the pressure acting upon it at each point of its stroke. It consists essentially of a small steam cylinder and a small drum upon which is rolled the paper for taking the diagram. The cylinder is provided with a piston whose motion is resisted by a spiral spring. Steam may be admitted beneath this piston and cause it to rise, or a vacuum created beneath it and cause it to fall, the amount of movement being a measure of the pressure, as in a spring-balance. Motion from the piston is conveyed by a series of levers to a pencil, which is made to press against a slip of paper rolled upon the drum. When the instrument is in use, its cylinder is connected to either end of the large cylinder of the engine, and the drum is made by suitable means to revolve back and forth, having a motion which corresponds to that of the engine piston, only it is on a much reduced scale. Until steam is admitted to the indicator there is no pressure upon its piston, and if the pencil point is then pressed against the paper on the drum, it will, as the latter moves back and forth, trace a straight line, which is the line of atmospheric pressure. When steam is allowed to enter, the indicator piston rises against the resistance of the spring to a height corresponding to the steam pressure, and if this pressure remains unchanged during a stroke, a straight line parallel to the atmospheric line will be traced; when release takes place the piston instantly falls and the pencil moves with it, and when a return stroke of the engine occurs, the pencil will trace a line corresponding to the back pressure against which the engine piston is moving. This gives an idea of the process of tracing a diagram when steam follows full stroke; when a cut-off is used, the pencil traces the same line as before until the cut-off valve closes, when, as the pressures fall, there is traced a curve which gives the pressure at each point of the forward motion according to the law for expansion of steam. The length of a diagram drawn in this way represents on a smaller scale the stroke of the engine, and the line traced by the pencil shows the pressures

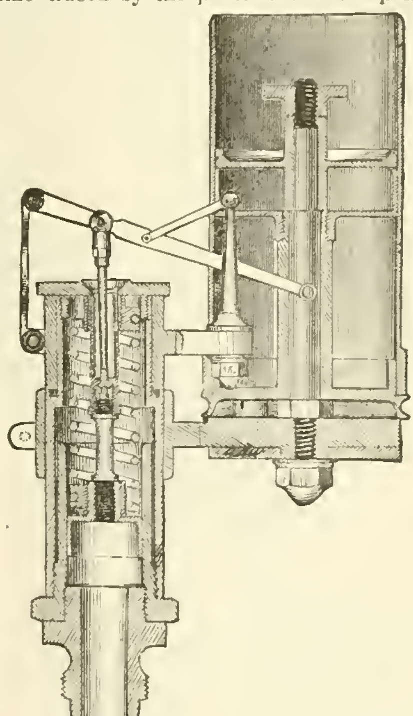


Fig. 2.

acting upon the piston. These pressures are measured by the movement of the spring contained in the indicator, an inch of movement, or an inch of height above the atmospheric line on the diagram, representing so many pounds pressure, according to the spring used; thus a 30 lb. spring would be compressed, so as to give the pencil a movement of one inch for 30 lbs. steam pressure, and a 40 lb. spring, one inch for 40 lbs. pressure, and so on. Having then, a scale, in which one inch is divided into 30 or 40 parts, or any other number of parts such as ordinarily used, we can readily measure any pressure dreetly from the diagram when once we are permitted to know what scale or spring has been employed.

Fig. 3 shows a neat construction of the theoretical expansion curve, which should always be drawn upon the diagram in order to compare it with the actual line traced by the indicator. To make the construction it is necessary to know the clearance space so as to draw the clearance line, B V, from which expansion is reckoned, to draw B C, the line of boiler pressure and also V V', the line of perfect vacuum. Then take any point such as O, on the expansion line of the diagram; this point must not be later than F, the point of release, because here the exhaust line begins; from O draw O P at right angles to B C, and O N at right angles to B V, join V and P and at N, where V P intersects O N, draw N M parallel to B V. Then M is the theoretical point of cut-off. The space M P can be divided into any number of parts which need not be equal, and lines drawn from V to points **a, b, c, etc.**, cut the line M N in points a', b', c', etc. From a and a' are drawn lines parallel to M N and O N respectively and where they intersect is one point of the curve. The same operation for b and b', gives another point and so on. When a little skill is acquired these lines need not be entirely drawn in, but only so much as to show the intersection which determines a point of the curve, and it is thus a very easy and expeditious method for drawing the true curve upon an indicator diagram. Fig. 2, is a sectional view of

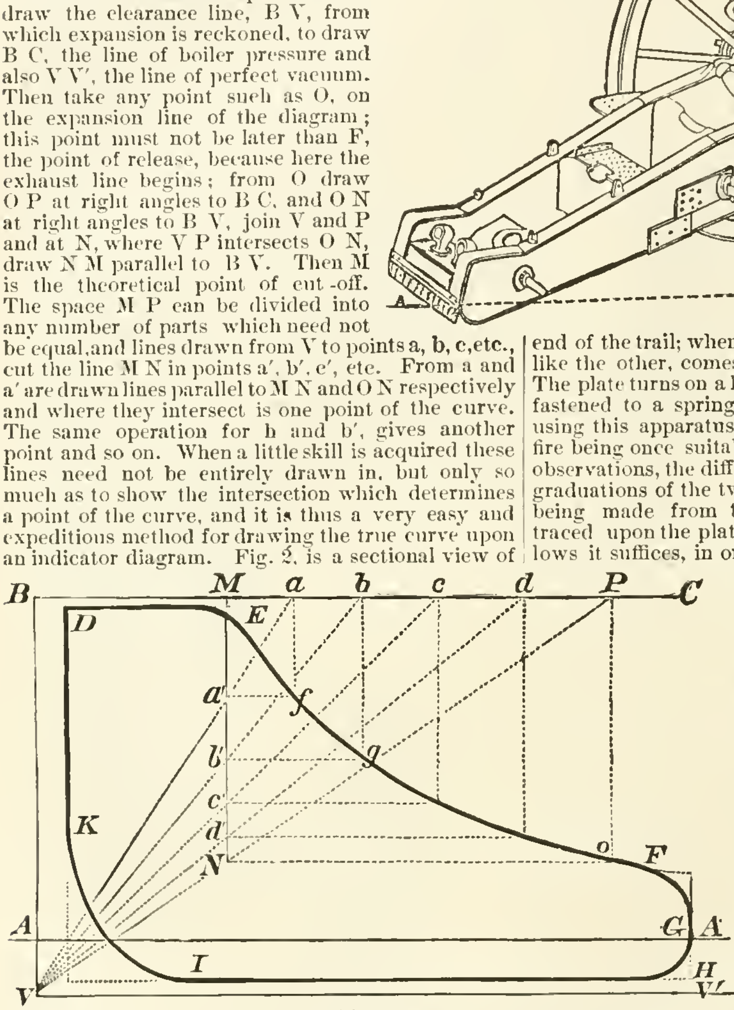
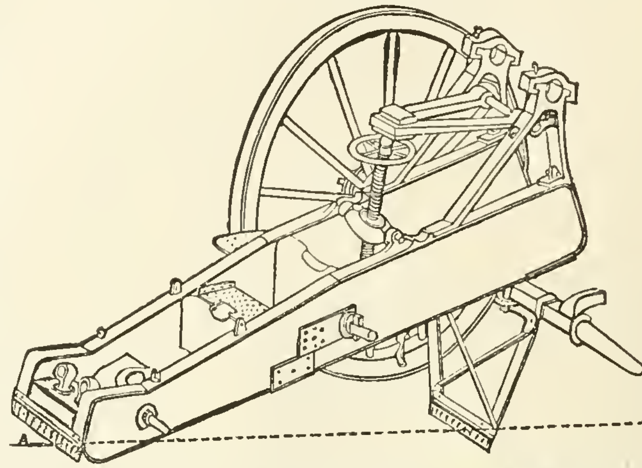


Fig. 3.

the Thompson Indicator, which is considered as the standard of this country and Europe. See *Planimeter* and *Thompson Indicator*.

INDICATOR RING.—A thin narrow ring of wrought iron, fitted on the breech-screw of a breech-loading gun, with a raised line of brass on it, which shows by its coincidence with a similar line on the top end of the breech-screw whether the vent is properly screwed up.

INDIRECT POINTING APPARATUS.—Varius apparatus for pointing guns indirectly have been employed from time to time. That employed by the Prussians in the sieges of the war of 1870-1871 and represented in the drawing is favorably endorsed by all officers who have employed the method. The apparatus is composed, 1st, of a trapezoidal frame of ron attached to the axle by means of straps; under the lower side, and parallel thereto, is fixed a graduated plate of brass. When the frame is lowered, the graduated plate touches the platform; but when not required for use it is raised up and secured by hooking it to some rings on the under side of the cheeks. 2d. of a plate similar in form and gradnation to the one already mentioned, which is attached to the butt



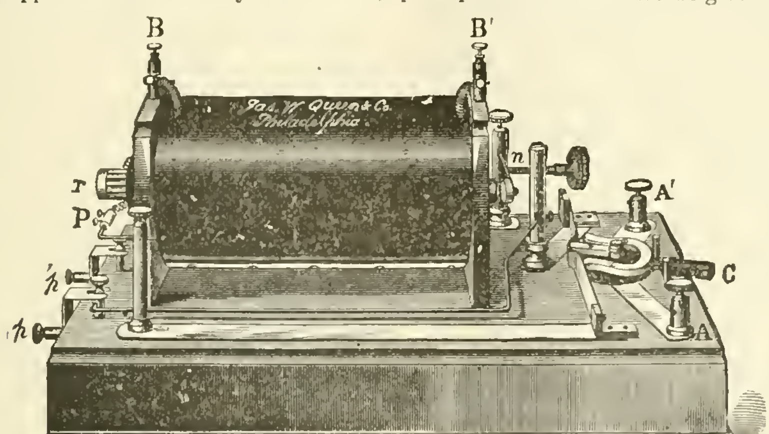
end of the trail; when the latter is lowered, this plate like the other, comes in contact with the platform. The plate turns on a hinge, and may be raised up and fastened to a spring-hook on the rear transom. In using this apparatus it is operated as follows: The fire being once suitably adjusted by means of direct observations, the difference which exists between the graduations of the two plates is noted, the readings being made from the zero to the directrix, AB, traced upon the platform. In all the firing that follows it suffices, in order to point the piece, to read the graduation of the first plate that coincides with the directrix, and then to shift the trail to the right or left until the difference between the graduations of the plates shall be equal to that originally noted. The graduation of the plate is arbitrary. In the Prussian artillery the principal divisions are 40 m. m. apart, and these intervals subdivided into 10 equal parts. These graduated scales permit of maintaining to a great exactness and without renewed pointing, a line of sight once established, which is of the greatest importance in firing at an object concealed from the view; they also permit of varying, laterally, the point of fall for distances, by displacing horizontally the point of departure of the line of sight, an operation required in breeching masonry, for making the horizontal cut. This method of pointing was employed by the Prussians with great success at the siege of Strasbourg, in batteries without embrasures, for breeching walls of masonry by a plunging fire.

INDORSED.—A term applied in Heraldry to two animals placed back to back. Two keys, two wings, etc., may also be indorsed, and a pelican is always drawn with his wings indorsed. The terms *Addorsed* and *Indorsed* have the same application.

INDUCTION OF ELECTRIC CURRENTS.—The discovery of the power of electric currents to induce currents in neighboring conducting circuits is due to Faraday. His researches on the subject, named by him *volta-electric* induction, were published in the Philosophical Transactions (1831-32). Henry (1832) observed that when contact was broken in a long galvanic circuit a bright spark occurred, which did not occur when the circuit was short. This was shown by Faraday (1834) to be due to the extra current induced by the various parts of the circuit in each other. Bachhoffnor and Sturgeon (1837) showed the superior action, in induction apparatus, of a bundle of iron wires to that of a solid bar of iron. Henry (1841) studied the indicative action of induced currents of different orders. De la Rive designed, in 1843, an electro-chemical condenser, consisting of a primary coil, which, by means of the extra current, could enable a single galvanic cell to decompose water. The same decomposition, however, had been effected by Wright in 1840. Ruhmkorff constructed (1850 or 1851) the first so-called *induction coil*, the excellence of which was chiefly attained by the proper insulation of the secondary coil. Fizeau (1853) increased immensely the power of the coil, by providing it with a condenser. Of late years coils of great power have been constructed, rivaling, if not exceeding the most powerful electric machines in length and power of spark.

The Fundamental law of current induction may be thus shown: Two long copper wires are fixed so as to be parallel and close to each other. The extremities of the one are in connection with the poles of a galvanic battery, and those of the other, with the binding-screws of a galvanometer. The instant the circuit of the battery is completed, and the current sent along one wire, a current in the opposite direction is induced in the other wire, which is shown by the deflection of the needle of the galvanometer. This induced current is only momentary, for though the current continues to circulate in the first wire, the needle soon falls back to its original position of rest, and the wire then gives free passage to other currents, and appears to be in no way affected. If, however, as the primary wire remains in any one position, all evidence of electricity in the secondary wire disappears; but if in this position the strength of the primary current should be increased or diminished, momentary currents in the secondary wire would again mark the changes in the primary, the increase causing an inverse, and the decrease a direct current. Hence we conclude, that *a current which begins, a current which approaches, or a current which increases in strength, induces an inverse momentary current in a neighboring conducting circuit*, and that *a current which stops, a current which retires, or a current which decreases in strength, induces a direct momentary current in a neighboring circuit.* For inverse, the word *negative*, and for direct, the word *positive*, are frequently employed in reference to induced currents.

In experiments like the above, it is much more convenient to wind the primary and secondary wires side by side round a bobbin, so as to form a coil. The wires are insulated from each other by a covering of wool or silk. Not only does such a disposition admit of very long wires being used, but it also disposes the wires employed to greater advantage, for each single turn of the primary wire acts not only on the corresponding turn of the secondary wire but on all the turns near it. The inductive effect of such a coil is much greater than that which would be obtained by the same extent of wires running side by side in a straight or crooked line. It is not even necessary that the two wires be wound round together, each may be wound on a separate bobbin, and the one placed inside the other. The primary coil is made of wire one-twelfth of an inch in diameter, covered with wool; and the secondary coil of silk-covered wire, one-eighteenth of an inch, much longer than the primary wire. With two such coils, many principles of induction can be given.



now, when the needle is at rest, the battery circuit be broken, and the current stopped, another momentary current is indicated by the galvanometer needle but in this case in the same direction as the inducing current. The inducing wire and current are called *primary*, and so are distinguished from the induced wire and current, which are termed *secondary*. The passive condition of the wire while thus under induction has been described by Faraday as electrotonic. An electric throb, so to speak, makes the setting in of this state, and another its vanishing; the former in the opposite direction to that of the inducing current, and the latter in the same direction. If the primary wire be movable, so that it can be suddenly brought near to, and withdrawn from the secondary, while the battery current passes steadily, currents are induced as in the former case, the approach of the wire being marked by an inverse current, and its withdrawal by a direct one. As long,

Let us place the primary coil within the secondary; let the primary, along with the self-acting rheotom, be put in the circuit of a galvanic cell, and let the secondary coil be connected with a galvanometer. The interruption in the primary current being effected by the rheotom with great rapidity, the induced inverse and direct currents are sent out with corresponding rapidity through the coil of the galvanometer. If this last be of a short and thick wire, so as not to tax the tension of the current transmitted, the induced currents will not deflect the needle; or if they should happen, through the unsteady action of the break, to do so, it only oscillates round its position of rest. This proves that *the quantity of electricity transmitted by the induced inverse and direct currents is the same*, for they each exert the same influence on the needles. But if the coil of the galvanometer consist of a long fine wire, the needle is kept deviated in a direction which argues the action of the direct current. This leads us to conclude that *both currents, though equal in quantity, are unequal in tension, the direct current having the highest tension*, for it has more power to force its way through the fine wire of the galvanometer than the inverse, Other proofs of the same principles may be easily furnished. The difference of the tension of the two induced currents, is accounted for in this way: when a change takes place in the primary current, the quantity of the electricity induced by it in the secondary wire is the same whether this change takes place quickly or slowly; the tension, however, is very different. When the change takes place slowly the total quantity of electricity in circulation continues to pass as slowly, and there is little in motion at one time; but when the same occurs quickly, it is sent with momentum, so to speak, and the quantity in circualtion at one time is as much greater, in comparison with the former case, as the time is shorter. It is this quick dispatch of electricity which constitutes the tension of the current. Now, as it takes some time before the primary current is fully established, the inverse induced current is slow and of low tension; but when the contact is broken, the primary current ceases much more suddenly than it began, and the direct induced current is quick and of high tension. This view of the matter is borne out by experiment, for it is found, that *whatever favors the suddenness of the changes of the primary current, heightens the tension of the currents induced by these changes*. The break, from this circumstance, forms an important element in the construction of all induction apparatus. The inductive power of the primary coil is immensely increased by placing a bundle of soft iron rods or wires in the center of it. The magnetism which begins and ceases in these at each passage of the current acts in conjunction with the inducing force of the coil. The center of the bobbin is hollow, to receive a bundle of this kind. The greater part of the inductive action is due to the iron core, and the induced currents got with and without it are not to be compared in point of energy. A solid bar of soft iron may also be used, but with much less advantage, for the induced currents which linger in it after the stoppage of the main current acting themselves inductively, impair the suddenness with which the current disappears from the primary wire and magnetism from the core. The thin layer of oxide which forms on the rods insulates them sufficiently from one another, and prevents the formation of such currents. It is partly for the same reason that metal tubes cannot be used for bobbins for either primary or secondary coils. If such were used, *closed circuits* would be formed in them, the reaction of which, however, would prolong the changes of the primary inducers and consequently impair the tension of the secondary current. Metal bobbins would not be open to this objection if they had a longitudinal slit, which would make the tranverse section a broken ring and circuit. The excitation of magnetism in the core is the principal aim of the primary coil, and as a strong current is essential to that object, it is made of thick wire and of moderate length. In the secondary coil, the tension of the induced current alone is aimed at, and with this view it is made of as thin wire as can be made, so as to admit of as many turns as posssible being brought within the influence of the core and primary coil. The electric conformation of the secondary coil is sometimes looked upon in the same light of that of a galvanic battery. The total electromotive force of the coil is the sum of that of all the turns in it, in the same way that the electro-motive force of the battery is proportionate to the number of cells.

Not only does a galvanic current induce electricity in a neighboring circuit, but it also acts inductively on itself. When contact is broken in a battery circuit, the galvanic spark is seen. When the wire is short, the spark is feeble, but it increases in brilliancy with the length of the circuit, and this becomes particularly observable, when the wire is wound round in a coil. This certainly does not arise from the current being strong with the long wire, and weak with the short one, for quite the reverse is the case, as might be shown with the aid of a galvanometer. The real cause of superior brilliancy of the galvanic spark with the long circuit is to be found in the induction of the primary current on the various parts of itself, exciting, as they are called, *extra currents* in the primary wire. It has been fully attested by experiment, that at the instant *a galvanic current begins and ends, extra currents are induced by the action of the several parts of its circuit upon each other, that at the beginning of the current being inverse, and that at the end direct*. As the extra current inverse acts opposite to the main current, it does not appear as a separate current but only retards the instantaneous passage of the main current. The extra current direct succeeds the main current, and has consequently a separate existence. It is what is generally referred to when the extra current is spoken of. This extra current is of much higher tension than the original current. The effect of the extra current on the direct induced current of the secondary coil is to lessen very decidedly its tension. If a way be made for the extra current, the tension of the induced current falls prodigiously. In a large coil-machine, which gives freely sparks of 1 or 2 in. in length, when the two portions of the break are joined by a thin wire, so as to allow the extra current to pass, sparks will not travel between the two poles, however near they are brought. When no such communication exists, a portion of the extra current leaps over between the separating parts of the break, and in so far diminishes the intensity of the secondary current. The condenser of the coil-machine, to be afterwards described, has for its object the absorption or suppression of the extra current, but the manner in which it effects this is not yet properly explained. The prejudicial effect of the extra current on the induced current is easily understood, when we bear in mind that it prolongs the cessation of the magnetism of the core and of the current in the primary coil, and thus imparing the suddenness of this change, reduces the tension of the induced current.

The essential parts of the induction coil have been already described in detail. A primary coil with its core of iron wire, and a secondary coil exterior to and insulated from a primary coil, form the main portion of the instrument. The primary coil is connected with the poles of a galvanic battery, and in the circuit a rheotom is introduced, to effect the interruptions of the current essential to its inductive action. The only parts not yet referred to are the condenser and the commutator. The condenser consists of several sheets of tinfoil and oiled silk, laid alternately the one above the other. The first, third, fifth, etc., sheets of tinfoil are connected by strips of the same material; so are the second, fourth, sixth, etc.; the whole forming a condensing apparatus like a Leyden jar, the odd sheets forming the one coating, and the even sheets the other. Each set of sheets is connected with one of the wires of the primary coil. The condenser is generally placed in the sole of the instrument, and does not meet the eye. The commutator consists of an ivory cylinder covered with conducting plates on two sides, and is so constructed that it can break contact, or transmit the current through the coil in either direction.

The drawing represents Queen's dissected Ruhmkorff coil, which is mostly adopted for the operations of mines, torpedoes, etc. A, A′, are binding posts, to connect with the battery; C is the Bertin commutator used in reversing the current; at P, the battery current enters the primary coil; this latter can be removed, as also can the core, r; at n, the battery current is automatically broken. The brass plates, p, p′, connect the condenser with the primary circuit; the condenser is contained in a sliding drawer, which can be very easily removed. B, B' are the terminals of the secondary coil. A copper conducting wire, which is insulated by one or two coats of gutta-percha, connects the charges with the galvanic apparatus. The charge is exploded by passing a spark through a very small portion of fulminate of mercury inserted between the ends of two copper wires, which are enclosed within a short tube of gutta-percha, coated within with sulphuret of copper. The wires are bent near the end of the tube and twisted around each other. A little meal powder is thrown around the fulminate and the tube, which, with the tube and the bent part of the wire, is tightly closed in a small gutta-percha bag, to keep out moisture. To fire a single mine, one end of the twist is soldered to the conducting wire and the other inserted into the earth to complete the circle. For several mines to be exploded at the same time, conducting wires connect the mines, and the ends of the twist are soldered one to each conductor, except the end one, which has one of its ends inserted into the earth. By this combination the series will be exploded without any sensible difference of time between the nearest and furthest mine. See *Galvanism*.

INERTIA.—A term expressive of that indifference to a state of rest or motion which is a universal property of matter, and may be expressed by saying *that a body in motion will continue in motion, and a body at rest will remain at rest, unless acted upon by some external force*. The latter part of this principle was known to the Ancients, and by them attributed to a certain repugnance to motion, which was a characteristic of all matter; but it was shown by Galileo that the former part was equally true and general. This property of matter has been called by Kepler *vis inertiæ*.

INESCUTCHEON.-In Heraldry, a single shield borne as a charge. When there are two or more, they are simply called escutcheons, for an inescutcheon, it is said, must always occupy the fess point of the shield. An inescutcheon is to be distinguished from an escutcheon of pretense, which is not a charge, but a separate coat. See *Heraldry*.

INFAMED.—In Heraldry, an epithet applied to a lion or other animal which has lost its tail, the loss being supposed to disgrace or defame it. *Defamed looking backwards* occurs in ancient blazon for counter-rampant regardant, the lion being supposed to be flying from an enemy . Often written *Defamed*.

INFAMOUS BEHAVIOR.—Disgrace with infamy and infamous behavior are terms in use in the military and naval codes to designate conduct (and penalty) which is not only opposed to discipline, but also disgraceful in a social sense. As infamous behavior, have been always classed in all countries desertion of colors on the field of battle, failure to attempt to succor comrades in danger, cold-blooded cruelty, and other crimes which are greatly subversive of morality. If a man is found guilty of any of these crimes by a Court-Martial, and not sentenced to death, the sentence is ordinarily discharge—or dismissal—with ignominy or infamy. So severe an enactment greatly adds to the force of the penalty, and stigmatizes the offender for life as a disgrace to his country and his cloth.

INFANTRY.—The term infantry was originally applied to a body of men collected by the *Infante* of Spain, for the purpose of rescuing his father from the Moors. The attempt being successful, the term was afterwards applied to foot-soldiers in general, as opposed to cavalry. Among the ancient nations of Europe the foot-soldiers constituted the chief strength of the armies. In the best days of the Grecian and Roman States, battles were won mainly by the force and discipline of the phalanges and legions, and the number of the infantry in the field far exceeded that of the cavalry. The cavalry were then, as at present employed chiefly in protecting the wings of the army and in completing a victory gained by the infantry. The ancient Franks, when they left the forests of Germany, were accustomed to march and fight on foot; and they persevered in this practice even after they had obtained possession of the country of the Gauls, which abounded with horses. But soon after the time of Charlemagne Institutions of Chivalry began to be generally adopted in the kingdoms of Europe. These led to frequent exhibitions of martial exercises on horseback in presence of the Sovereigns and assembled Nobles; and the interest inspired by the achievements of the Knights on those occasions was naturally followed by a high regard for that order of men. By degrees the cavalry, which was composed of persons possessing rank and property, and completely armed, acquired the reputation of being the principal arm; while the foot-soldiers, badly armed and disciplined, were held in comparatively small estimation. This continued 400 years, and although war was the principal occupation of mankind, military science fell into neglect. But Rulers were forced by the power of feudalism to make an alliance with the despised class of foot-soldiers, and in 1214 we find that some of the German infantry was recognized to be "very good, and trained to fight on the level even against cavalry." The cavalry of France was routed at Courtrai by the infantry during the next century, and the Austrians suffered defeat by the efficient work of the Swiss pike at Morgarten (1315), Sempach (1386), and Nafels (1388). At Cressy and Poictiers (1346–1356) the Knights of England dismounted to fight beside the successful infantry. The principal weapons of the infantry before the invention of gunpowder were long-bows, halberds, cross-bows, spiked clubs, axes, pikes, staight-swords, shields, corselets, mail-jackets, helmets and partisans. In the 16th century, however, these weapons were replaced by fire-arms, and in the 18th century, the musket was in general use. It became customary during the Thirty Years' War to form battalions of infantry composed of 500 men, which were massed into dense columns during battle in spite of the deadly effect of the enemy's artillery and fire-arms. The absurdity of this formation was first exposed by Gustav Adolph, who recognizing the destructiveness of fire-arms, arranged his battalions with a view to increasing the effectiveness of the fire of his troops, while avoiding exposure to that from the enemy. His tactics were so successful at Breitenfeld and Lutzen (1631-32) that they were soon afterwards universally adopted. The bayonet came into use in 1670, and the socket-bayonet about 1699. Fredrick the Great made many improvements till then comparatively unknown. The rapidity with which his infantry troops performed their evolutions during battle contributed largely toward his famous victories in the Seven Years' War. In fact the Prussian infantry have ever since his time served as models for other European countries. The superiority of this arm consists in the troops being able to act on ground where cavalry cannot, and it is obvious that the latter must be nearly useless in the attack of fortified towns. During the War of the Rebellion in this country skirmishing was in vogue in the northern and southern armies. It had been in use during the Revolutionary War, and was well suited to the American character. Skirmishing has since been adopted in Prussia, and the skirmish line is recognized as the proper formation in battle to avoid the destructive effect of the breech-loaders. The co-operation, however, of cavalry and infantry troops was neglected by American Generals. Artillery fire usually opened the battle, and was followed by the advance of the whole line on the run in a final charge. The Infantry Tactics in general use were those of Casey, founded on those of Scott. Casey's Tactics, however, were abandoned for those of Hardee, and in 1867 those of Upton were finally adopted.

INFANTRY COLORS.—In the United States, each Regiment of Infantry has two silken Colors. The first, or the National Color, of stars and stripes, as described for the garrison flag; the number and name of the regiment is embroidered with silver on the center stripe. The second, or Regimental Color, is blue, with the arms of the United States embroidered in silk on the center. The name of the regiment in a scroll, underneath the eagle. The size of each Color is six feet six inches fly, and six feet deep on the pike. The length of the pike, including the spear and ferrule is nine feet ten inches. The fringe, yellow; cords and tassels, blue and white silk intermixed. See *Colors*.

INFERIOR.—A term signifying, in a military sense, junior in rank. Inferior officers are those of the lower ranks or grades.

INFERNAL MACHINE.—A term applied to various deadly contrivances; for instance, to the battery-gun with which the attempt to assassinate Louis Philippe was made, and the devices used on similar historical occasions. A noted *infernal machine* was the fire-ship used by the English at St. Malo. This was a three-decker charged with powder on the first deck; shells, carcasses, etc., on the second; and with barrels filled with combustibles on the third; the gun deck was covered with old guns overloaded. It was intended to destroy ships, bridges, etc.

INFLAMMATION.—When grains of powder are united to form a charge, and fire is communicated to one of them, the heated and expansive gases evolved insinuate themselves into the interstices of the charge, envelop the grains, and ignite them one after another. This propagation of ignition is called *inflammation*, and its velocity, *the velocity of inflammation*. It is much greater than that of combustion, and it should not be confounded with it. When powder is burned in an open train, fine powder inflames more rapidly than coarse; such, however, is not the case in fire-arms, owing to the diminution of the interstices. If a charge were composed of mealed powder, the flame could no longer find its way through the interstices, and the velocity of inflammation and combustion would become the same. Now supposing one grain or particle alone be ignited, it will first be inflamed over its whole surface, and the progressive combustion will take place from the exterior to the interior. Its *rate of combustion* will therefore depend upon both its shape and size, leaving out entirely, for the present, the question of density and hardness. A particle of spherical or cubical form will expose less surface to ignition in proportion to its volume than one of an elongated or flat shape, and will consequently require a longer period for the combustion of its entire mass; the larger the particle, also, the longer will be the time required for its combustion. Looking, then, at one grain of powder by itself, we may say that the larger it is, and the more nearly its form approaches a sphere, the longer will its combustion take, and the slower will be the evolution of the gas. When, however, we come to regard the action of an aggregation of such particles, as in the charge of a gun, the *rate of ignition* of the whole charge is also affected by the size and shape of the grain. The part of the charge first ignited is that near the vent, and the remainder is inflamed by contact with the heated gas generated by the combustion of this portion, so that the rate of ignition of the whole mass will be regulated by the greater or less facility with which the gas can penetrate throughout the charge, which is itself dependent upon the shape and size of the interstices between the grains. If the grains be spherical and regular in form, the interstices will be comparatively large and uniform, and the gas will penetrate the mass with facility; again, the larger the grains, the larger the interstices between them. If, on the other hand, they be flat or flaky and irregular in shape, the passage of the gas will be more difficult, and the rate of inflammation of the charge reduced. We see, therefore, that the considerations which affect the more or less rapid combustion of an individual grain of gunpowder, also affect the rate of ignition of a charge of such grains, but in an opposite direction; so that a form of grain which will individually burn rapidly may offer an increased resistance to the passage of the heated gas through the charge, and thereby retard its ignition, while a grain which will burn more slowly may allow of the charge being more rapidly ignited. By varying the size and shape of the grain alone, a powder may therefore be obtained, a charge of which shall be ignited rapidly throughout, but burn comparatively slowly, or one which shall be ignited more slowly, but when once inflamed burn very rapidly. It is necessary to draw a clear distinction between a rapidly igniting and a quickly burning powder. The heat developed increases with the charge, and as the velocity of the gases increases with their temperature, it is therefore evident that a large charge is consumed quicker than a small one; it is also true that the loss of heat absorbed by the surface of the bore is much less sensible when the charge is great than when it is small; that is, the quantity absorbed is proportional to the surface or the square of the caliber of the gun and the heat developed increases as the cube of the caliber. With proper data we can readily determine the density of the gaseous products at any particular moment of combustion. For this purpose, take the case in which the inflammation of the whole charge is considered instantaneous, and let P be the weight of the charge; d' the density of the composition of which the powder is made; V the space in which the gases expand; t' the time of combustion of a single grain; t the time since the combustion began; d the density of the gases at a given instant.

The weight of powder remaining after a time, t, will be equal to $P\left(1-\frac{t}{t'}\right)^3$, and the volume will be equal to $\frac{P}{d'}\left(1-\frac{t}{t'}\right)^3$; the weight of gaseous products evolved will be equal to

$$P\left(1-\left(1-\frac{t}{t'}\right)^3\right)$$

; and their density will be equal to this quantity divided by the space, V, diminished by the space occupied by the powder unburnt at the end of the time, t.

Or,

$$d=\frac{P\left(1-\left(1-\frac{t}{t'}\right)^3\right)}{V-\frac{P}{d'}\left(1-\frac{t}{t'}\right)^3}.$$

Let K, represent the ratio of the weight of powder which would fill the space V, to the weight of the charge P, and D, the gravimetric density, or weight of a unit of volume of powder, we shall have the equation,

$$\frac{DV}{P}=K, \text{ or } \frac{V}{P}=\frac{K}{D};$$

and the formula for the density of the gaseous products becomes,

$$d=\frac{1-\left(1-\frac{t}{t'}\right)^3}{\frac{K}{D}-\frac{1}{d'}\left(1-\frac{t}{t'}\right)}=D\frac{1-\left(1-\frac{t}{t'}\right)^3}{\left(1-\frac{t}{t'}\right)^3\frac{D}{d'}}.$$

If the charge fills the entire space V, $K=1$, and

$$d = D\frac{1-\left(1-\frac{t}{t'}\right)^3}{1-\left(1-\frac{t}{t'}\right)^3\frac{D}{d'}}.$$

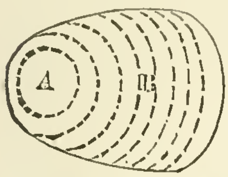
When the grains are sumed, $t=t'$, and $d=\frac{D}{K}$; and if $K=1$, $d=D$.

Having determined the mean density of the gaseous products at any instant of the combustion, we can determine the pressure exerted on the enclosing surfaces by means of Rumford's formula

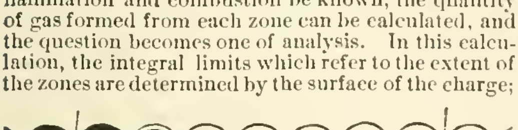
$$P=1.841\ (905d)^{1+0.362}.$$

This value of P supposes that the entire charge is inflamed at the same time—a supposition that is not strictly correct, except for small and lightly-rammed charges. When the charge is large, and well-rammed, as in cannon, it is necessary to take into consideration the time of inflammation.

In a majority of cases the preceding formulas will give the relation between the density and expansive force of gunpowder, without sensible error; but when the grains are small, and the charge is compressed by ramming, the interstices are diminished in size, and the inflammation is comparatively less rapid; besides, the size and form of the charge exert an influence which increases with its length. It is proposed to modify the formulas, and adapt them to the most general case, by considering the inflammation progressive. Take a charge of powder, of any form whatever, and consider it ignited at the point, A, the inflammation will reach the surface of the concentric zone, B, the radius of which is tv, in the time t, v being the velocity of inflammation. There will be portions of the charge situated within this zone which the flame will not have reached; others in which the combustion is completed; and others, between these two, in which the inflammation is completed, but the combustion is only partially completed, as represented.



The extent of the inflamed zones being determined by the form and dimensions of the charge, exerts a great influence on the development of the gases, and consequently on their density. If the velocities of inflammation and combustion be known, the quantity of gas formed from each zone can be calculated, and the question becomes one of analysis. In this calculation, the integral limits which refer to the extent of the zones are determined by the surface of the charge;



and those which refer to the progress of the combustion of the grains will be the point of ignition and the surface of inflammation; or, if ϕ be the time necessary for the flame to reach the surface of the zone, the radius of which is x, the time of partial combustion of a grain of this zone will be $t-\phi$, and its complete combustion is expressed by the relation $t=t'+\phi$.

For this zone the density of the gaseous products at the instant of inflammation will be $d=0$, as when completely consumed $d=D$.

The intermediate values maybe determined by formula (1)

$$d = \frac{D\left(1-\left(1-\frac{t}{t'}\right)^3\right)}{K-\left(1-\frac{t}{t'}\right)^3\frac{D}{d'}};$$

by substituting $t-\phi$ for t, and supposing $K=1$, should the charge completely fill the space in which it is burned. Integrating between the determined limits, we obtain the mean density of the gases developed. The solution of this question, in a general sense, is very difficult, and requires the aid of the differential calculus. There are particular cases, however, where the solution is not difficult; for instance, where the charge is of cylindrical form and is placed at the bottom of the bore of a gun. See *Explosion* and *Gunpowder*.

INFORMANT.—In case a civil person is the complainant, he becomes the principal witness before a Court-Martial, and after giving his evidence may remain in Court, in order that the Judge-Advocate may refer to him.

INFORMERS.—In the British service, soldiers who gave information of false musters, or of pay illegally detained; and were, for said services, entitled to their discharge.

INGAUNI.—A tribe dwelling on the mountains and seacost of Genoa in the first and second centuries B.C. They were very active in the wars between the Romans and Ligurians, and were Allies of the Carthaginians in the second Punic War. They were regarded as a distinct tribe in the time of Pliny and Strabo, but after the battle with Emilius Paulus, 181 B. C., in which they lost 15,000 men, very little was heard of them. The town Albenga, then called Albium Ingaurium, was their Capital.

INITIAL TENSION.—The system of *initial tension* consists in making a gun of concentric tubes, by putting on each successive layer, proceeding outward from the center, with an initial tension exceeding that of those below it; in other words, so that each hoop shall compress the one within it. The inner layer is thus in compression while the outer layer is in the highest tension. The inner layer is able to sustain the first and greatest stretch, and the outer layer, although stretched less by the explosion of the powder, has already been stretched into high tension, and thus has to do an equal amount of work. The intermediate layers bear the same relation to the initial strain, and to the strain of the powder, so that, in short, all the layers contribute equally of their tensile strength to resist the strain of the explosion. Each hoop, or tube, has this element of weakness, that its inner circumference is more stretched than its outer one. Absolute perfection would necessitate infinitely thin hoops, and, practically, the thinner the layers the greater will be the strength, provided the mechanical difficulties in construction, and more especially in applying, a great number of thin strata with the proper tension do not outweigh the advantages. The two principal methods of applying the system are by *shrinking* on, or by *forcing* on, the hoops. If the hoops are put on by shrinking, two embarrassments arise: *First*. The hoop must be accurately bored, and after each layer has been put on, the gun must be put in a lathe and the outside turned. Great accuracy of labor is required—labor of the most expensive class. *Secondly*. The process of shrinking on is not to be depended upon; nowhere is there a difficulty in insuring the exact temperature required, but scarcely any two pieces of iron will shrink identically. The fitting of hoops with nice adjustment would be difficult, theoretically; practically, it would not be done. But the chief embarrassment is the uneoual effect of heat.

In the first place, heating the layers over a fire to expand them subjects one part to more heat than another; the temperature of the surface and interior are unequal, thus causing irregular strains. This may be remedied by boiling the hoops in oil, which would toughen as well as expand the hoops. In the second place, the hoops are often heated to redness, when oxidation takes place. The internal diameter of the hoop is increased, and scale is left between some parts and not between others. In the third place, cast-iron and steel sensibly and permanently enlarge in proportion to the amount of carbon they contain when subjected to the heat.

Whitworth and Blakely advocate the method of forcing the hoops on with hydrostatic pressure. The forcing of a slightly conical ring over a correspondingly conical tube obviates the necessity of great accuracy in the diameter of either pieces. The truth of the cone depends upon the correctness of the lathe. The truth of the surfaces is also a question of good tools. The tension of the ring depends on the distance to which it is forced in the conical tube, and this may be regulated by the safety-valve of the hydrostatic-press. With special tools, and when correctness depends upon the mechanical appliances, which can be adjusted with the utmost nicety, an inexpert workman could hardly fail to do well. See *Built-up Guns*, *Cannon*, *Ordnance*, and *Varying Elasticity*.

INITIAL VELOCITY.—In gunnery, the speed with which the ball leaves the muzzle of the gun. This was formerly calculated from the momentum as shown by the Ballistic Pendulum. A very great improvement of late years is the Electro-ballistic Pendulum, the invention of a Major Navez of the Belgian service, which actually measures the interval of time during which the shot traverses a short space of ground. The apparatus consists of a steel pendulum falling at the side of a graduated sector of a circle. Behind the segment is a piece of iron capable of being magnetised by a galvanic battery adjoining. The wires for completing the circuit between the battery and the magnet are so arranged that they are in connection with two targets of paper or other thin material in the line of the projectile's fire. So long as the circuit is complete, and before the experiment, the magnet holds the pendulum at its highest point. When the shot pierces the first target, the circuit is broken, iron demagnetised, and the pendulum released; these effects being absolutely simultaneous. With equal simultaneity, the piercing the second target re-establishes the circuit, magnetises the iron, and arrests the pendulum in its descent. The distance between the targets is known, and the accumulating resistance of the atmosphere within that time; the sector being finely graduated, the distance traversed by the pendulum shows exactly the fraction of a second occupied, and from these data the initial velocity is a matter of simple computation. Of an ordinary smooth-bore cannon, the initial velocity is near to 1600 feet per second. See *Ballistic Pendulum*, *Chronoscope*, *Gun-pendulum*, and *Velocity*.

INITAL VELOCITY OF ROTATION.—Let V be the initial velocity of the projectile, or space which it would pass over in one second, in the direction of flight, moving with the velocity with which it leaves the piece, and l the distance passed over by the projectile in making one revolution; then $\frac{V}{l}$ will be the number of revolutions in one second, and $2\pi\frac{V}{l}$ the *angular velocity* of the projectile at the muzzle. The velocity of rotation of a point on the surface is given by the expression,

$$rw=2\pi r\frac{V}{l},$$

in which r is its distance from the axis of motion, and w is the angular velocity. See *Grooves*, *Rotation*, and *Velocity of Rotation*.

INITIATIVE.—In offensive warfare, to take the *initiative* is the power of compelling your adversary to make his movements dependent on your own, the result of which is to give the invader of a territory great advantage. It is also explained as the success obtained by the invader of a territory, suitable for military movements, and defended only by an army, not by fortifications; not only is the advantage in his first onset, but in subsequent engagements, thus disconcerting and to some extent crippling his adversary so as to frustrate or deprive him of the power of carrying out offensive measures.

INJURIES.—In the exercise of professional duty by military officers, injuries may frequently be occasioned to other officers, or to private individuals, whose legal remedies are here considered. As between officers themselves, the language of the Articles of War is sufficiently comprehensive to bring most of such cases within the cognizance of a Court-Martial; but a Court-Martial has no power to award pecuniary damages for injurious conduct. Its jurisdiction is criminal, and its judgments are penal. It may happen, too, that the common feeling of the service, to which the offending or the complaining party belongs, would in many cases render an application to such a tribunal utterly fruitless; as the general sentiment of the members of a particular profession or class of society, respecting a matter of professional or corporate right or conduct, is often found to be at variance with the public law of the land. Civil actions are therefore maintainable against commissioned officers, for exceeding their powers, or for exercising them in an oppressive, injurious, and improper manner, whether towards military persons or others. Extreme difficulties, however, lie in the way of plaintiffs in actions of this nature, for no such action is maintainable for an injury, unless it be accompanied by malice or injustice: and the knowledge of this, while it can never check the conduct of good men, may form a check on the bad. Where an officer makes a slip in form, great latitude ought to be allowed; but for a corrupt abuse of authority none can be made. It will be convenient to consider the law upon this subject; 1st, as it applies to wrongs committed by officers towards persons under military authority; and, 2dly, as it applies to persons not subject to such authority. Some of the decisions that will be quoted were pronounced in cases where naval officers were concerned; but the principle of the decisions applies equally to both services. I. *Wrongs towards Persons under Military Authority.*—A notion appears to have at one time extensively prevailed that an officer could have no remedy against ill treatment received from his superiors in the course of professional duty, except by bringing the offending party to a Court-Martial, and subjecting him to the penalties of the Articles of War. This opinion, however, was quite unfounded in point of law; and such a state of things might often be productive of the worst consequences. The point was distinctly raised in Grant *v.* Shand, where an action was brought by an officer in the army against his superior officer for oppressive, insulting, and violent conduct. The plaintiff was directed to give a military order: and it appeared that he sent two persons, who failed. The defendant thereupon said to the plaintiff, "What a stupid person you are," and twice struck him; and although the circumstances occurred at Gibraltar, and in the actual execution of military service, it was held at the trial that the action was maintainable; and a verdict was found for the plaintiff. An application was afterwards made to the Court of King's Bench to set aside the verdict; and Lord Mansfield, the Chief-Justice, was very desirous to grant a new trial; but the Court, after argument, refused to disturb the verdict. So also an action will lie for unjust treatment under the form of discipline, as in Swinton *v.* Molloy, where the defendant, who was Captain of the *Trident* man-of-war, put the Purser into confinement, kept him imprisoned for three days without inquiring into the case, and then released him on hearing his defence. The Purser brought his action against Captain Molloy, for all his unlawful detention in custody; and, upon the evidence, Lord Mansfield said, that such conduct on the part of the Captain did not appear to have been a discharge of his duty, and therefore that his justification under the discipline of the navy had failed him. The jury gave £1,000 damages. In the foregoing case no want of uprightness was attributed to Captain Molloy; and the decision rested wholly on the circumstance of his having committed an injustice, although without a corrupt intention. Cruelty or unnecessary severity, when wilfully committed in the exercise of superior authority, are also good causes of action. Thus in Wall *v.* Macnamara, the action was brought by the plaintiff, as Captain in the African Corps, against the defendant, Lieutenant Governor and Military Commandant of Senegambia, for imprisoning the plaintiff for the space of nine months at Gambia, in Africa. The defense was a justification of the imprisonment under the Mutiny Act, for the disobedience of orders. At the trial it appeared that the imprisonment of Captain Wall, which was at first legal, namely, for leaving his post without leave from his Superior Officer, though in a bad state of health, was aggravated with many circumstances of cruelty, which were adverted to by Lord Mansfield, in the following extract from his charge to the jury: "It is admitted that the plaintiff was to blame in leaving his post. But there was no enemy, no mutiny, no danger. His health was declining, and he trusted to the benevolence of the defendant to consider the circumstances under which he acted. But supposing it to have been the defendant's duty to call the plaintiff to a military account for his misconduct, what apology is there for denying him the use of the common air in a sultry climate, and shutting him up in a gloomy prison, when there was no possibility of bringing him to a trial for several months, there not being a sufficient number of officers to form a Court-Martial? These circumstances, independent of the direct evidence of malice, as sworn to by one of the witnesses, are sufficient for you to presume a bad, malignant motive in the defendant, which would destroy his justification, had it even been within the powers delegated to the defendant by his commission. The jury thereupon, after deliberation, found a verdict for Captain Wall, with £1,000 damages. An undue assumption of authority in matter not within the range of military discipline, is also a good ground of action against a Superior Officer. This appears from the case of Warden *v.* Bailey, where the plaintiff was a permanent Sergeant in the Bedford regiment of local militia, of which the defendant was the Adjutant. In November, 1809, the Lieutenant-colonel issued a regimental order for establishing an evening school at Bedford. He appointed the Sergeant-major the Master and ordered all Sergeants and Corporals, including the plaintiff, to attend and pay eight-pence a week towards the expenses of the school. The plaintiff and some other of the scholars having afterwards omitted to attend, several were tried by Court-Martial and punished. The plaintiff, however, was only reprimanded, and he promised regular attendance in future. Shortly afterwards he was ordered to attend a drill on parade, when the defendant, who appears to have been a shopkeeper, shook his fist at the Plaintiff, called him a rascal, and told him he deserved to be shot. The defendant then directed a Sergeant to draw his sword and hold it over the plaintiff's head, and if he should stir to run him through; and, by the defendant's direction, a Corporal took off the plaintiff's sash and sword. The plaintiff was then conducted, by the defendant's order, to Bedford gaol, with directions that he should be locked up in solitary confinement, and kept on bread and water. He was thus imprisoned for three days. He was then brought up before the Colonel and the defendant, and other officers of the regiment, and again remanded to the gaol. The plaintiff's health having been impaired by the continuance of this treatment for several weeks, he was afterwards conducted to his own house, and there kept a close prisoner until January 1810, when he was escorted by a file of Corporals from Bedford to Stilton, to be tried by Court-Martial for mutinous words spoken on parade at the time of his arrest, and for thereby exciting others to disobedience. He was tried accordingly, but liberated in March, 1810. Upon this he brought his action against the Adjutant for the wrongful imprisonment, when an objection was taken that the question of the propriety of the arrest was not within the jurisdiction of the Civil Courts. The Courts of Common Pleas, however, overruled this objection. Sir James Mansfield, C. J.; "It might be very convenient that a military officer might be enabled to make the man under his command learn to read or write,—it might be very useful, but is not a part of military discipline. Then, there is a tax of 8*d.* a week for learning to read and write. . . . . . The subject cannot be taxed, even in the most indirect way, unless it originates in the Lower House of Parliament." Mr Justice Lawrence: "It is no part of military duty to attend a school, and learn to write and read. If writing is necessary to Corporals and Sergeants, the Superior Officers must select men who *can* write and read; and if they do not continue to do it well, they may be reduced to the ranks. Nor is it any part of military duty to pay for keeping a school light and warm: this very far exceeds the power of any Colonel to order." In a subsequent stage of the same case, when it was attempted to justify or defend the mutinous expressions used by Warden on parade as above stated, on the ground of the illegality of the order which gave rise to them, the Court held, that although Warden had been unlawfully arrested for disobedience to that order, such a circumstance afforded no warrant for insubordinate language on Warden's part, and therefore no exemption from military arrest and punishment for the same. "Nor will he (said Lord Ellenborough, C. J.) be less an object of military punishment, because the order of the Lieutenant-colonel, to which this language referred, might not be a valid one, and such as he was strictly competent to make. . . . . . There may be disorderly conduct to the prejudice of good and military discipline, in the manner and terms used and adopted by one soldier in dissuading another soldier not to obey an order not strictly legal. If any erroneous order on the part of a Commanding Officer would not only justify the individual disobedience of it by the soldier, but would justify him in making inflammatory and reproachful public comments upon same to his fellow-soldiers, equally the objects of such order with himself, is it possible that military order and discipline could be maintained?" The common defence of officers, against whom actions of this nature are brought, is a justification of their conduct as agreeable to the discipline of the service, and contributary to the maintenance of that discipline. And there can be no doubt that where the conduct brought into question is not an oppressive, malicious, or unreasonable exercise of power, and does not amount to an excess or abuse of authority, an action is wholly unsustainable. The principles upon which the Courts of Law proceed in actions arising out of the abuse of military power, will receive further illustration from the language of Lord Mansfield, in summing up the evidence to the jury in Wall v. Macnamara. His Lordship thus expressed himself: "In trying the legality of acts done by military officers in the exercise of their duty, particularly beyond the seas, where cases may occur without the possibility of application for proper advice, greater latitude ought to be allowed: and they ought not to suffer for a slip of form, if their intention appears by the evidence to have been upright. It is the same as when complaints are brought against inferior Civil Magistrates, as Justices of the Peace, for acts done by them in the exercise of their civil duty. There the principal inquiry to be made by a Court of Justice is, *how the heart stood?* and if there appear to be nothing wrong there, great latitude will be allowed for misapprehension or mistake. But, on the other hand, if the heart is wrong—if cruelty, malice, and oppression appear to have occasioned or aggravated the imprisonment, or other injury complained of they shall not cover themselves with the thin veil of legal forms, nor escape under cover of a justification the most technically regular, from that punishment, which it is your province and your duty to inflict on so scandalous an abuse of public trust." It is no legal objection to an action for the abuse of military authority, that the defendant has not been tried and convicted by a Court-Martial, for that argument holds in no case short of felony. The infliction of an unjust or illegal sentence, pronounced by a Court-Martial, is a good cause of action by the prisoner, against all or any of the Members of the Court, and all persons concerned in the execution of the sentence; such a sentence, if it exceeds the authorized measure of punishment, being not merely invalid for the excess, but absolutely void altogether. The most remarkable case on record of this kind is that of Lieutenant Frye, of the Marines, who, after on unnecessary previous imprisonment for fourteen months, was brought to trial before a Naval Court-Martial at Port Royal in the West Indies, and sentenced to be imprisoned for 15 years, for disobedience of orders, in refusing to assist in the imprisonment of another officer, without an order in writing from the Captain of Her Majesty's ship *Oxford*, on board of which Lieutenant Frye was serving. At the trial the written depositions of several illiterate Blacks were improperly received in evidence against him, in lieu of their oral testimony, which might have been obtained and sifted by cross-examination; and the sentence pronounced was itself illegal for its excessiveness, the Act 22, George II., which contains the naval Articles of War, not allowing any imprisonment beyond the term of two years. On the return to England of Admiral Sir Chaloner Ogle, the president of the Court-Martial, Lieutenant Frye brought an action against him in the Court of Common Pleas for his illegal conduct at the trial, when the jury under the direction of the Lord Chief Justice Willis, gave a verdict for the Plaintiff, with £1,000 damages. The Chief Justice at the same time informed Lieutenant Frye that he might have an action against all or any of the other members of his Court-Martial; and Lieutenant Frye accordingly issued writs against Rear Admiral Mayne and Captain Renton, upon whom the same were served as they were coming ashore at the conclusion of the proceedings of the day at another Court-Martial, of which they were acting members, for the trial of Vice Admiral Lestock, for his conduct in a naval engagement with the French fleet off Toulon, in the early part of the same year. This was deemed a great insult by the members of the sitting Court-Martial, who accordingly passed some resolutions or remonstrances in strong language, highly derogatory to the Chief Justice, which they forwarded to the Lords of the Admiralty, by whom the affair was reported to the King. His Majesty, through the Duke of Newcastle signified to the Admiralty "his great displeasure at the insult offered to the Court-Martial, by which the military discipline of the navy is so much affected; and the King highly disapproved of the behavior of Lieutenant Frye on the occasion." The Lord Chief Justice, as soon as he heard of the resolutions of the Court-Martial, ordered every member of it to be taken into custody, and was proceeding to uphold the dignity of his Court, in a very decided manner, when the whole affair was terminated in November, 1746, by the Members of the Court-Martial signing and sending to his Lordship a very ample written apology for their conduct. On the reception of this paper in the Court of Common Pleas it was read aloud, and ordered to be registered among the records as a "Memorial," said the Lord Chief Justice, "to the present and future ages, that whoever set themselves up in opposition to the laws, or think themselves above the law, will in the end find themselves mistaken. The proceedings and the apology were also published in the *London Gazette* of 15th November, 1746. It may be useful to mention here, as a legal point giving rights of redress between military men, that a Superior Officer cannot safely deal for his own advantage, in money matters, with a Junior Officer under his command. The influence which a Senior Officer can exercise over his Junior is such as to destroy, or at least to control, in the purview of a Court of Equity, that entire feeling which is very proper and essential to the perfection of a bargain or contract; and if a Regimental Officer places himself in a position where such influence may operate to the prejudice of the Junior, the transactions between them are liable to be set aside for want of fairness or conscientiousness. This is the rule applied to dealings between a guardian and his ward, a physician and his patient, a landlord and his steward, a clergyman and a penitent, and all other cases where the existence of just and unavoidable influence may lead to abuse.

II. *Wrongs towards Persons not under Military Authority.*—Injuries may be occasioned to persons not subject to military authority, by officers mistaking or exceeding their powers, or exercising them with malice, negligence, or unskilfulness; but for acts of this kind a remedy lies only in the Civil Courts; the military tribunals, as already observed, having no power to grant pecuniary compensation by way of damages, and non-military persons having no *locus standi* as prosecutors before such Courts, which are instituted solely for the maintenance of order and discipline among the armed forces.

In cases of the kind now under consideration, it is quite immaterial whether the cause of action has arisen within the realm, or beyond the seas; though this proposition was not finally established until the year 1774, when the great case of Fabrigas *v.* Mostyn was determined in the Court of King's Bench, and put an end to all further question or doubt upon the subject. The Plaintiff was a native of Minorca, of which Island the defendant, General Mostyn, was Governor. The General had by his own absolute authority imprisoned the plaintiff and banished him from the Island without a trial. The defence was, that in the peculiar district of Minorca, where the offence occurred, no ordinary Court or Magistrate could have had jurisdiction. But the proof of this defence failed, and the jury gave the plaintiff £3,000 damages. The objection, however, was taken that the action did not lie, by reason of the foreign locality of the cause of it, and the point was twice argued at great length; but judgement was eventually pronounced against General Mostyn, in accordance with the verdict of the jury. It should be noticed also that as General Mostyn, happened to be a Governor, his appointment gave him the character of a Viceroy, so that *locally and during his government* no civil or criminal action lay against him. On principles of public justice, therefore, it was necessary that a remedy should be had in England. The *undue assumption* or *mistaken* exercise of authority by officers towards non-military persons, is a clear ground of action against them in the Civil Courts, even though there be no malice accompanying the transaction.

Captain Gambier, of the Navy, under the orders of Admiral Boscawen, pulled down the houses of some sutlers on the coast of Nova Scotia, who supplied the the seamen of the fleet with spirituous liquors. The act was done with good intention on the part of the Admiral; for the health of the sailors had been affected by frequenting these houses. Captain Gambier, on his return to England, incautiously brought home in his ship one of the sutlers whose houses had been thus demolished. The man would never otherwise have got to England; but on his arrival he was advised to bring an action against Captain Gambier. He did so, and recovered £1,000 damages. But as the Captain had acted by the orders of Admiral Boscawen, the representatives of the Admiral defended the action, and paid the damages and costs. This was a favorable, case, unaccompanied by any malicious feeling; but the parties concerned did not attempt to disturb the verdict. Admiral Sir Hugh

Palliser was defendant in similar action for destroying fishing huts on the Labrador coast. After the Treaty of Paris, the Canadians, early in the season, erected huts for fishing, and by such means obtained an advantage over the fishermen who came from England. It was a nice question upon the rights of the Canadians. But the Admiral on the grounds of public policy, ordered the huts to be destroyed. An action was brought against him in England by one of the injured parties, and the case ended in arbitration. But on the part of the Admiral it was never contended that the action did not lie by reason of the subject-matter of occurrence beyond the seas.

"I remember," said Lord Mansfield, "early in my time being counsel in an action brought by a carpenter in the train of artillery against Governor Sabine, who was Governor of Gibralter, and who had barely confirmed the sentence of a Court-Martial, by which the plaintiff had been tried and sentenced to be whipped. The Governor was very ably defended, but nobody ever thought the action would not lie; and it being proved that the tradesmen who followed the train were not liable to martial law, the Court were of that opinion, and the jury found the defendant guilty of the trespass, as having had a share in the sentence, and gave £700 damages." The following case, involving the same principle, occurred in India, and was there tried before the Supreme Court of Madras. Mr. H. Smith was agent, at Secunderabad, of a mercantile house at Madras, from whom he received a very handsome salary. He became indebted to a soldier of H. M.'s 33d regiment for some work intrusted to him, and a dispute having arisen between them as to the amount, this led to a violent altercation between Mr. Smith and the Superintendent of the Bazaar acting under the local military regulations. Lieutenant-colonel Gore thereupon sent a file of men to arrest the Plaintiff, who was accordingly seized about six o'clock in the evening, and marched from his house through the streets of the cantonment to the main guard at Secunderabad, where he was kept till twelve o'clock the next day. In consequence of these proceedings, he brought an action against Colonel Gore for false imprisonment. Secunderabad was an open cantonment for a part of the subsidiary force serving in the Territories of the Nizam; the force consisting partly of British and partly native troops. It had barracks, and the men were hutted. It was also upon a field establishment, constantly ready for immediate service. The Article of War then in force, was thus intituted, "Of duties in quarters, in garrison, and in the field;" and it enacted, "that all sutlers and retainers to the camp, and all persons whatsoever serving with forces *in the field*, though not enlisted soldiers, are to be subject to orders, according to rules and discipline of war." Sir Thomas Strange, C. J.: "The question was, whether the troops, *being cantoned*, were in the state to which the cited Articles of War applied. The Court thought they were not. It might have been a field force, being upon a field establishment, so as to be ready to move at the shortest notice. There might be great similarity in the arrangements adopted for an army, whether in the field or cantoned. A respectable witness, Brigade-major Lyne, intimated as much. Still, so far as the Court could form a judgment upon a question of this nature, there seemed to be a difference between a camp and a cantonment, which appeared material. . . . . . When in the field, not only the army, but its appendages, must be under the immediate control of the Officer Commanding it, according to the rules and discipline of war. So situated, the sutler, who chose to follow the camp, identified himself in a manner with the soldier for every purpose almost but that of fighting. . . . . . The plaintiff called upon the Court to say, whether the force in question, under the command of the defendant, was at the time in the field. It seemed impossible to say that it was, without confounding ideas apparently very distinct. . . . . . The defendant appeared to have acted under a mistake of his authority, for which he was liable to answer, as it had been productive of serious injury to the plaintiff." Judgment was therefore given against Colonel Gore, with fifty pagodas damages. In the foregoing case reference was made to an action brought by Mr. Robert Bailie, an up-country trader in the province of Bengal, against Major General Robert Stewart, for an assault and false imprisonment. Mr. Bailie had resided within the cantonments of Cawnpore for many years, and dealt in European articles, which he principally disposed of to the military stationed there. In October, 1797, upon a complaint made to him by one of the people of his Zenanah, he tied up and very severely flogged one of his *Chowkydars*. For this act Major-General Stewart ordered Mr. Bailie to be tried by Court-Martial; and as he acknowledged to have used no less than six switch whips in the flogging, alleging as his reason, that as they were new whips he was afraid of breaking them and spoiling their sale, the Court-Martial sentenced him to five days' imprisonment, and to make an apology to the Commanding Officer. This sentence General Stewart, thought he did not approve of it, confirmed; and issued orders for Mr. Bailie to depart the camp as soon after his enlargement as possible. The Supreme Court of Calcutta held Mr. Bailie to be a sutler within the meaning of the Articles of War, so as to render him amenable to military law. But in the above mentioned action of Smith *v.* Lieutenant-colonel Gore, the Chief Justice, Sir T. Strange, declined to be governed by the decision in General Stewart's case, as the note furnished to the Court did not clearly show whether or not the army was in the field when the transaction occurred. An *unreasonable* or *malicious* exercise of power will, in like manner, render an officer liable to an action for damages. An instance of this occurred in the year 1783, when an action was brought against General Murray, Governor of Minorca, for improperly suspending the Judge of the Vice-admiralty Court of that Island. The General had professed himself ready to restore the Judge on his making a particular apology; and on reference to the Home Authorities, the King approved of the suspension, unless the Governor's terms were complied with. There was no doubt as to General Murray's power to suspend the Judge for proper cause; yet, on the proof of his having unreasonably and improperly exercised the authority, and notwithstanding the King's approbation of his proceedings, damages to the amount of £5,000 were awarded against him by a jury; and, as Mr. Baron Eyre observed, it never occurred to any lawyer that there was any pretence for questioning the verdict. *Negligence* or *unskilfulness* in the exercise of an officer's duty may also be a cause of action for damages in respect of private injuries thus occasioned; and in such cases the approval of an officer's conduct by the Government, or by the superior military authorities, will neither relieve him from liability to an action, nor have any influence upon the decision of the Courts of Westminster Hall. Those tribunals investigate such matters on independent evidence, according to their own rules, and pay no regard to the previous conclusions of official functionaries, however high their rank may be.

It is a rule of English law, in unison with the law of nations, by which all civilized States are governed, that no officer engaged in military operations in his country's cause, by the order or with the sanction of the constituted authorities, shall incur any individual or private responsibility for acts done by virtue of his commission or official instructions. Such transactions being of a public nature, redress or satisfaction for injuries to which they give birth, is to be sought by public means alone, from the sovereign power of the belligerent or offending state, according to the principles of international law, and the general usages of civilization, which never suffer such matters to be litigated before ordinary tribunals. If, in time of peace, the citizens of a friendly Foreign State sustain a private injury at the hands of a naval or military officer serving under the orders of the British Government, but unauthorized by his commission or instructions to do the act complained of, the ordinary tribunals of England afford the same redress against him as in the case of a British subject similarly aggrieved; and this rule applies even in those cases where the violated rights of the foreigner are such as the law of England denies or prohibits to its own subjects. But if the British Government have expressly instructed the officer to commit the act which constitutes or gives occasion to the grievance, the matter becomes an affair of state which is not cognizable by the Courts of Law, and must be adjusted by diplomatic arrangement between the two Governments concerned. In such cases also it is quite sufficient, if the officer's proceedings, though not originally directed or authorized by the terms of his instructions, are afterward sanctioned and adopted by the Government; for this renders them public acts, over which courts of law have no jurisdiction.

INJURIES TO CANNON.—With the exception of the bending of the trunnions of bronze cannon by long firing, the principal injuries to which cannon are subject, are internal, and arise from the separate actions of the powder and the projectile. They increase in extent with the caliber, whatever may be the nature of the piece, but are modified by the material of which it is made.

The injuries from the powder generally occur in the rear of the projectile. They are, 1st. The *enlargement* of that portion of the bore which contains the powder, arising from the compression of the metal. This injury is more marked when a sabot or wad is placed between the powder and the projectile, and is greatest in a vertical direction. 2d. *Cavities*, produced by the melting away of a portion of the metal by the heat of combustion of the charge. 3d. *Cracks*, arising from tearing asunder of the particles of the metal at the surface of the bore. At first a crack of this kind is scarcely perceptible, but it is increased by the continued firing until it extends completely through the side of the piece. It generally commences at the junction of the chamber with the bore, as this portion is less supported than others. 4th. *Furrows*, produced by the erosive action of the inflamed gases. This injury is most apparent where the current of the gas is most rapid, or at the inner orifice of the vent, and on the surface of the bore, immediately over the seat of the projectile. The wear of the vents of bronze cannon is obviated by inserting a copper vent-piece. The effect of continuous firing on the vents of iron cannon is to produce a uniform enlargement of the inner orifice, and to seriously weaken the piece. The appearance of a vent thus enlarged, is irregular and angular, with its greatest diameter in the direction of the axis of the bore. To obviate the serious consequences that result from this injury Captain Dahlgren has placed in his naval guns two vents, each a short distance from, and on opposite sides of the vertical plane, passing through the axis of the piece. One of them is filled with melted zinc, the other is used until it becomes so much enlarged as to endanger the safety of the piece; it is then filled with zinc, and the first one opened.

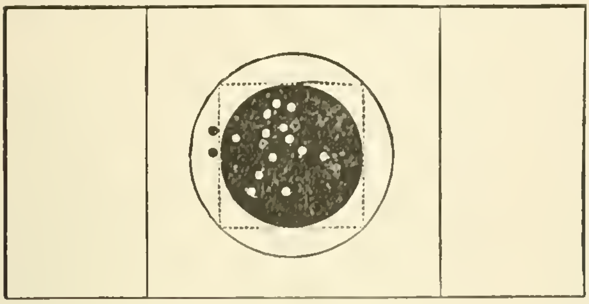
The injuries arising from the action of the projectile occur around the projectile, and in front of it. They are, 1st. *The lodgement*. This is an indentation in the lower side of the bore, produced by the pressure upon the ball by the escape of the gas through the windage, before the ball has moved from its seat. The elasticity of the metal, and the *burr*, or *crowding up*, of the metal in front of the projectile, cause it to rebound, and being carried forward by the force of the charge, to strike against the upper side of the bore, a short distance in front of the trunnions. From this it is reflected against the bottom, and re-reflected against the top of the bore, and so on until it leaves the piece. The first indentation is called the *lodgement*; the other *enlargements*. In pieces of ordinary length, there are generally three enlargements, when this injury first makes its appearance, but their number is increased as the *lodgement* is deepened and the angle of incidence increased. Bronze pieces are considered unserviceable when the depth of the lodgement is .18 in., and the depth of an enlargement is .16 in. The effect of this bounding motion, is to alternately raise and depress the piece in its trunnion-beds, and to diminish the accuracy of fire, until finally, the piece becomes unfit for service. It is principally from this injury that bronze guns become unserviceable. Mortars and howitzers are not much affected by it. The principal means used to obviate this injury, are to wrap the projectile with cloth or paper (as the cylinder-cap of the cartridge used with field-guns), and to shift the seat of the projectile. The latter may be done by a wad, or lengthened sabot, or by reducing the diameter and increasing the length of the cartridge. The last of these methods is considered the most practical as well as the most effective; and it has an additional advantage of diminishing the strain on the bore, by increasing the space in which the charge expands before the ball can be moved. The French bronze siege-guns, which formerly were rendered unserviceable in 600 service-rounds, now endure, by this method, 2,500 service-rounds. 2d. *Scratches*, or furrows made upon the surface of the bore by rough projectiles, or by case-shot. This is not a serious injury. 3d. *Cuts*, made by the fragments of projectiles which break in the bore. 4th. *Wearing away of the lands of rifle-cannon*, especially at the driving edges. 5th. *Enlargement of the muzzle*, arising from the forcing outward of the metal by the striking of the projectile against the side of the bore, as it leaves the piece. By this action, the shape of the muzzle is elongated in a vertical direction. 6th. *Cracks on the exterior*. These are formed by the compression of the metal within, generally at the chase, where the metal is thinnest. This portion of a bronze-gun is the first to give way by long firing, whereas, cast-iron cannon are burst in rear of the trunnion, and the fracture passes through the vent, if it be much enlarged.

The principal injuries to which cast-iron cannon are liable are the wearing away of the metal of the bore above and below the projectile, and at the interior corners of the vent. In guns which have seen much service the enlargements thus occasioned have been known to exceed one inch in both cases. It has been seen that the strength of cast-iron cannon is diminished by repeated firing, and that there is a limit beyond which they should not be used. For American cannon this limit has been fixed at one thousand service-rounds. The number of times which an iron piece has been fired may be approximately determined by the size of the bore, and vent if it be not bushed. The first is taken with the "star gauge," and the second by an impression in wax. Slight cracks in the surface of the bore, particularly about the seat of the charge, indicate the approaching fracture of a cast-iron gun. The injuries to which wrought-iron cannon are most subject, are the enlargement of the bore by the extension or compression of the metal around it, and the rapid enlargement of slight cracks and cavities by the flame of the powder. See *Cannon*.

INLYING PICKET.—A body of infantry or cavalry in campaign, detailed to march, if called upon, and held ready for that purpose in camp or quarters

INNER.—The name given to a certain part of a target. A shot striking in this space (a circular ring) on the Creedmoor target counts 3. On the regulation target, the smallest circle, always painted black, is called the *bull's-eye;* the ring embraced between the bull's-eye and the circumference of the next larger circle is called the *center*; the ring between the second and third circles is called the *inner;* and the space outside the larger circle is called the *outer*. In the target represented on next page, the space between the second circle and the vertical lines is the *inner*, and the space outside the vertical lines is the *outer*.

INNER FLANK.—That which is nearer the point on which a line rests, or which is farther from the enemy. In drill, it is always that flank which is nearer the point from which the line is dressed.



Inner.

INNISKILLINERS.—In the British service, officers and soldiers of the Sixth Dragoons and the Twenty-seventh Foot; so called from the two regiments having been originally raised at Inniskillen, a town of Ulster, where the inhabitants distinguished themselves in favor of King William against James II. Often written *Enniskilliners*.

INROAD.—The entrance of an enemy into a country with purposes of hostility; a sudden or desultory incursion or invasion; encroachment, notwithstanding efforts to prevent it.

INSCONCED.—In the military art, when any part of an army has fortified itself with a sconce, or small work, in order to defend some pass, etc., it is said to be insconced. *Ensconce* signifies in a general sense to cover as with a fort.

INSPECTION.—Divisions and brigades are inspected between the fifteenth and twentieth of each month by inspecting officers designated for the purpose. The Commanders of regiments and posts make an inspection of their commands on the last day of every month. Captains inspect their companies every Sunday morning, and no soldier is excused from Sunday inspection except the guard, the sick, and the necessary attendants in the hospital. Medical officers having charge of hospitals make a thorough inspection of them every Sunday morning. Troops are inspected when mustered for payment. Besides these inspections, frequent visits are made during the month by the Commanding Officer, company and medical officers, to the men's quarters, the hospital, guard-house, etc. Except when otherwise specially provided for by the Secretary of War or the General of the Army, every military post, station, and command in the Army is inspected at least once every year by Division or Department Inspectors, under the direction of their respective Commanders. In addition to these inspections, post, station, and other permanent Commanders, between the first and fifth days of September in each year, make thorough inspections of their respective commands, and forward reports thereof, through the proper military channels, to the Inspector General's Office, at the Headquarters of the Army, so as to reach that office not later than October 1st. These reports do not interfere or dispense with those of the inspecting officers.

Inspections are made under specific orders clearly defining their object, which will be exhibited to the officers whose troops or affairs are to be examined. Commanding Officers are to see that every facility is afforded for such examination. Inspectors give orders only when specially authorized to do so; and then give them in the name of the officer authorizing it. They must report with strict impartiality all irregularities. They should refrain from informal conversation on the subjects of investigation, and from all expression of approval or disapprobation. Inspectors take care that no injustice be done to organizations or individuals by reports not fully sustained by thorough personal examination. Before leaving a command, the Inspector publicly informs the troops that opportunity will be given any soldier to lay before him a well-grounded complaint without any of his officers being present.

The sphere of inquiry of Inspectors generally includes every branch of military affairs, and whether the military laws and regulations are fully complied with. In specific cases, it is defined and limited by the orders they receive. Generally, report is made as to zeal and ability of Commanding Officers, and whether they possess the requisite professional knowledge for the proper exercise of their command; whether they preserve harmony and unanimity in the command, and observe the system of instruction and treatment of subordinates enjoined by the Regulations; whether the officers are properly instructed and efficient. Special report is also to be made in case of any officer of intemperate or immoral habits, or who has proper assosociates, or who is addicted to gaming, or is unfit for active service by infirmity or any other cause; whether the number of men in ranks at inspection corresponds with the returns, and how absentees are accounted for; whether the band exceeds the authorized number, and any men not musicians are mustered with it; as to the discipline, military appearance, and bearing of the troops; their instruction in all military exercises and duties; the nature and frequency of exercises and recitations in tactics; the target practice; whether they are practiced in marching with the full kit; the state of their batteries, or arms, equipments, and accouterments of all kinds; the sufficiency, uniformity, and fit of their clothing; when the troops were last paid, and, if payment be deferred, the cause of delay.

In the inspection of a post, it should be reported when and by whom the post was last inspected; whether it be sufficiently garrisoned, and the armament and supplies of all kinds sufficient in kind and quantity; the strength of the garrison and its armament; whether the Commanding Officer is familiar with the design and capacity for defense of the work, the ground in its vicinity, and the principles of defense of fortified places; in case of frontier and sea-coast forts, whether the Commanders understand and properly execute the laws relating to neutrality, quarantine, etc., and the regulations prescribing international courtesy; as to the cleanliness, state of repair, and sanitary condition of barracks and quarters; as to the kitchens and messes, the sufficiency, variety, and preparation of food; of the guard-house, prisons, bake-house; of the hospital, and whether the sick are properly cared for; of the stables, harness, means of transportation and animals, the number unserviceable; in the case of Cavalry and Artillery horses, as to their grooming, shoeing, veterinary treatment, and general condition; as to the capacity of the officers conducting the Administrative and Staff services, the fidelity and economy of their disbursements, and whether payments and issues are made strictly in accordance with law and the Regulations. The regularity of issues and payments; whether supplies reported on hand are verified; whether the labor of the supply departments is performed by troops or by civilians. If by civilians, their number, the cost, and reasons in justification of their employment; as to the condition of all public property and stores, and whether any is used for private purposes; whether buildings and property are properly secured against fire, theft, exposure, and damage; whether forage, wood, and Subsistence supplies are properly protected and under sentinels; as to the neighboring Indian tribes, their number, disposition, and other information useful in a military view; as to the population, resources, routes, and means of travel, etc., of the surrounding country.

INSPECTION ARMS.—A command in the Manual of Arms, directing that the piece be placed in a prescribed position, preparatory to its inspection. The movement is executed as follows: The recruits being at order arms, bayonets fixed, the Instructor commands—

1. *Inspection*, 2. ARMS.

Commencing on the right, the Instructor inspects the pieces in succession. Each recruit, as the Instructor approaches him, tosses his piece quickly with the right hand opposite the left eye, catching it with the left hand between the rear-sight and the lower band, the thumb extended along the stock, the barrel to the right, and inclined slightly to the front, the hand at the height of the chin; he then passes his right hand quickly to the lock, placing the thumb on the hammer, the elbow raised as high as the hand, the fingers, closed together, extending in front of lock. (Two.) The recruit presses the thumb on the hammer, lowering the elbow at the same time, and brings the hammer to the half-cock; then drops the right hand by the side; the Instructor takes the piece with the right hand at the small of the stock (the recruit dropping the left hand by the side), inspects, and hands it back to the recruit, who receives it with the left hand in the position prescribed in the first motion, passes his right hand, as before, to the hammer, and the fore-finger to the trigger, which he pulls, at the same time pressing the hammer downward to free it from the half-cock notch, thus bringing the hammer to the safety-notch; the piece is then lowered with the left hand, seized near the middle band with the right, and brought to the position of *order*. As the Instructor returns the piece, the recruit next on the left throws up his piece to the position of *inspection*, and so throughout the squad. Should the piece be inspected without handling, the recruit resumes the *order* as the Inspector passes to the next man, who immediately tosses up his piece.

INSPECTION MARKS.—All cannon are required to be weighed, and to be marked as follows, viz.: the *number of the gun*, *the initials of the Inspector's name*, on the face of the muzzle—the numbers in a separate series, for each kind and caliber at each foundry; the initial letters of the name of the *founder* and the *foundry*, on the end of the right trunnion; the *year of fabrication*, on the end of the left trunnion; the *foundry number*, on the end of the right rimbase, above the trunnion; the *weight of the piece in pounds*, on the base of the breech; the letters U. S., on the upper surface of the piece, near the end of the reinforce. The *natural line of sight*, when the axis of the trunnions is horizontal, should be marked on the base-ring and on the swell of the muzzle, whilst the piece is in the trunnion-lathe. Cannon *rejected* on inspection, are marked XC, on the face of the muzzle; if condemned for erroneous dimensions which cannot be remedied, add XD; if by powder-proof, XP; if by water-proof, XW. Converted guns are marked as follows: The *number of the gun*; the *weight of the piece in pounds*; the *initials of the Inspector's name*, and that of the *foundry where the gun is converted*, and the *year of the conversion* on the face of the tube, in a circle concentric with the bore, in letters and figures at least one inch long. The initials of the *foundry where the tube is made*, and the *number of the tube*, in small type, on the face of the tube, under the initials of the Inspector. The results of all final measurements and examinations are noted on the inspection report of the gun. See *Inspection of Ordnance*.

INSPECTION OF ACCOUNTS.—The Inspections of Disbursing Officers' accounts, which are required by law, are made quarterly, or four times within the year, with a reasonable interval between any two examinations. Division and Department Commanders usually provide for the inspection of Disbursing Officers' accounts through the Inspectors attached to their headquarters, or by detail of suitable officers within their commands for the purpose. The law provides, in regard to Inspection of Accounts, "that no officer so detailed shall be in any way connected with the Department or Corps making the disbursement." The Inspector makes a minute and thorough inspection of the accounts of Disbursing Officers, and compares the result in each case with the officer's balance at his place of deposit; and each Inspector is held responsible for any defalcation or misapplication of the public money or property which may occur within the command to which he is assigned that an active vigilance on his part might have detected.

INSPECTION OF CONDEMNED PROPERTY.—Inspectors are the only officers authorized to inspect public property with a view to condemnation. The final disposition of condemned property, except it be worthless, can only be ordered by Commanding Generals of Departments. All surveys and reports having in view the *condemnation* of public property, for whatever cause, should be made by Inspector Generals, or Inspectors specially designated by the Commander of a Department or an army in the field, or by higher authority. Such surveys and reports having a different object from those of Boards of Survey, are required independently of any preliminary action of a Board on the same matter.

An officer commanding a Department, or an army in the field, may give orders, on the report of authorized Inspectors, to sell, destroy, or make such other disposition of any condemned property as the case may require—ordnance and ordnance stores alone excepted, for which the orders of the War Department must always be taken. But if the property be of very considerable value, and there should be reason to suppose that it could be advantageously applied or disposed of elsewhere than within his command, he should refer the matter to the Chief of the Staff Department to which it belongs, for the orders of the War Department. No other persons than those above designated, or the General-in-Chief, can order the final disposition of condemned property, saving only in the case of horses, which should be killed at once to prevent contagion, and of provisions or other stores which are rapidly deteriorating, when the immediate Commander may have to act perforce. Inventories of condemned property are made in triplicate, one to be retained by the person accountable, one to accompany his accounts, and one to be forwarded through the Department, or other superior headquarters, to the Chief of the Staff Department to which the property belongs.

Officers inspecting public property cause the destruction, in their presence, of all property found to be worthless, and which is without any money value at the place of inspection. The action of an Inspector, on property of this character, is final, and his inspection report on the same is a valid voucher for the officer responsible for the property. In the discharge of the duty devolved upon Inspectors in this regulation, they are regarded as answerable that their action is proper and judicious according to the circumstances of the case. Unserviceable arms and stores will be inspected and disposed of in like manner with other property. Their *sale* can be ordered by the Secretary of War only.

INSPECTION OF ORDNANCE.—The objects of inspecting cannon are to verify their dimensions, particularly those which affect the accuracy of fire, and the relation of the piece to its carriage, and to detect any defects of metal and workmanship, that would be likely to impair their strength and endurance. Smooth-bore cannon presented for inspection and proof are placed on skids for the convenience of turning and moving them easily. They are first examined carefully on the exterior to ascertain whether there be any flaws or cracks in the metal, whether they be finished as prescribed, and to judge, as well as practicable, of the quality of the metal. They must not be covered with paint, lacker, or any other composition. If it be ascertained that an attempt has been made to conceal any flaws or cavities by plugging or filling them with cement or any substance, the gun is rejected without further examination. After this preliminary examination, the Inspector proceeds to verify the dimensions of the piece. The interior of the bore is first examined by reflecting the sun's rays into it from the mirror, or, if the sun be obscured, by a lighted candle or a lamp placed on the end of a rod and inserted into the bore. The cylinder-gauge screwed on the staff is then pushed gently to the bottom of the cylindrical part of the bore and withdrawn; it must go to the bottom or the bore is too small. The bore of the piece is then measured with the star-gauge, beginning at bottom. Measurements should be made at intervals of ¼ inch to the front of seat of shot, and at intervals of 1 inch from that point to the muzzle. In rifled guns the measurements are taken from land to land, and afterwards from groove to groove, the head of the star-gauge being fitted with the suitable "guide" to insure the proper position of the measuring points. The position of the trunnions with regard to the axis of the bore and to each other is next ascertained. To verify the position of the axis of the trunnions, set the trunnion-square on the trunnions, and see that the lower edges of its branches touch them throughout their whole length; push the slide down till it touches the surface of the piece, and secure it in that position by the thumb-screw; turn the gun over, and apply the trunnion-square to the opposite side, and if, when the point of the slide touches the surface of the piece, the lower edges of the branches rest on the trunnions, the axis of the trunnions is in the same plane with the axis of the bore; if they do not touch the trunnions, their axis is above the axis of the bore by half the space between; and if the edges touch the trunnions and the point of the slide does not touch the surface of the piece, their axis is below the axis of the bore. If the alignment of the trunnions be accurate, the edges of the trunnion-square will fit on them when applied to different parts of their surface; their diameter and cylindrical form and the diameter of the rimbases are verified with the trunnion-gauge. To ascertain the length of the bore, screw the guide-plate and measuring-point on the cylinder-staff and push them to the bottom of the bore; place a half-tompion in the muzzle and rest the staff in its groove; apply a straight-edge to the face of the muzzle and read the length of the bore on the staff. The exterior lengths are measured by the rule or by a profile, the accuracy of which is first verified; the exterior diameters are measured with the calipers and graduated by a rule. The position of the interior orifice of the vent is found from the mark made on the rammer-head by the vent-gauge inserted in the vent, while the rammer-head is held against the bottom of the bore. Two impressions are taken. The position of the exterior orifice of the vent is also verified. The vent is examined with gauges, and the vent-searcher is to ascertain if there are any cavities in it. All smooth-bore bronze ordnance should be bored under size from .04 to .05 inch, and, after proof, reamed out to the exact caliber. Whitish spots show a separation of the tin from the copper, and, if extensive, should condemn the piece. A great variation from the true weight, which the dimensions do not account for, shows a defect in the alloy. In mortars, the dimensions of the chambers and the form of the breech may be verified with patterns made of plate-iron. After the powder proof the bore is washed and wiped clean, and the bore and vent are again examined, and the bore remeasured. The results of each of the measurements and examinations are noted on the inspection report against the number of the gun. A proper discretion must be exercised in the inspection of ordnance; such slight imperfections as do not injure a piece for service may be disregarded, whilst the instructions should be strictly enforced with regard to defects which may impair its utility.

The duties of the inspection of converted guns commence with the inception of the work, and the most important are performed before the gun is completed. The breech-cup is verified by the steel templet before it is screwed into place. The different shoulders and the shape and pitch of screw-threads are similarly gauged before the parts are united; diameters of tubes are verified, and the base of the tube and recess for the muzzle-collar before the insertion. The dimensions of the casing are also proven. When the gun is presented for final inspection it is placed horizontally on the skids, and inspected as explained above for smooth-bore cannon.

That the finished bore of a bronze piece may not be injured by the proof-charge, it is bored out under size, from .04 to .05 inch, and, after proof, reamed out to the true size. When the powder-proof is finished, the bore should be cleaned and examined; the vent should be stopped up with a greased wooden plug, the muzzle raised, and the gun filled with water, to which pressure should be applied to force it into any cavities that exist; or the water should be allowed to remain in the bore twenty-four hours. The bore must then be sponged dry and clean, and viewed with a mirror or candle, to discover if any water oozes from cracks or cavities, and also, if any enlargement has taken place. The quantity that runs out of a crack or honey-comb will indicate the extent of the defect; and if it exceed a few drops, the piece should be rejected, although the measured depth of the cavity may not exceed the allowance. After the bore has been reamed out to its proper size, its dimensions are again verified, and an examination of the bore and vent is made, to detect any defects which may have been caused or developed by the proof. Whitish spots show a separation of the tin from the copper, and, if extensive, should condemn the piece. A great variation from the true weight which the dimensions do not account for, shows a defect in the alloy.

Bronze cannon should be rejected for the following sized cavities or honey-combs: *Exterior.* Any hole or cavity 0.25 in. deep in front of the trunnions, and 0.2 in. deep at or behind the trunnions. *Interior.* From the muzzle to the reinforce, any cavity 0.15 in. deep. Any cavity from the reinforce to bottom of the bore. In all other respects, the inspection of cast-iron and bronze cannon are alike. See *Calipers, Cascabel-block, Chamber-gauge, Cylinder-gauge, Disk, Impression-taker, Measuring-staff, Mirror, Profile-boards, Proof of Ordnance, Rammer-head, Searcher, Star-gauge, Template, Trunnion-gauge, Trunnion-rule, Trunnion-square, Vent-gauges, Vent-guide,* and *Vent-searcher.*

INSPECTION OF POWDER.—The Inspector of gunpowder should satisfy himself before its reception as to the purity of the ingredients employed by the manufacturer, and that their proper preparation and careful manipulation through all the various stages of manufacture have been rigidly observed. Before powder for the military service is received from the manufacturer, it is inspected and proved. For this purpose at least 50 barrels are thoroughly mixed together. One barrel of this is proved. Musket powder should be fired three rounds with service charges. Mortar and cannon powder should be fired three rounds with heaviest charges in a field and siege-gun respectively. Mammoth, hexagonal, cubical, prismatic, or other special powders, three rounds with battering charges from guns in which these powders are to be used. The density and granulation of the powder, as well as the velocity and pressure obtained in its proof, should conform to the Ordnance Regulation in these respects, for the particular service or piece for which the powder is required, within the allowed limits of variation.

Gunpowder should be of an even-sized grain, angular and irregular in form, without sharp corners, and very hard. When new, it should leave no trace of dust when poured on the back of the hand, and when flashed in quantities of 10 grains on copper plate it should leave no bead or foulness. It should give the required initial velocity to the ball, and not more than the maximum pressure on the gun, and should absorb but little moisture from the air.

The size of the grain is tested by standard sieves made of sheet brass pierced with round holes. Two sieves are used for each kind of powder, Nos. 1 and 2 for musket, 3 and 4 for mortar, 5 and 6 for cannon and 7 and 8 for mammoth powder.

A compact shape of grain approaching the cube or sphere, is desirable. Elongated flat scales are objectionable. The number of grains in the several weighed samples should be counted.

Diam. of holes for musket-powder..No. 1, 0.03 in.; No. 2, 0.06 in.
Diam. of holes for mortar-powder...No. 3, 0.10 in.; No. 4, 0.25 in.
Diam. of holes for cannon-powder..No. 5, 0.25 in.; No. 6, 0.50 in.
Diam. of holes for mammoth-powder No. 7, 0.75 in.; No. 8, 0.90 in.
Hexagonal, Cubical, Prismatic. } Dimensions of these powders vary with the caliber of the gun in which they are used, and have not as yet been definitely determined upon in our service.

Gravimetric density is the weight of a given measured quantity. It is usually expressed by the weight of a cubic foot in ounces. This cannot be relied upon for the true density when accuracy is desired, as the shape of the grain may make the denser powder seem the lighter. Its only value is a fair idea of the value of air space in a given weight. The specific gravity of gunpowder varies from 1.65 to 1.8. It is important that it should be determined with accuracy. Alcohol and water saturated with saltpeter have been used for this purpose; but they do not furnish accurate results. Mercury only is to be relied upon. Hardness is tested by breaking the grains between the fingers; the hardness is judged of by experience. It is very necessary that the density or specific gravity of the powder should be most accurately determined. For this delicate operation a very ingenious instrument has been devised by Colonel Mallet, of the French Army, called a Mercury Densimeter.

Initial velocity is determined by any of the electro-ballistic machines available; the Boulengé chronograph is one of the simplest and most generally used for proof of powder. The strain upon the gun is determined by the Rodman pressure-gauge, or some suitable contrivance. The amount of moisture in powder is determined by drying samples in an oven with a water bottom. A vessel of tin, double-walled, except the face containing the door, is fitted at the top with an opening for the introduction of water; the door is double; the inner skin-lining has perforations at the top to allow the escape of moisture given up by the powder. Ledges on the inside of the oven support the powder-trays. Before use, the water space is filled with boiling water; a spirit lamp keeps up the heat; the supply of water is kept up to compensate for evaporation. The powder is subjected to heat as long as it loses weight, the loss indicating the percentage of moisture driven off. On being removed from the oven it should be transferred at once to perfectly clean, dry, and air-tight weighing bottles. The ability to resist moisture is determined by subjecting samples which have been dried to exposure, first in open air, then in a hygroscope containing a solution of niter at 100° cooled to 80° Fahr.

On breaking the grains, a fine ashen-gray color throughout should appear; the grain texture should be close, without white specks even when magnified. "Flashing" on glass or porcelain plates, small copper measures for fine-grain powders inverted on the plates, keeps the heap nearly the same at each trial. The powder should be in small conical heaps; if the incorporation is good, only smoke marks remain on the plate after flashing; if bad, specks of undecomposed niter and sulphur will form a dirty residue. The test requires experience to insure good judgment. The relative incorporation is determined by the balance; the greater increase of weight on the plate, the less satisfactory the powder in this respect. Moist powder flashes badly. The report of inspection should show the place and date of fabrication and of proof, the kind of powder and its general qualities, as the number of grains in 100 grains, its specific gravity; whether hard or soft, round or angular, of uniform or irregular size; whether free from dust or not; the initial velocities and pressures per square inch obtained in each fire; the amount of moisture absorbed; and, finally, the height of the barometer and hygrometer at the time of proof. Each barrel is marked on both heads, (in white oil-colors, the head painted black), with the number of the barrel, the name of the manufacturer, year of fabrication, and the kind of powder, *cannon*, *mortar*, or *musket*, *etc.*, the mean initial velocity, the pressure per square inch on the pressure-piston, and density. Each time the powder is proved, the initial velocity is marked below the former proofs, and the date of the trial opposite to it. See *Analysis of Powder*, *Densimeter*, *Gunpowder*, and *Hygroscope*.

INSPECTION OF PROJECTILES.—The principal points to be observed in inspecting shot and shells are to see that they are of the proper form and size; that they are made of suitable metal; and that they have no defects, concealed or otherwise, which will endanger their use, or impair the accuracy of their fire. As it is impracticable to make all projectiles of exact dimensions, certain variations are allowed in fabrication. They should be inspected whilst perfectly clean, and before becoming rusty, so that flaws and imperfections in the metal can be detected by the eye.

Spherical Projectiles.—The inspecting instruments required for shot are one *large* and one *small gauge* and one *cylindrical-gauge* for each caliber. The cylinder-gauge has the same diameter as the large gauge; it is Constructed of cast-iron and is five calibers long. The large and small gauges are made with a difference in diameter of 0.02 inch for projectiles turned in a lathe, and 0.04 inch for those not so turned. All these gauges should be verified from time to time, and when they have become 0.01 inch larger than their true diameter they should no longer be used. One *hammer* having a flat face and a conical point. One *searcher* of steel wire. One *cold-chisel. Steel punches. Figure-stamps.*

The shot should be inspected before they become rusty; after being well cleaned each shot should be carefully examined to see that its surface is smooth, that the metal is sound and free from seams, flaws, and blisters. If cavities or small holes appear on the surface, strike the point of the hammer or punch into them and ascertain their depth with the searcher; if the depth of the cavity exceeds 0.2 inch, the shot should be rejected. The discovery of any attempt on the part of those engaged in the fabrication of the shot to conceal such defects by filling up the holes should insure rejection. The shot must pass in every direction through the large gauge and not at all through the small one, and the mean of their diameters should be nearer that of the former gauge than of the latter.

After having been thus examined, the shot are passed through the cylinder-gauge, which is placed at an inclination of about two inches between the two ends, and supported on blocks of wood in such a manner as to be easily turned from time to time to prevent its being worn into furrows. Shot which *slide* or *stick* in the cylinder should be rejected. The average weight of shot of 10 inches and under is deduced from that of three parcels of 20 to 50 each, taken indiscriminately from the pile; some of those which appear to be the smallest should be also weighed, and if they fall short of the prescribed weight of their caliber by more than one thirty-second part, they should be rejected. Shot of larger caliber than 10 inches should each one be weighed by itself and its weight stamped upon it near one of the ears for the shell-hooks.

The dimensions of grape and canister shot are verified by means of a large and small gauge attached to the same handle. The surface of the shot should be smooth and free from seams and cavities. For the inspection of shells and case-shot, the following inspecting instruments are required in addition to those used in inspecting shot, viz: *Calipers* for measuring the thickness of the projectiles at the side. *Calipers* for measuring the thickness at the bottom. *Gauges* for the dimensions of the fuse-hole, and for the thickness of metal at the fuse-hole. *A pair of hand-bellows; wooden plugs* to fit the fuse-hole and bored through to receive the muzzle of the bellows.

The surface of the shell and its exterior dimensions are examined as in the case of shot, particular attention being paid to the hemisphere opposite the other indication of the soundness of the metal, as the parts containing cavities will dry more slowly than the other parts. The mean weight of shells of 10 inches and under is ascertained in the same manner as that of shot, and larger ones should be weighed and stamped the same as with shot of like caliber. All projectiles rejected in the inspection should be marked with an X made with a cold-chisel; on shot near the gate; or, when turned, near one ear, and on hollow projectiles near the fuse-hole.

Elongated Projectiles.—The following Table will show the points upon which the Inspecting Officer must inform himself and report before accepting shot, and the variations he is authorized to allow:

Subject of measurement.	Allowed variations
Projectile:	
Length of cylindrical portion of body }	±0.4
Length of head }	
Length of base for sabot	±0.5
Total length of projectile	+ .15 / .1
Diameter of cylindrical portion	±0.2
Diameter of base over threads	± .01
Pitch of threads	0
Radius of head	± .05
Thickness of bottom	.1
Length of interior cavity	± .1
Thickness of walls at—inches from—	
Thickness of walls at—inches from—	
Eccentricity of axis of interior cavity at——from base	0.1
Diameter of fuse (or screw-plug) hole.	± .01
Pitch of thread on fuse (or screw-plug hole)	0
Length of thread on fuse (or screw-plug) hole	± .1
Diameter of hole for shell-hooks	± .01
Depth of hole for shell-hooks	± .05
Distance from base of projectile	± .02
Weight of projectile, pounds	± .2
Sabot:	
Height of sabot	± .02
Exterior diameter of sabot	± .02
Interior diameter of sabot	± .01
Maximum thickness of outer lip	± .01
Minimum thickness of outer lip	± .01
Depth of cannelure	± .03
Maximum width	± .01
Weight of sabot	
Weight of sabot and projectile, pounds	± .2

No. of—— inch —— examined	Weight of total number accepted
No. rejected for erroneous dimensions of head.	Mean weight of projectile.
No. rejected for erroneous dimensions of cylindric body or base	No. of sabots examined...
No. rejected for erroneous dimensions of interior cavity	No. of sabots rejected for erroneous dimensions...
No. rejected for eccentricity of interior cavity...	No. sabots rejected for defects in material or finish
No. rejected for defects in material or finish	Total number of sabots rejected
Total number rejected....	No. of sabots accepted....
Total number accepted....	Weight of total number accepted
Weight of heaviest one accepted	Mean weight of sabot......
Weight of lightest one accepted	Weight of total number of shot and sabots accepted

fuse-hole. Cavities and imperfections in casting are generally found about 30° from the top of the shell when in the position in which it was cast. Shells should be rejected for rough casting, projecting seams, sand-flaws, a collection of dross, cavities or honey-combs of more than two-tenths of an inch in depth, whatever their diameter, or a number of small holes giving the projectiles a spongy appearance.

The shell is next struck with the hammer to judge by the sound whether it be free from cracks; the position and dimensions of the ears are verified. The thickness of the metal is then measured at several points on the great circle perpendicular to the axis of the fuse-hole. The diameter of the fuse-hole, which should be accurately reamed, is then verified, and the soundness of the metal about the inside of the hole is ascertained by inserting the finger.

The shell is now placed upon a trivet in a tub containing water deep enough to cover it nearly to the fuse-hole; the bellows and plug are inserted into the fuse-hole, and the air forced well into the shell. If there be any holes in the shell, the air will rise in bubbles through the water. This test also gives an-

The following instruments are required and used as indictated:

1. One large ring-gauge, with handle; interior diameter 0″.03 less than the diameter of bore of gun.

2. One small ring-gauge, with handle; interior diameter 0″.07 less than the diameter of bore of gun.

3. One cylinder-gauge made of cast-iron and five calibers in length; interior diameter same as large ring.

4. Calipers for measuring the thickness of the walls of the shot or shell and determining the eccentricity. This instrument consists of two parallel arms, formed by a continuous steel strap. One arm is terminated by a curved point, and is graduated into inches and quarters, from the end toward the center; the other arm carries a socket, at right angles to its length, through which slides a graduated measuring-rod. The zero of the scale corresponds to the position of the rod when it is in contact with the curved point, and a vernier-scale on the socket permits measurements to 0″.01. To use the instrument, the arm with the curved point is inserted into the cavity through the screw-plug hole, and the clamp is screwed fast

at the required point. Two short cylindrical arms on the clamp serve as bearers, and allow a motion of the instrument only on its own plane. The eccentricity of a spherical projectile is measured by the distance of the center of gravity from the center of figure. In oblong shot, however, it varies directly for each cross-section from the seat of the core, which is near the screw-plug hole, to the head of the cavity, and is measured by the angle made by the axis of the cavity with the axis of the projectile. To determine the axis of the cavity, the greatest and least thickness of the walls are measured at two or more depths. Half the difference between the two will give the distance between the axis of the cavity and that of the projectile for that particular section. It is ordinarily considered sufficient, however, to determine the eccentricity of but one cross-section near the center of gravity and compare it with the known results of previous experiments.

5. The first intimation of eccentricity is shown upon the *rolling-table*, which consists of a heavy cast-iron plate, beveled with great care, and two parallel rails attached to it and separated from each other by a distance slightly less than the length of the cylindrical part of the shot. When a shot is rolled upon the rails, the heaviest side must come to rest beneath, and a more or less readiness to assume a particular point of rest indicates approximately the amount of eccentricity.

6. *Measuring-rod* for determining the length of cavity; made of steel and graduated into tenths of an inch for a short distance on each side of the point indicating the proper length.

7. *Gauge*, for length of screw-plug hole; made and graduated like the preceding.

8. *Templet*, for gauging the profile of the shot; made of steel; graduated to indicate the length of head, position of shell-hook holes, length of cylindrical part, and total length.

9. *Gauge* for the Butler sabot. This is made of steel and in two parts; the one screwed upon the other when not in use. The lower part gauges the sabot as regards pitch and length of thread, length and thickness of ring; the upper part gauges the length and pitch of the thread upon the base of the shot. A *small templet* gauges the depth and width of cannelure and thickness of outer lip.

10. One *hammer*, weighing half-a-pound, having a flat face and conical point.

11. One *searcher* of steel wire No. 20, with handle; *steel punches* and a *cold-chisel*.

The shot should be inspected before it becomes rusty. It is first placed upon the rolling-table and examined with the eye for defects in material, which in shot cast with the head down, are apt to occur as cavities in and about the base. These, when discovered, are probed with the "searcher" or steel punch; if more than 0".2 deep, or of such character as to suggest weak, imperfect metal, the shot is condemned. The head of the shot is struck with the hammer at its junction with the cylindrical part, for the purpose of detecting cracks liable to be produced there in cooling chilled shot. A dull sound indicates the existence of such a defect, which is further tested by hammering with a sledge. It is then rolled, and, should the amount of eccentricity be considered doubtful as regards that allowed, is measured with the calipers. The length of cavity and of screw-plug hole are then verified, and the templet applied to the profile. Rolling it from the table, it is stood on end and the gauge screwed to the base. The sabot is then screwed to its gauge, the dimensions of the cannelure verified with the small templet, and the character of the metal examined. The sabot and screw-plug are then fitted to the shot, and it is again stood on its head and the ring-gauges are applied to it. The smaller should not pass over the shot at all; the larger should pass over its entire length. It is then passed through the cylinder-gauge, which is fastened, slightly inclined, to a block of wood; the weight is finally determined and stamped at once upon the body of the shot near the sabot. Shot and shell rejected during inspection are marked with an X made with a cold-chisel.

With each lot of shot, and from the same metal, is cast a cylindrical column about 2 feet high and 2½ inches in diameter in a sand mold, and the head of a projectile in the usual iron mold. As soon as cool and before the shot have been sent to the "finishing shop" a test specimen is cut from the column, its specific gravity determined, then broken in the testing-machine, and its fracture examined. The chilled head is split under a hammer to expose the depth of chill, and the results so determined are compared with an occasional shot cut open along its axis. Should the tenacity, density, or chill be unsatisfactory the entire lot is condemned.

Chilled shot are intended for the penetration of wrought-iron plates, and were the result of experiments to substitute for the steel projectiles first used one of cheaper material of the requisite hardness.

A fracture of the head of a chilled shot presents the following appearance: The exterior layer is white, of crystalline structure, the crystals being disposed normal to the exterior surface. The central part is dark, granular, and less compact than the rest of the mass, showing the presence of considerable graphitic carbon, while the intermediate layers show less graphite and grow harder and denser as they approach and finally blend with the exterior.

Different metallurgic processes, and among them the repeated fusion of iron, qualify it for chilling. The desired result has been obtained in England by adding to a mixture of gray iron and shot scrap four per cent. of ilmenite, an ore of iron in combination with titanic acid, and containing—

Iron oxide (equivalent to 45.3 metallic iron)	61.4
Titanic acid	33.2
Silica	4.2
Tin oxide	1.2
Manganese	Trace.

In consequence of the chilling process, the head is so hard as to resist even a file, while the cylindrical body is soft mottled iron. The head is not touched after casting in order to preserve intact the skin, which is the soundest and densest part.

The chilling power of the metal-mold, which depends upon its heat-conducting power, varies with its thickness and somewhat with its own temperature and that of the melted metal when poured into it. The specific gravity of chilled cast-iron is greater than that of gray or mottled iron, and this fact is used in discovering the depth of chill of a shot by weighing the shot first in air and then in water, and comparing the results with those obtained from a standard projectile of the same weight in air. The shot which weighs the less in water will be chilled to the less extent, since the discrepancy must be due to the lower density of its chilled head. See *Projectiles* and *Shell-gauge*.

INSPECTION OF SMALL ARMS.—All the materials used in the manufacture of arms must be of the best quality, and they should be tested by the Inspectors according to the prescribed methods. The wood for gunstocks should be seasoned at least three years and kept in a dry place two years before being worked. It must be free from knots and sap, and no wood which is brash or light or worm-eaten, or in any degree decayed, or which is cut across the grain at the handle of the stock, or which is kiln-dried, should be used or received. The following rules for inspection apply to all small-arms, whether made at the national armories or by contract at private establishments. The attention of the inspecting officers should be directed as much as possible to the operation of the workmen in the course of the fabrication of arms. Each component part is first inspected by itself and afterward the arm in a finished state. The material and the forms and dimensions of all the parts must conform strictly to those of established patterns, the workmanship and finish must equal those of the model arms, and the several parts must be browned, blued, case-hardened, or polished, as in the standard model. The forms and dimensions of the parts are verified by means of standard gauges.

The barrels are inspected in each of the following stages: Rolled, first straightened, first bored, second bored, third turned, third bored, second milled, ground, proved, fourth bored, fifth bored, second polished, rifled, second muzzle filed, sixth milled, seventh milled, fourth turned, fifth turned, cut, profiled, filed, and browned. In these inspections the Inspector will verify the barrel with proper gauges for each stage. He will see that the thread for the receiver on the barrel is well cut and the bayonet-stud well brazed on; that the exterior and interior dimensions of the barrel are correct; that there are no interior hammer-marks, ring-bores, cinder-holes, flaws, cracks, or other defects which will not disappear in finishing.

The barrels rejected for defects that can be remedied will be stamped on the upper side near the breech with the mark of condemnation, which is always the letter C. If the defect be of such a nature as not to prevent the use of the barrel for a shorter arm when cut off, the mark will be made on the defective part.

The barrels will be proved in the ground stage. They wlll be fired twice with the following charges:

First Charge.			Second Charge.			Size of Ball.	
Powder.	Ball.	W'ds.	Powder.	Ball.	W'ds.	Weight.	Diameter.
Grains. 280	No. 1	No. 2	Grains. 250	No. 1	No. 2	Grains. 500	Inches .43

The wad is formed by rolling up a strip of paper 0".01 thick, 1" wide, and 12" long.

One wad is placed on the powder and the other on the ball, and the charge is well rammed with a copper rod. The wad occupies, when rammed, about ¾" in the length of the barrel. The barrels are closed for proof with proving-plugs, having vents in them. During the loading the vents are closed by leather thongs. The barrels are clamped down in a semicircular bed capable of holding about 40, with the proving-plugs abutting against set-screws working through a rim around the bed. The barrels are prevented from moving forward, under pressure of the set screws, by collars screwed on the barrels at their rear ends, which abut against a rim parallel to the one mentioned. In order to prevent accidents, it is prescribed that each barrel as soon as loaded shall be carried to the proof-room and placed in the bed. When the bed is full the leather thongs are removed. A powder-train is laid in a groove containing the vents. The train is fired from the outside of the room by means of a percussion lock and cap.

Musket powder will be used for proving the barrels of rifles and carbines; the powder must be of the best quality as regards the initial velocity and pressure; it must be proved immediately before being used, unless it shall have been proved within one year and the Inspector has no reason to suppose that it has become deteriorated. The measures for the proof-charges should be of a conical form, with the mouth as small as may be convenient, in order that there may be less variation in the quantity of the powder. Before commencing the proof of barrels, the Inspector will satisfy himself as to the quality and proof of the powder, the size of the balls and of the wads. After each discharge he will pass the ramrod into each barrel, and those which have missed fire will be reprimed and discharged before proceeding to the proof of another lot. After each proof-charge the Inspector will examine the barrels which have burst and note the cause of the defect, whether in the material or workmanship. He will examine those which have not burst, and will condemn any which are evidentally defective. He will stamp the letter P after each round on every barrel which successfully endures the test. The letter is stamped on the under side of the barrel and near its breech-end. To avoid errors, the stamping is done in the proof-room. After the second polishing, the barrel receives the final stamp, viz: V. for viewed, P. for proved, and the eagle's head under them, placed on its upper left side just in front of the receiver. After firing, the barrels should be washed clean in hot water. The examination is then made. They should be inspected in the interior and on the exterior.

The Inspector will reject such as are too large in the bore, and such as have holes, cross-cracks, scales, seams, or ring-bores; he will examine the brazing of the bayonet-stud and see that the barrel is not notched too deeply or indented inside. The barrels having been reduced to their ultimate dimensions, straightened, and completely finished, are again carefully inspected to verify the straightness of the bore, the exterior and interior diameters, and their weight, which should not vary more than one ounce from the standard weight. The straightness of the barrel may be ascertained by holding it up to the light and reflecting a straight edge on the different parts of the bore, by which means an experienced eye readily detects any inaccuracy in the bore. The small or standard gauge should pass freely through the whole length of the barrel, and the bore should not admit the large or limit plug. The grooves should be carefully examined to see that they are formed according to the pattern, and that they are even and uniform throughout. The breech-screws and receivers will be examined to see that they are of the proper dimensions, are sound in every part, and have good threads. They are case-hardened. The screw must be tried in the receiver to see that it occupies all the threads in the tap of the receiver. *Marks*—Barrels condemned for defects detected after proof, or at any time in the course of inspection, are marked with the letter C, struck in deeply. The breech-blocks are stamped "U. S. Model;" also with the year of adoption of model, just in rear of the hinge. The number of the gun is stamped on the upper rear portion of the receiver. The barrel, receiver, and breech-block having been assembled, they are placed in a skeleton frame. One round is fired with 80 grains charge: "P" is then stamped on the barrel, immediately below the eagle's head. The gun is then completely assembled, and fired five rounds with service-ammunition to see that all the parts are in perfect working order. If all be found satisfactory, "P" is stamped on the under side of the stock, in rear of the guard-plate.

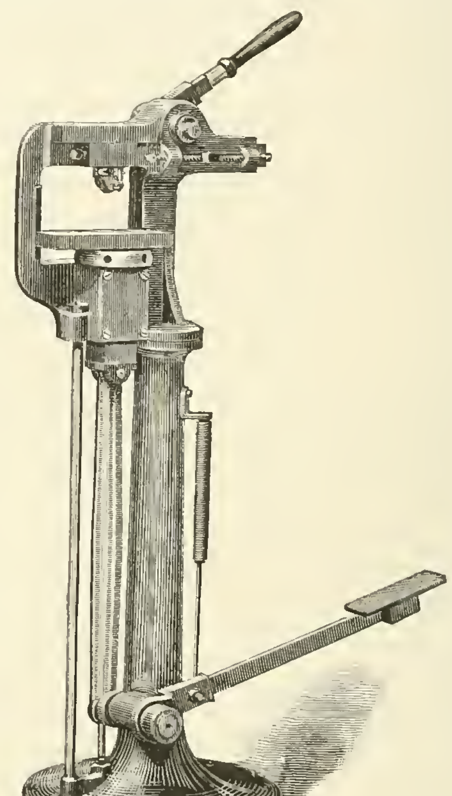
The locks having been put together the Inspector observes; 1st. That they are clean in the inside; 2d. That the sear works freely when the sear-screw is driven as far as it will go, and that the nose is sufficiently strong and falls properly into the notches of the tumbler; 3d. That the bridle has no cracks or flaws about the holes for the tumbler-pivot and screws; 4th. That the springs are well bent and of good proportion, that the fixed branches fit close to the lock-plate, and that the movable branches swing clear of it without having too much play; 5th. That the slits of the screw-heads are not defective; 6th. That the arbor and pivot of the tumbler fit accurately in their holes; 7th. That the hook of the tumbler does not fall below the edge of the lock-plate when the cock is drawn; 8th. That the notches of the tumbler are sound and smooth, and that the tumbler fits and turns well; 9th. That the main-spring swivel is sound by snapping the hammer several times on the bare cone; 10th. That the hammer fits well on the square of the tumbler, and that it does not rest on the lock-plate when screwed up tight, and that it has the proper set in relation to the firing-pin; 11th. That all the parts work well together. The lock is adjusted so that when cocked a scale attached midway of the finger-piece of trigger will pull off at from five to seven pounds. When mounted in stock the pull on the trigger should be not less than six nor more than eight pounds. The place of fabrication is stamped on the lock-plate, with the letters "U. S." over it. An eagle is stamped just in rear of the former stamps. The initials of the Master Armorer or principal Inspector are stamped on the stock opposite the rear end of the lock with italic letters.

The soundness and freedom of the ramrod from flaws and cross-cracks are ascertained by the sound it gives when suspended by one end and gently struck with a piece of metal, and by bending over a curved piece of oak plank, 31½ inches long and 5 inches high at its middle point, one end of the rod being held by a staple. The rod should be turned at the same time so as to present the different portions of the surface successively to inspection. The diameter and length of rod are verified by proper gauges. The fitting of the groove is ascertained by drawing and returning the rod smartly several times to see that it holds well and does not stick too tight; the ramrod must bear on the rod-stop, and in that position its head should not project beyond the end of the barrel; it should fill the groove well; the open part of the groove should be in the center of the stock, the covered part in the middle of the thickness of the stock, between the outside and the bottom of the barrel-groove, and the rod should not interfere with the front side-screw.

The form and dimensions of the bayonet are verified with the proper gauges. The temper is tried by springing the bayonet attached to a barrel, the point resting on the floor. The bayonet is also tested in the following manner: A curved piece of oak plank, 16⅝ inches long, 3 inches high at each end, and four inches at the middle is securely attached to the workbench. A staple is fastened at one end of the curve, and a metal bridge ½ inch high at the other. The point of the bayonet-blade is placed in the staple, and the bayonet, fixed on a barrel, is bent, face and back alternately, over the plank. In this situation the blade is also examined for flaws and cross-cracks. It should not remain bent after this trial. The Inspector then seizes the blade near the point, and strikes the elbow on the workbench to ascertain that the welding is sound. If the proof shows no defects, he verifies the dimensions and bore of the socket and the accuracy of the channels. He examines the dimensions of the clasp to see that it fits well to the shoulder; that it turns evenly without binding in any part; that the stop is well placed and firmly set; that the clasp-screw and its thread in the stud of the clasp are well cut; that the elbow has the proper form and dimensions. Bayonets are marked on the face of the blade, near the neck. Those rejected for defects that cannot be remedied are marked with the stamp of condemnation.

The examination of the stock is directed—1st. To the quality of wood; that it has good straight grain, is well seasoned, and free from sap and worm-holes. The degree of seasoning is indicated by the smell of wood; by the appearance of the lock and barrel, etc., when removed from the stock; they will be rusted by unseasoned wood; by rolling a thin shaving between the fingers it will crumble if the wood be well seasoned, otherwise it will be tough and will bend. The medium weight of a well-seasoned rifle-stock is 1 pound 14 ounces; of a carbine-stock, 1 pound 11 ounces. Stocks made of good walnut will not weigh more than three ounces less than these weights. 2d. To the workmanship; that it is free from splits, especially about the barrel-groove and heading; that the grooves and beds are of the proper forms and dimensions; that the roundings for the bands are smooth and accurate; that the stock has the proper *fall* or crook, and is of the right length; that the holes are well drilled, and that those for the wood screws have good threads. In examining the bed of the lock, see—1st. That all the edges are sharp and smooth; 2d. That the beds of the sear-screw and sear-spring screw are not bored down to the trigger or to the breech-screw; 3d. That the beds of the main-spring and main-spring screw do not penetrate to the barrel; 4th. That the holes for the tang of the sear are as small as possible, so that the sear shall not be wood-bound; 5th. That the wires fit well in their holes *Marks*—The stocks inspected are marked on the left side with the stamp of approval (the initial of the Inspector's name), or of condemnation, as the case may be.

The front part of the trigger at half-cock should be nearly perpendicular to the surface of the guard-plate; the slit of the trigger should be of the exact width, so that the trigger shall have no lateral motion. It is important that the guard-plate should bear firmly on the wood in every part, as otherwise by driving the tang-screw too hard the trigger might be brought too close to the sear, and the action of the lock be thus interfered with. The butt-plate should be well fitted in the center of the stock. The bands should fit smoothly at the shoulders, and closely to the stock and barrel, but not so tight as to



require a great effort to remove them. The band-springs should not be too deeply set; they should spring back freely when pressed down; the holes for the wires should not interfere with the barrel or ramrod grooves. All the mountings should fit smoothly to the stock. The stock should have the proper fall or crook, which is ascertained by applying the pattern, and by trying the piece in the position of aiming. By sighting along the barrel it will be seen whether it is well stocked; whether the bands, the front and rear sights, and the bayonet, are well set.

The Inspector is not restricted to the particular examinations above mentioned; he will make any other examinations which he may deem necessary to ascertain the quality of any part of the arms and their conformity to the standard models; if he discover or suspect any attempts on the part of the workmen to cover or conceal serious defects, he will subject the arms to the most severe scrutiny in order to detect such defects. In the inspection of contract arms the Inspector will judge of the quality of materials and workmanship by the rules which govern in like cases at the national armories without exacting in any case more rigid conditions than are enforced at those establishments. The Ordnance Officer charged with the inspection of arms, or the Master Armorer at the national armory, will cause at least one in twenty of each lot of arms passed by a Sub-inspector to be taken to pieces in his presence, and he will examine them strictly, agreeably to the foregoing directions, before affixing his stamp of approval on the finished arms, all of which must be examined by him. As a general rule, every part condemned, on inspection, will be indelibly marked with the letter C, and every principal part approved will be marked with the initials of the Inspector's name. Care must be taken that the marks of approval are not stamped so deep as to be injurious. Finished arms approved in inspection will be marked on the left face of the stock with the initials of the name of the principal Inspector and the year of inspection. The drawing shows the marking-machine used for stamping the letters etc., on the finished work. It is so constructed that roller dies may be used on flat surfaces, or flat dies on work of cylindrical form. The die is fastened to a sliding carriage, or rack, is made to traverse the work by a hand-lever, and is brought to bear on the work by a foot-lever, the work being held on the tables by a suitable fixture. The machine has both horizontal and vertical adjustments, and is mounted on a column of convenient height.

The inspection of revolvers should include the following: 1. *Bluing*—Examine the polishing and bluing of the cylinder, barrel, and frame, and see that all sharp edges and corners have been removed. 2. *Opening*—Bring the hammer to half cock, and open in usual manner. 3. *Testing in "skeleton" revolver*—Remove the cylinder from the frame and place it in a "skeleton" revolver carefully made for the purpose, and test the cylinder and ratchet to see that they will interchange. The cylinder is removed by turning the cylinder-catch-cam screw back one-half turn, thus liberating the cylinder-catch. 4. *Extractor*—Examine the extractor and extractor-spring; see that the extractor is held to place in cavity in cylinder; that the spline and steady-pin do not allow the extractor to project over the chambers of cylinder; and that the extractor fits the cavity in the cylinder, see that extractor-spring is properly wound and holds extractor to place. Test extractor-stem, turning the stem back one-eighth turn by placing pin in the hole of head. Test the screw by bringing it back firmly to place. 5. *Cylinder-catch*—Cylinder removed, revolver at half cock. Test cylinder-catch-cam screw, turning to place; see that cylinder-catch cam brings the cylinder-catch to place, firmly holding the same, and that the mark on head of catch-cam screw corresponds with the mark on the cylinder-catch. Test cylinder-catch with frame and barrel-catch. Closing the revolver, holding the barrel-catch back by thumb of right hand, see that cylinder-catch passes over incline of frame freely, yet rides over same, having a bearing on rear surface; that tang of barrel strikes on top of the post of frame, not allowing the cylinder-catch to rest on the frame except at incline. 6. *Barrel-catch*. See that barrel-catch opens sufficiently, passes over cylinder-catch freely, and holds same firmly to place; that it is clear of the barrel-tang at all points except where it engages with hook on cylinder-catch. Test the barrel-catch spring and barrel-catch screw. 7. *Action of barrel and cylinder catches*—Open the revolver, let the hammer down, and endeavor to close the revolver; see that barrel-catch prevents by being forced back on hammer; bring revolver to half-cock; close it; see that barrel-catch is forced back by under side of cylinder-catch hook, properly engaging with same under the influence of barrel-catch spring. 8. *Hammer-nose or firing-pin*—Bring the hammer to full cock. Snap off. Examine nose of hammer and see that it projects sufficiently. See that the bearing for the extractor-stud is correct. 9. *Cylinder, etc.*—Examine rachet and extractor-stud; test stud with a socket-wrench; test extractor with chambers of cylinder with a plug-gauge. 10. *Lock-work*—Bring hammer to full cock. Examine the hand and test hand-spring. Test the stop-spring. Examine base-pin. 11. *Adjustment*—Set the hammer to half-cock; turn the cylinder-catch-cam screw back one-half turn; open cylinder-catch; replace the cylinder and turn the catch-cam screw back to place. Close the revolver. See that the cylinder is free and properly adjusted with the cylinder-catch; that it revolves freely on the base-pin; that it rotates in either direction; that the gas-ring is free from the barrel; that the hand does not rest against the ratchet; that the extractor-stud is properly adjusted to the recoil-plate, holding the cylinder on end of base-pin, allowing no longitudinal play. Gauge distance of cylinders from barrel, limits 0″.006 and 0″.008. Gauge distance of cylinder from recoil-plate, which should be 0″.065. 12. *Joint and limb work*—Work the joint of the barrel and frame, testing and adjusting it by the joint-pivot screw. See that the friction-collar moves freely on the joint pivot. By working the joint of the barrel and frame, test the extractor, extractor-spring, lifter, friction-collar, pawl and pawl-springs. See that extractor works freely, projects to the proper distance, and returns when released from lifter by the pawl; that extractor-spring works freely, is of proper strength, returns the extractor quickly and holds it firmly in its place; see that the lifter works freely on joint-pivot, engaging with pawl and is held by same under the influence of pawl-spring until released. See that pawl works freely on pawl-pin, in frame; that the catch on the front end of the pawl engages promptly with catch on the lifter, under the influence of the pawl-spring at the rear end of the pawl, and is released by front end of the pawl passing up the incline in front of joint; that the pawl-spring is of proper strength. 13. *Screws and pins*—Examine and test the cylinder-catch, hammer-stud, side-plate, guard and stock screws. Try each screw, bringing it down to its bearing, if not down; turn back one-eighth of a turn, then back to place; see if the parts come together. This verifies the countersinking of the holes, thickness of head, and length of screw. Examine and test pawl, stop, and trigger pins. 14. *Stock*—Examine material and workmanship. 15. *Pull*—Weigh the pulling off, which should be 9 pounds, with limits, 8 pounds and 10 pounds. See that it cannot be pulled off when at half-cock. 16. *Alignment of barrel and cylinder*—This may be tested by placing steel "thimbles" in the chambers, bringing to full cock and inserting a caliber-gauge at the muzzle. The lower end of this gauge has a tenon which fits the inside of the "thimble." If the axis of the chamber does not coincide with that of the barrel, the gauge will not go down. The "thimbles" are similar in form to the cartridge-shell 17. *Action of revolver*—To test: Grasp the revolver with left hand, near joint, barrel resting between thumb and forefinger, the index-finger resting on barrel, the second finger against cylinder-catch and on the cylinder with the third finger; thereby allowing the necessary amount of friction to be applied to test the lock-work. Slowly cocking the revolver with the right hand, test the working of the hand and ratchet, hand-spring, stop and stop-spring, stop and stop notch in cylinder. See that stop leaves stop notch in cylinder before the hand takes hold of ratchet; that sear enters the half and full cock-notches of hammer promptly, and does not "creep" when released by pressure on trigger; that hammer works freely in frame; that the mainspring has proper action on hammer and is correctly adjusted by the strain-screw. Rest butt of revolver firmly, cock rapidly, and see if the stop notch in cylinder is thrown past the stop bolt; try each notch. 18. See that the arms are properly stamped and numbered, and that they have sustained no damage during assembling and inspection. See *Fabrication of Fire-arms*, and *Small-arms*.

INSPECTION OF TRANSPORTS.—In inspecting water transportation for troops, the Inspector must be governed by circumstances and necessities. Military emergency is not unfrequently a controlling consideration, but should never cause undue risk to life. In an ordinary condition of things, and especially in voyages of any length, Inspectors are to see that the vessels provided are such as promise reasonable comfort to passengers. If there be anything to indicate necessity for a critical inspection, the services of an expert are to be employed.

The Inspector should examine the contract and see that its stipulations are complied with, and ascertain how the vessel is rated at the underwriters; the age of the hull and machinery, and their existing conditions, so far as he can judge. He should inquire when the vessel was last in dock, the condition of the boilers, and when last put in. He should examine whether the outfit of tackle, spare spars, etc., is sufficient; whether there is an ample provision of boats, life-buoys, and deck-room enough for quarters for officers and enlisted men, and if the limit of the Act of Congress defining the relation of tonnage to passengers is not exceeded. He should see that the vessel's crew is large enough for her proper working, and inquire into the competency of the officers; that there are the proper instruments of navigation, compasses, etc.; report if the chronometers have been rated, and if there is a supply of charts. The water tanks and butts are to be looked at to see if there is water for passengers and crew. He should specially inspect the cooking arrangements, see that the vessel is clean, and that the portion occupied by troops is dry and well ventilated.

In order that the paddles may be secure from the action of the waves, in a side-wheel sea-going steamer, the projection on the sides under the guards, called the sponsons, should be covered up to make that portion as solid as any other part of the ship; the keel, stern-apron or inner stern, futtocks, floor-timbers, dead-wood, stern-post, transom, inner post, frame and filling timbers abreast of the engine, the wales, the rudder and rudder fastenings, should be increased in strength twenty-five per cent. over those of river steamers. The weight of machinery should be below the water-line. The vessel should be high between decks and well ventilated by hatches, wind-sails, and side-lights. There ought to be water-closet and temporary bath arrangements. Provision for sufficient masts and sails in the event of accident to the motive power, should be made, and there ought not to be less than a fore and aft sail to each mast set upon a gaff, and a trysail to each mast to be set in a storm. See *Transports.*

INSPECTION OF TROOPS.—A close examination of troops is generally made each Sunday morning and previous to muster. In the United States Army, a battalion is inspected as follows; *Dismounted Troops.* The battalion being in line, bayonets fixed, the Colonel causes it to break into column of companies, right in front, and commands; *Rear open order*, 2. MARCH. At the first command, the right and left guides of each company step three yards to the rear to mark the alignment for the rear rank. Each Captain hastens to the right, verifies the position of the guides, and then places himself facing the left, three yards in front of the right file. The Adjutant places himself on the left of the color-guard, and commands: 1. *Forward*, 2. *Guide left*. At the command *march*, the ranks are opened in each company; the Adjutant conducts the color-guard to the head of the column, posts it twelve yards in front of the center of the leading company, and then brings it to rear open order. The Drum-major conducts the band, passing by the right flank of the battalion, to the rear of the column, and posts it, facing to the front, twelve yards in rear of the rear company. The Colonel next commands: 1. *Field and staff to the front*, 2. MARCH. The commissioned officers, thus designated, form in the order of rank from right to left, fieldofficers on the right, on a line equal to the front of the column, six yards in front of the colors, the non-commissioned staff form in a similar manner, three yards in rear of the field-officers. The Colonel, seeing the movement executed, takes post on the right of the Lieutenant-colonel, and awaits the approach of the inspecting officer. Such field and staff officers as may be superior in rank to the Inspector do not take post in front of the column, but accompany the inspecting officer. After inspecting the field and staff, the Colonel commands: 1. *Order*, 2. ARMS, and the Inspector, accompanied by these officers, passes down the open column, looking at every rank, front and rear. The field and staff return their swords as soon as inspected. The Colonel now commands: 1. *In place*, 2. REST. When the Inspector, commencing at the head of the column, proceeds to make a minute inspection of the non-commissioned staff, color-guard, and the several companies in succession. The Adjutant gives the necessary commands for the inspection of the color-guard. The non-commissioned staff and color-guard may be dismissed as soon as inspected. As the Inspector successively approaches the companies, the Captains command: 1. *Company*, 2. ATTENTION, 3. *Inspection*, 4. ARMS. The Captain, as soon as inspected, returns his sword, and accompanies the inspecting officer; Lieutenants, when the Inspector begins the inspection of the front rank, face about and stand in place rest; the arms, accouterments, and dress of each soldier having been minutely inspected, the Captain commands: 1. *Open*, 2. BOXES: when the ammunition and boxes are examined. The Captain then closes ranks, stacks arms, opens ranks, and commands: 1. *Front rank*, 2. ABOUT, 3. FACE, 4. *Unsling*, 5. KNAPSACKS, 6. *Open*, 7. KNAPSACKS. The men of the front rank having faced about take a short step forward so as to be free from the stacks. At the command *unsling*, each man unfastens his knapsack, and, standing erect, holds it by the straps in front of the knees, flap from him; at the command *knapsacks*, he places the knapsack on the ground, flap upward, the great-coat six inches from the feet, and then stands at attention; at the seventh command, he opens the knapsack, turning the flap toward the feet, the flap resting on the great-coat; he then stands at attention. The Inspector having inspected the knapsacks, the Captain commands: 1. *Repack*, 2. KNAPSACKS. At the command *knapsacks*, each soldier repacks and buckles up his knapsack, leaving it in the same position as before opening it, and then stands at attention. The Captain then commands; 1. *Sling*, 2. KNAPSACKS. At the command *sling*, each man grasps the unbuckled strap of the knapsack with the right hand, the buckled strap with the left hand, the right hand uppermost, and stands erect, the flap of the knapsack from him; at the second command, he replaces the knapsack on his back. The Captain then commands; 1. *Front rank*, 2. ABOUT, 3. FACE. The men of the front rank having faced about, step forward to the line of stacks; the Captain then closes the ranks, takes arms, and on intimation from the Inspector, marches the company to its quarters and dismisses it. In a long column, some of the rearmost companies after the inspection of dress and general appearance, may be permitted to stack arms and break ranks until just before the Inspector approaches them, when they *take arms*, and resume their position. The band plays during the inspection of the companies, and is brought to rear open order by the Drum-major on the approach of the Inspector. Each man as the Inspector approaches him raises his instrument in front of the body, reverses it so as to show both sides, and then returns it to its former position. In column of several companies, the inspection of dress and general appearance may be dispensed with, the battalion being brought to an order, and in place rest, as soon as the field and staff have been inspected. At inspection of quarters, the Inspector is accompanied by all the officers, or by such of them as he may designate; the men, with gloves and accouterments, stand covered in front of their respective bunks; in camp they stand in front of their tents; the senior non-commissioned officer upon the approach of the Inspector, commands: 1. *Company* (or *squad*), 2. ATTENTION.

Mounted Troops.—The battalion being in line, the Major causes it to break into column of companies, right in front, and commands: 1. *Rear open order*, 2. MARCH. At the first command, the Adjutant places himself on the left of the guard of the standard, if the standard be with the battalion, and commands: 1. *Forward*, 2. *Guide left*. At the command *march*, the ranks are opened in each company; the Adjutant conducts the guard of the standard to the head of the column, and posts it six yards in front of the officers of the leading company, opposite the center of the company. The band, if there be one, passes by the right flank of the battalion, to the rear of the column, and takes post, facing to the front, twelve yards in rear of the rear company. The trumpeters of the battalion, if consolidated with the band, return to their respective companies; the Major's trumpeter places himself on the right of the trumpeters of the leading company. The Major nexts commands: 1. *Field and staff to the front*, 2. MARCH. The commissioned officers, thus designated, form in the order of rank from right to left, field-officers on the right, on a line equal to the front of the column, fifteen yards in front of the standard; the non-commissioned staff form in a similar manner, six yards in rear of the field-officers. The Major, seeing the movement executed, takes post on the right of the field and staff, and awaits the approach of the inspecting officer. Such field and staff officers as may be superior in rank to the Inspector do not take post in front of the column, but accompany the inspecting officer. After inspecting the field and staff, the Inspector, accompanied by these officers, passes down the open column, looking at every rank, front and rear. The field and staff return their sabers as soon as inspected. The Inspector, having returned to the head of the column, proceeds to make a minute inspection of the non-commissioned staff, guard of the standard, and the several companies in succession. The Adjutant gives the necessary commands for the inspection of the guard of the standard. The non-commissioned staff and guard of the standard may be dismissed as soon as inspected. As the Inspector successively approaches the companies, the Captains command: 1. *Inspection*, 2. ARMS. The Captain, as soon as inspected, returns his saber, and accompanies the inspecting officer; the Lieutenants, when the Inspector begins the inspection of the rank, face about and remain at ease, unless otherwise instructed.

After inspection of dress and general appearance, if the Inspector desires to inspect the companies dismounted, instead of mounted, the Major dismounts the battalion and forms rank. The horses of the officers are held by trumpeters. The inspection is conducted in the same order as before. At the command: 1. *Inspection*, 2. ARMS, the men take the reins off the horses' necks, pass the right arm through the reins, face to the front, and *unsling carbine*. The arms are then inspected as prescribed in the School of the Soldier Dismounted. The inspection being completed, the Captain, on intimation from the Inspector, causes carbines to be slung, then mounts the company, and dismisses it.

Inspection of a Battery.—The battery being in line, the Captain commands: 1. *Prepare for inspection*, 2. *Action*, 3. FRONT, 4. *Right*, 5. DRESS, 6. FRONT, 7. DRAW, 8. SABER. These commands are executed as prescribed for review, the trumpeters also drawing saber; if the inspection has been preceded by a review, the Captain may omit the seventh and eighth commands, cautioning the trumpeters to draw saber. The inspecting officer inspects the Captain, and then the chiefs of platoon, beginning on the right; passing around the left of the battery, he inspects the chief of caissons, then goes to the right and inspects the trumpeters and guidon; the Inspector next goes to the right section of the right platoon and inspects the section; beginning with the chief, who executes *inspection saber*, he passes in front of the piece, along the right of the section, and in rear of the caisson, returning by the left of the section to the front; he then goes to the left section of the right platoon and inspects it, as prescribed for the right section; he then inspects the other sections in like manner. As the Inspector approaches each limber, No. 6 opens the lid of the chest so as to show its contents; he closes the lid as soon as the Inspector passes the limber on its left. The caisson corporal opens and closes the lid of the caisson limber-chest, as explained for No. 6; he also, when so directed, opens and closes the lids of the other chests. The trumpeters, chiefs of section, first-sergeant, quartermaster-sergeant, and the artificers when mounted, execute *inspection saber* as the Inspector approaches them. The Captain, as soon as inspected, returns saber and accompanies the Inspector. Each chief of platoon accompanies the Inspector during the inspection of his platoon; he then returns to his post, faces to the rear, and remains at ease. As soon as the forge and battery-wagon, after the commands *action, front*, have taken their places in line with the limbers and caissons, the senior blacksmith opens the lid of the limber-chest of the forge, and the wheelwright opens the battery-wagon; they then resume their posts. If mounted, they dismount and give the reins of their horses to the wheel-drivers of the forge and battery-wagon, respectively, and then conform to what has been just prescribed. The forge and battery-wagon having been inspected, each is closed by the proper artificers, who resume their posts. If they have horses, after closing the forge and battery-wagon they mount, return to their posts, and draw saber. The inspection of the battery-wagon being completed, the Captain returns to the front and center of the battery, faces toward it, and commands: 1. *Drivers*, 2. PREPARE TO DISMOUNT, 3. DISMOUNT, 4. INSPECTION KNAPSACKS AND VALISES. At the command *dismount*, all the officers and mounted men dismount; the horses of the Captain, chiefs of platoon, and chief of caissons, are held by the trumpeters, assisted by the guidon if necessary. At the fourth command, each cannoneer takes his knapsack from the carriage, returns to his post, places his knapsack on the ground, flap upward, the great-coat six inches from the feet, opens his knapsack, turning the flap toward the feet, the flap resting on the great-coat, and then stands at attention; each mounted man unstraps his valise from the saddle, and places it at his feet in the position of stand to horse, opens his valise, and then stands to horse. The Inspector, accompanied by the Captain, then inspects the knapsacks and valises, passing through the battery as before prescribed, each chief of platoon accompanying him during inspection of his platoon. The Captain then commands: REPACK KNAPSACKS AND VALISES. At this command, the knapsacks and valises are closed and strapped in their proper places; the cannoneers then resume their posts and the drivers stand to horse. The knapsack of each cannoneer rests vertically on the foot-boards of the chest on which he mounts, so as to be under his legs, the flap from the chest; the knapsacks are secured to the chest by means of a strap which is passed in front of the knapsacks, and is fastened to the ends of the chest. The knapsacks of the first-sergeant, quartermaster-sergeant, chiefs of section, trumpeters, guidon, and the artificers when mounted, are usually inspected in quarters; on the march their knapsacks, unless otherwise prescribed by the

Captain, are carried on the foot-boards of the limber-chests of the forge and battery-wagon, and in the baggage-wagons. The knapsacks and valises having been inspected, the officers mount; the Captain then commands: 1. *Drivers*, 2. PREPARE TO MOUNT 3. MOUNT. At the third command, all the mounted men mount. The inspection being completed, the Captain, upon some intimation from the Inspector, forms line, marches the battery to its park, and dismisses it. The battery is frequently inspected in full marching order—the men in blouses, and equipped with haversacks and canteens; knapsacks and valises packed; overcoats, when not worn, rolled and strapped to the knapsacks or saddles; horses equipped with nose-bags and halters; caissons loaded with a day's forage.

INSPECTION REPORTS.—Reports of the various kinds of inspections, for the information of the Inspector General. Inspecting officers, before transmitting their reports to their Commanders, indorse thereon the remedies that have been applied by the local Commanders for the correction of irregularities that may have been brought to their notice. All Superior Commanders in forwarding the reports, indorse them with their action, and such remarks as may be of importance for the information of the Commander of the Army.

Copies of all non-confidential Inspection Reports are forwarded to the Inspector General, through the ascending channels of communication. Commanding Officers only may forward copies of confidential reports.

INSPECTOR GENERAL.—Inspector and Inspector General are terms in military affairs, having a somewhat vague signification. There are Inspectors General of Cavalry, Infantry, Artillery, Engineers, Militia, and Volunteers, whose duties are really those which their names infer—viz., the periodical inspection of the several corps of their respective arms, and the pointing out of deficiences, the corps being under the command, however, of its own officers, and not of the Inspector General. The Inspectors General of Musketry and Gunnery Instruction in the English Army are charged with the direct superintendence and ordering of such instruction throughout the army. In the Medical Department, the Inspectors General of Hospitals constitute the highest grade of surgeons, under the Director General of the whole department. Inspectors are employed in many capacities. Inspectors of Volunteers are Staff Officers charged with the administration and organizing of the detached corps of Volunteers in their several districts. The post of Inspector General of Auxiliary Forces has lately been abolished, and his duties transferred to the Department of the Adjutant General, in order to bring the Militia and Volunteers more immediately under the supervision of the Commander-in-Chief.

INSPECTOR GENERAL'S DEPARTMENT.—In the United States, the law at present provides for one Inspector General, with the rank of Brigadier General; two Inspectors General, with the rank of Lieutenant-colonel; and two with the rank of Major. Also, that the Secretary of War may, in addition, detail Officers of the Line, not to exceed four, to act as Inspectors General. In the British service, the Inspectors Generals are officers appointed by the Horse Guards, with the exception of the Inspector General of Fortifications, to carry out, in the most searching manner, the duties of inspection in their respective branches, and to bring to the notice of the Commander-in-Chief all points with which he should be made acquainted. They are assisted in their duties by *Inspectors*, who act under their instructions.

INSUBORDINATION. Disobedience to lawful authority, under the following phases, viz.: 1. Striking a Superior Officer; 2. Using or offering violence against a Superior Officer; 3. Offering violence in a military prison; 4. Disobeying the command of a Superior Officer; 5. Using threatening language to a Superior. For either of the above offenses an officer or soldier is to be tried by a General Court-Martial.

INSULT.—In a military sense, to attack boldly and in open day, without going through the slow operations of trenches, working by mines and laps, or having recourse to those usual forms of war by advancing gradually towards the object in view. An enemy is said to *insult* a coast when he suddenly appears upon it, and debarks troops with an immediate purpose to attack.

INSURGENTS.—Soldiers or people generally in a state of insurrection. The term, however, admits of one exception. Hungarian Insurgents (*Insurgenten die Ungarischen*) mean the Hungarian Militia, called out or summoned by general proclamation, as under the old feudal system.

INSURRECTION.—A rising of people in arms against their Government, or a portion of it, or against one or more of its laws, or against an officer or officers of the Government. It may be confined to mere armed resistance, or it may have greater ends in view. See *Civil War* and *Rebellion*.

INTELLIGENCE DEPARTMENT—A branch of the Quartermaster General's Department, presided over by the Deputy Quartermaster General. It has for its object the collecting, sifting, and arranging of all information on subjects useful to the Government or Army in peace or war. This Department in England is comparatively of recent date. Its functions comprise:—Topography; Strategical and Tactical Questions; Concentrations; Collection of all data bearing on the organization of foreign armies; Home and Colonial Defense, etc. The information to be obtained on the above subjects is gathered in time of peace, so that, when war breaks out, the General commanding an expedition may have put into his hands the most detailed information that maps can contain of the country in which operations are to be carried on, and all such other information needful for the vigorous prosecution of the war. Formerly, whatever information the General received was through the Quartermaster General's Department, then imperfectly organized for obtaining such intelligence as is now afforded, and also by reconnoisances a day or two in advance of the Army. Now-a-days, the General is made acquainted with the country he has to traverse before he sets out, and is thus often enabled to map out his future movements before commencing operations. To the Intelligence Department may be attributed, to a great extent, the success of the German arms during the war of 1870—71. Before starting on the campaign, maps of the country the Army was to invade were largely distributed, and also handbooks containing information on many valuable points such as railways, localities, power of districts to afford food, etc.—in short, all information tending to the successful issue of the war. The Intelligence Department of England is modelled after that on the Continent, but only for defensive purposes; It is composed of Staff Officers, whose education and intelligence fit them well for the duties they have to perform. The Department may be said to be at present merely the nucleus of what will be, it is to be hoped, a still larger one. There is ample field for an increased number of Staff Officers, and in comparison with the Continental Department, the establishment is small. The following extract from a lecture given at the United Service Institution, in February 1875, by Major Brackenbury, R. A., D. A. Q. M. G. an officer of the Intelligence Department, will put the reader in possession of the information to be acquired, and the work to be performed by the Staff Officers of such a Department, as carried out in Prussia, Austria and France:—

"1. A thorough military acquaintance with the topography and resources of all lands belonging to the nation and its neighborhood.

"2. An intimate acquaintance with the armies and military institutions of foreign powers, as well as of the home armies and institutions.

"3. A scheme for movement of troops by railway, road, or water, according to probable eventualities. This is based on a study of home and foreign means of communication.

"4. Military history, which is always a mine of information if honestly drawn up according to official knowledge.

"5. Selections from the above items of knowledge carefully drawn up and published for the information of the army. This requires frequent use of the printing-press.

"6. In the three countries the Staff is charged with the issue of the requisite maps in case of war, and, for this purpose, is in close intimacy with the great map-making establishments represented by the Ordnance Survey, which is a civil branch, though conducted by officers of the Royal Engineers."

In time of war, the duties of this department would be similar to those performed by that section of the General Staff in Continental armies, with this exception, that in consequence of the paucity of officers employed in this branch of the service, it would have to be supplemented by special Staff Officers, in connection with the Quartermaster General's Department. Preparatory to the commencement of hostilities, all the information concerning the country in which the operations are to be carried on—collected and collated by the Intellgence Department in time of peace—will be furnished to the General in command, who will next have to obtain further information through this Department as to the enemy's positions, *moral*, etc., by means of outposts, reconnoissances, spies, and emissaries. The names of the enemy's Generals, the organization and the dress of his troops can then be learnt, as the capture of a single prisoner or patrol may show, even by his uniform, buttons, or lace, the presence of a particular corps. Newspapers may furnish information of great value. During the Prusso-Austrian war of 1866, the first authentic information the Prussians received of Benedeck's march from Olmütz to Vienna was derived from Brackenbury's letters. The information obtained by the means of outposts is of very great importance; and the first step taken by the Staff of Continental armies, after the declaration of war, is to draw a *cordon* of light cavalry; to this force one or two officers of the Intelligence Department are attached. One sphere of action is up to the enemy's outposts, whose movements must be watched, and all information concerning them be obtained through the videttes, reconnoissances, etc., without driving them in, to do which would need a reconnoissance in force a measure of doubtful value, as it often leads to a general engagement. The Officer Commanding an outpost is responsible for the amount, as well as for the correctness, of all the information he sends to the Officer Commanding; he has, therefore, to exercise his discretion as to what intelligence he sends in, and this should be rather too much than too little. In transmitting any knowledge he has acquired, he must adhere as much as possible to the words of the informant; but if the information be of great value, the person from whom it has been obtained, such as a prisoner, deserter, or patrol leader, should be sent in to headquarters. The information obtained from prisoners, deserters, and persons from the enemy's side, is always valuable. The first two classes do not as a rule know much, but travelers, and particularly boys, are great sources of information, as they are close observers, and are less likely to be influenced by patriotism, and a small bribe will suffice as remuneration for the news supplied.

The real rank and file of an Intelligence Department, before and after hostilities have begun, are the regular paid spies. Officers commanding outposts can make use of local spies, but the main body of these men remain attached to the headquarters, for specific purposes, under an officer specially appointed for that duty, who should possess the following qualifications:—

1. Thorough reticency.
2. Keen knowledge of human nature.
3. Distrust of all unsupported information.

Lack of information is not the difficulty in war time, for the shifting tendency of men's fears is to exaggerate dangers; the number of spies, therefore, may be safely reduced. There are two classes of spies as shown above:—1. *Local Spies.*—These are men accidentally employed, and whose business may take them into the enemy's lines. They are to be trusted in gaining intelligence; moreover, their powers of information are naturally confined to a small area, and as they are probably well acquainted with that area, and their being on business, they are not so liable to suspicion. 2. *Paid Spies.*—These should always be kept apart and in ignorance of each other. They should receive liberal pay, according to the result of work. In India, the plan formerly adopted in paying the native spies was to put a bucketful of gol mohurs before the man, and to allow him to take away as many as his two hands could hold. Some military writers lay down that all the information obtained by the Intelligence Department should be published to the army, as experience has shown that, by acting thus, surprises and panics have been guarded against, great fatigue saved, and that the best marches have been made when the men knew the object of the undertaking. Having collected the required information, the next point will be the transmission of such intelligence. This is performed in three ways:—

1. By the electric telegraph.
2. By visual signalling.
3. By mounted orderlies.

Sometimes the three are combined. The electric telegraph is applicable for long distances, between stationary points and along main lines; between camps at some distance from one another, field telegraphs may be laid down. Visual signalling is useful in broken ground, across obstacles, with ships at sea, and also for moderate distances, where the points are not stationary for any time, such as the outposts. It was found particularly useful in the Looshai expedition on the borders of Assam. For short distances mounted orderlies can be used, between points constantly moving, as well as for transmission of news in wooded countries. The following have been found good distances to transmit intelligence by the modes indicated:—

Electric telegraph, above 8 miles;
Visual signalling, 1½ to 8 miles;
Orderlies, 1 to 1½ mile.

INTENDANCE.—In Continental Armies, an establishment corresponding to the English branch of the Control Department.

In the German army it is a small Department, and the duties are more restricted and entirely civil. Until 1866, Prussia had no combatant officers attached to the Intendance. It has much less independent responsibility, and clashes less with the War Department, because it only refers to matters beyond general control, and large funds are always placed at its disposal by the military authorities; nearly two-thirds of the army expenditure is paid by it, like the Clothing Department. In France, the Intendance possesses the direction and control of everything that concerns pay, provisions (*munitions de bouche*,) contracts for the same, Clothing Department, etc. This Department is officered exclusively by officers of the army, of no lower rank than that of Captain, and whose age does not exceed 35 years; they have to pass an examination before a Board of Officers. Their functions are purely administrative, and they have no relative rank.

INTENDANT.—INTENDANT MILITAIRE.—An officer in the French army charged with the organization and direction of all the civil services attending a force in the field. The officers acting under his orders are those in charge of all the finance services, the provisions, stores, hospitals, artillery train, and transport departments, besides the interpreters, guides, and such like temporary services. The *Intendant-en-Chief* of an army is the Representative of the Minister of War; and, short of superseding the General's orders, can exercise, in case of need, all the functions of that high officer of state. The Intendance is divided into Intendants, ranking with General Officers, Sub-Intendants with Colonels, and Assistant-Intendants with Majors; besides Cadets, who receive no pay, and constitute a probationary grade.

Intendant was the name given in France before the Revolution to the Overseer of a Province. Such permanent officers were first appointed by Henry II. (1551). Under the complete system of centralization established by Richelieu, these Intendants, as they were now called, became the mere organs of the Royal Minister, to the exclusion of all provincial action. To them belonged the proportioning of assessments, the levying of soldiers, etc. The National Assembly in 1789, established in each department an elective administration. Napoleon virtually restored the Intendants, but exchanged the hated name for that of *Prefects*.

INTERCHANGEABLE.—The meaning of this word is self-evident, viz.; that which may be given and taken mutually. In military *matériel*, the term is used to express that an article which suits or fits any part of a machine, a lock of a gun, a wheel, etc., will fit corresponding parts of a like article; and thus all parts of *matériel* are for the most part made interchangeable.

INTERIOR ECONOMY—Applied to military affairs relates to the whole management of a regiment, the responsibility of which lies with the Commanding Officer, as he is the mover and director of everything pertaining to his command. It includes all duties in which the officers and men are interested, such in the former case, as their mess, band, funds, etc., and in the latter, to the messes of the non commissioned officers and soldiers, their amusements, libraries, in fact, everything tending to the good order and welfare of the regiment.

INTERIOR FLANKING ANGLE.—In fortification, the angle formed by the meeting of the line of defense and the curtain.

INTERIOR FORM OF CANNON.—The aim in all gun construction is to obtain the maximum amount of work from a given charge and weight of piece, this within the limits of safety to the piece itself. To attain this, the relations between the interior dimensions, the charge, and the projectile, have to be in each case studied and regulated with the greatest care. The dimensions of a piece are also governed somewhat by the nature of its service, and circumstances under which it is to be fired. The interior of cannon may be divided into three distinct parts; 1st, The *vent*, or channel which communicates fire to the charge; 2d, *The seat of the charge*, or chamber, if its diameter be different from the rest of the bore; 3d, The *cylinder*, or that portion of the bore passed over by the projectile. See these parts under proper headings.

INTERIOR RETRENCHMENTS.—When a breach is made in the enciente, although military usage and a point of honor require of the garrison to sustain at least one assault, the consequences of defeat are of too serious a character to expect such an effort, unless a place of safety be provided, into which the garrison may retreat after defending the breach and obtain an honorable capitulation. On this account, and also to lengthen the defence, *interior retrenchments* are made in the bastions. These works may be either of a temporary or permanent character, but it is generally conceded that the latter class alone offers a serious obstacle to the enemy. The former, moreover, requires that the retrenchment should be thrown up during the siege, an undertaking of great difficulty, both from the annoyance of the enemy's fire and the fatigued state of the garrison, occasioned by its ordinary duties. The works may be placed within the bastions, which are the parts of the enciente usually breached, or in rear of their gorges. Those which are placed within the bastions extend across them either between the faces or between the flanks. When placed at the gorge they connect the two adjacent curtains. They may be divided into four classes, viz.: 1st, those that rest against the faces of the bastions; 2d, those that rest against the flanks; 3d, those that rest against the two adjacent urtains; 4th, and those that comprehend several bastions. The plan of these works varies with their position, the size of the bastions, or the more or less openness of their salient angles. In small bastions with very acute salients, when the retrenchment rests upon the faces, it usually receives the form of a tenaille or an inverted redan, the angle of the tenaille being about 100δ. When the bastions are large and the salient angle quite open or obtuse, the retrenchment may receive the form of a small bastion front resting upon the faces. Either of these forms may in like manner be used when the retrenchment rests upon the flanks of the bastion. But as this position enables a retrenchment of the form of an ordinary redan to have its ditches swept by the fire of the flanks of the adjacent bastions, this form is in some cases used in preference. When placed between two curtains at the gorge of a bastion the plan of the retrenchment is always a bastioned front. See *Interior Works* and *Permanent Fortifications*.

INTERIOR SLOPE.—In fortification, the surface connecting the superior slope with the banquette tread. It is well to make the interior slope vertical (and it is oftentimes made so) for the reason that defenders in that case can stand close to the parapet in delivering their fire. A vertical slope would require a strong construction of some kind, to retain the earth in position, and to resist the horizontal thrust produced by the prism of rupture. When the materials for making this construction are abundant and convenient, a vertical slope, or one nearly so, may be used. A steep slope requires a strong revetment, otherwise it is to be preferred. A gentler slope requires a slighter protection, but has the disadvantage of placing the soldier too far from the interior crest when he is in a standing position: and it exposes him more to projectiles grazing the interior crest. The rarity of hand-to-hand conflicts on the parapet, and the use of breech-loading weapons, allow the use of gentler slopes for the interior of the work than were formerly regarded as admissible. Gentle slopes are accompanied, however, by the disadvantage of requiring the soldier to occupy a recumbent position when firing his piece. See *Field-fortification*.

INTERIOR WORKS.—Besides the works exterior to the enceinte, the object of which is to retard the assailant in his attempts to enter it by breaching, Engineers have placed within it other works, termed *interior works*. They are placed on such points as are exposed to be breached by the enemy's artillery, and are intended to cut these off from that portion of the enceinte not so exposed. By them the garrison is enabled to make an effectual defense of the breach when the assault upon it is made. When intended for the defense of the breach alone, they are called *interior retrenchments*. They are of various forms, being adapted to the position they occupy and the degree of resistance to be offered, and are usually constructed with a revetted scarp and counterscarp to secure them against an open assault. When a considerable command is given to an interior work over the one in which it is placed with the view of obtaining a plunging fire on points which the enemy may occupy on the exterior, it receives the name of a *cavalier*. When an interior work is detached from the enceinte and is organized to receive the garrison and rely on its own resources after the main work has fallen, it is termed a *citadel*. See *Interior Retrenchments*.

INTERN.—A term used in a military sense to express the act of giving shelter to troops which have taken refuge on neutral territory. On passing the frontier the men are disarmed and sent to the different quarters allotted to them, generally in the interior of the country; they are treated on the same footing as the soldiers of the country, and the officers are allowed to keep their arms, horses, and baggage, but have to give their parole that they will not attempt to escape. Towards the end of the war of 1870 71, Bourbaki's Army, sorely pressed by the Germans took refuge in Switzerland, to escape being taken prisoners and were interned there.

INTERNAL PRESSURE GAUGE. Various forms of the Internal Pressure-gauge have been proposed. That by Doctor W. E. Woodbridge is found satisfactory. It consists essentially of a piston having a conical cavity, pressed by the powder-gauge against a disk of copper which enters the cavity in proportion as it is crushed. The surface of the cavity is formed with a fine spiral thread, continuous from the face of the piston to the apex of the cone—the turns of their threads being divided into tenths by lines radiating from the apex. These are impressed upon the copper according to the extent that the metal has been forced into the cavity, and a reading of the number of turns of the spiral affords an indication of the pressure to which the piston has been subjected. It may be considered to be a modification of a form of Internal Gauge proposed by Captain Henry Metcalfe, Ordnance Department, the spiral cutter of which is convex. The cut on the disk is divided for facility of reading the pressure. See *Pressure-Gauge*.

INTERNATIONAL DATE LINE.—The line at which dates change, being made later by one day by those who cross the line from east to west, and earlier by one day by those crossing it from west to east. If a person start at midday, that is, when the sun was shining perpendicularly on the meridian that passes through the place of starting, and travel westward, keeping pace with the sun, thus keeping the sun directly over the meridian of the place at which he might be, he would make a complete journey around the globe in twenty-four hours; and return to his place of starting at noon the next day. Twenty-four hours would have passed, but to the traveler the sun would have been shining perpendicularly as at noon all the time; and the question arises, when or at what point did the traveler change from noon of one day to noon of the next? For instance, if he should start at Monday noon and keep the sun in the zenith, he would arrive at the place of starting Tuesday noon—it would be noon-day to him during the whole journey of twenty-four hours—Monday noon would change to Tuesday noon without an intervening night; where would the change occur? It is to him apparently still Monday noon, and to obtain the correct date he must drop a day. The reason for dropping a day can be more fully shown as follows:—Remembering that the earth makes one complete revolution on its axis in twenty-four hours, and thus the sun in its apparent diurnal revolution moves over 360 degrees of space in twenty-four hours, it thus moves over 15 degrees of space in one hour, from which it is evident that the difference in longitude which causes the difference in the relative time, may be estimated in time, allowing 15 degrees to an hour, or one degree to four minutes. Therefore, suppose a man starting from any given point, travel one degree west, his watch, instead of marking twelve o'clock at noon, according to the correct time at that place, would mark four minutes after twelve. Let him travel west 15 degrees, and he will find that 1 o'clock by his watch will be noon-day by the sun. Let him go on to 120 degrees, and when the sun is in the zenith his watch will indicate eight o'clock P. M. Completing his journey around the globe, he will have gained, in this manner, twenty-four hours. From this it will be seen that in order to obtain the correct date twenty-four hours must be subtracted from his time. On the other hand, if a person could travel eastward at the same speed with which the sun apparently travels westward (the same rate of speed with which the earth revolves on its axis), if he should start on his journey at noon-day, he would meet the sun when exactly on the opposite side of the earth from the place of starting, and continuing the journey would again meet the sun at the place of starting, thus seeing three noon-days within the twenty-four hours, or apparently gaining a day. This we know to be impossible, since only twenty-four hours of time have passed, while in reality an extra period of light has been gained, and thus to obtain the correct local date a day must be added to your time. From this we see that, for every time a person travels around the earth in either direction, there is a difference in time of one day, and the result is the same regardless of the rate of speed. To avoid the confusion of dates which must necessarily result from this constant gain on one side and loss on the other, it has been proposed to determine upon some line at which eastern bound travelers shall add one day, and westward bound travelers shall drop a day from their reckoning, and thus prevent a disagreement in regard to the day of the week. The line at which this addition or subtraction shall be made is what is meant by the date-line.

INTERNATIONAL LAW.—The body of rules, derived from custom, or treaty, by which nations, either tacitly or expressly, agree to be governed in their intercourse with each other. Some of the rules have existed from the beginning of history; their number has gradually increased, their scope widened, and their quality improved. The Amphictyonic Council, formed in very early times and limited to Grecian tribes, required that after a battle an exchange of prisoners should be made, and a truce declared in order that the dead might be buried. They also bound themselves not to destroy any city included in the alliance, or to cut it off from running water in war or peace. The Romans in their early days established a College of Heralds for declaring war, and allowed only sworn soldiers to take part in it. The influence of Christianity, declaring the universal brotherhood of man as one of its fundamental truths, has been great and beneficent in the sphere of national character and intercourse. Many barbarities fell at once before it, and many others have been gradually mitigated and subdued.

International Law has two natural divisions—the one containing rules for the intercourse of nations during peace, and the other regulating the changes made by war.

RIGHTS AND DUTIES OF NATIONS DURING PEACE.—1. Individuals cannot be parties to International Law; but may, if strangers, claim humane treatment under the law of nature broader than that of nations. Only independent, organized communities are nations, and have the power of making treaties with other nations. Protected or dependent States, Provinces and Colonies, the members of Confederacies, and separate Kingdoms made one by a permanent compact, must conduct all their intercourse with other nations through that nation on which they are dependent, or of which they are a part. No particular form of government and no difference of religious belief necessarily excludes a nation from the obligations and advantages of International Law. Independent States have equal duties and rights, without reference to their size or other relative differences, and are sovereign in the sense of having no political superior. The individual States of the American Union may be said to have a certain local and relative sovereignty; but with respect to other nations the United States only constitute a Sovereign State. International Law deals only with State *de facto*. While a body, hitherto dependent or forming a part of a nation, is striving to effect its independence, other nations cannot help it, without creating a state of war with the parent State. A State cannot evade its obligations by change of Constitution. Denmark and Norway, when separating in 1814, each took its share of the debt of the United Kingdom; and the United States assumed the debts of the preceding Confederation. The independence of a State implies, first of all, freedom in the conduct of its internal affairs. Generally there can be no legal interference with them by anothre State. Yet when a State, by external alliances, is increasing its power in a degree that endangers the welfare or tranquility of its neighbors, the right of interfering in order to preserve the balance of power is claimed and has been exercised; as, for example, in the war of the Spanish Succession, and after the French Revolution and the fall of Napoleon. On the other hand, when circumstances do not require or warrant such an interference, there have been national declarations designed to forestall and prevent it. An instance of this was furnished by what is called the Monroe Doctrine—President Monroe's declaration made in order to prevent European interference in what had been Spanish America—that "The United States would consider any attempt on the part of the allied European Powers to extend their system to any portion of our hemisphere as dangerous to our peace and safety." Also, when any great cruelty has been practiced by the strong against the weak the right of interference by other nations is claimed. A signal instance was furnished in 1827, during the struggle for independence by the Greeks against the Turks, when the allied fleets of Great Britain, France, and Russia destroyed the Turkish fleet.

2. A State has a sovereign right to its territories and property. Its property consists of public buildings, forts, ships, lands, money, and similar possessions. All private property, also, within its limits is under its protection. Its territory includes all the surface of land or water within its limits; of harbors, gulfs, and straits within certain headlands; and of the sea within a league from the shore. Outside of this limit the sea is free to all nations for commerce and fishing. But while foreigners are free to catch fish in any part of the ocean contiguous to the territory of a State—as on the banks of Newfoundland—they cannot dry their nets or cure their fish on the adjoining coasts unless the privilege has been granted by treaty. A ship owned by inhabitants of a country cannot be regarded as national territory, but is simply private property under the protection of the national flag. In a foreign port it may be attached for debt, and its crew are accountable to the laws of the port and of the country for any misconduct which they may commit. Rivers between two countries, unless a contrary provision is made by treaty, are common to both, and the boundary runs through the principal channel. When a river rises in one State and enters the sea in another, each portion, strictly speaking, is subject to the State within whose limits it is contained. The dwellers on the upper shores have no right, except by concession, to descend to the sea through the lower territory. Yet there seems to be an equitable claim to the privilege almost amounting to a right; and within the present century almost all such navigable rivers in the Christian world have been opened by treaty to the use of those who live on their upper waters. Among these may be mentioned the Rhine, Scheldt, Danube, La Plata and its tributaries, Amazon, and St. Lawrence.

3. Duties which foreigners coming into a country owe to its laws and government. Aliens, sojourning in a country, must submit to its laws unless released from their jurisdiction by special treaty or international custom. They are secure in the enjoyment of their property, the use of the Courts, and the transaction of lawful business. They can dispose of their property by will to persons residing abroad, or can transmit it to their own country. They have also the protection of Consuls and Ambassadors appointed by their own country. Several classes of persons are specially exempt, in a greater or less degree, from the jurisdiction of local laws; as, for example, Sovereigns traveling through a foreign country, Ambassadors accredited to it, the officers and men of national ships in its ports, and foreign armies when passing through it by permission. In England formerly no one born a subject could lawfully expatriate himself, nor could any foreigner be naturalized except by Special Act of Parliament. But in 1884 provision was made for granting foreigners all the rights of native-born subjects except membership of the Privy Council or of Parliament. In the United States a foreigner may be legally naturalized after five years' residence, and three years after he has formally declared his intention to renounce his former nationality and become a citizen. Persons who have committed offense against the laws of their country often flee for refuge into another. If the offense be political only, the nations which are most free themselves generally allow the fugitives to remain; but if they have committed, or are charged with crime, they may be delivered up for trial to their own country when demanded according to the provisions of treaties made for the purpose. An Ambassador in very ancient times was considered a sacred person; and, as national intercourse and comity have been enlarged, there has been a proportionate increase in his rights and privileges. His person, dwelling-place, property, family, and attendants, are, in a great degree and as a rule, exempt from the criminal and civil jurisdiction of the country to which he is sent. He has liberty of worship, according to the customs of his country and to his own choice, for himself, his household, and by extension of courtesy, for other persons belonging to his nation. In some countries this liberty has been restricted to worship in his own house. Consuls are agents who have no diplomatic character, but are sent to reside in certain districts to protect the interests, chiefly commercial, of the country which appoints them. Their duties are imposed by their own Government, and are performed by permission of the foreign power. They are honored and protected by the flag of their country; but their privileges are, in general, much less than those of Ambassadors, except in Mohammedan countries, where, having often been required to perform diplomatic duties, they have acquired corresponding rights. The modern office of Consul arose in the commercial times of the Middle Ages, when companies of merchants, going to reside in the eastern parts of the Mediterranean, had officers, chosen at first by themselves and afterward by their governments, to settle disputes that arose in conducting business affairs. Treaties are compacts between nations for the regulation of intercourse between both governments and people. They comprise, in a great measure the history of International Law. The power to make them is determined by the Constitution of individual States. In the United States they are negotiated under the direction of the President, and are ratified by a two-thirds vote of the Senate. When they promise the payment of money it must be appropriated for the purpose by a vote of the House of Representatives.

II. International Relations as Modified by War. 1. War is a contention by force of arms between two or more nations. In order to be just it must be necessarily undertaken to repel an injury or to obtain a righteous demand. The power of deciding for what purpose and when it is to be waged must be left to each nation, because there can be no other judge. A nation that has been wronged, or thinks it has, may take no notice of the wrong, or employ only peaceful measures to obtain redress, or accept the offered mediation of a friendly power, or propose arbitration, or use armed force. In general, other nations have no right to interfere. Yet, in some cases, war between two nations may become to other nations a cause for war. Mediation offers a way for escaping war which may be equally honorable and advantageous to both parties. Yet it can only give advice which may be rejected by one or both of the parties. Arbitration, in special cases, may be simple, easy, and effective. The parties agree on the Arbitrators, the points to be considered, the time and place, and the law which is to govern the case; and they bind themselves to abide by the decision. The success which has, in numerous instances within the present century, been attained by arbitration, and especially in the recent important case between the United States and Great Britain arising out of the war for the suppression of the Southern Rebellion, warrants the hope that war may often, in a similar way, be avoided. After the happy settlement in the instance last mentioned, the British House of Commons presented an address to the Queen, praying that measures might be taken "With a view to further improvement in International Law and the establishment of a general and permanent system of international arbitration."

2. War between two nations interrupts all recognized intercourse between the individual members of each. The relations of commerce, the right given by treaty to reside in either country, and all communication by direct channels between them, come to an end. Sometimes permission is granted to remain still in the country; and generally time is granted to remove with property and effects. The treaty of 1794 between the United States and Great Britain stipulates that "Neither the debts due from individuals of the one nation to individuals of the other, nor shares nor moneys which they may have in the public funds or in the public or private banks, shall ever, in any event of war or national difference, be sequestered or confiscated." According to Chancellor Kent, "As a general rule, the obligations of treaties are dissipated by hostilities." It is said also by another writer that "Great Britain, in practice, admits of no exception to the rule that all treaties, as such, are brought to an end by a subsequent war between the parties." The peace of Westphalia and the treaty of Utrecht have been renewed several times when the nations concerned in them, after having been at war, were making new treaties of peace.

3. The interests of humanity demand that, during warlike operations on land, non-combatants should be molested as little as possible in the prosecution of their peaceful interests and in the enjoyment of their homes. On the sea, ships and cargoes belonging to enemies have, until recently, been accounted lawful prey; but in the enlarged commercial relations of the world much progress has been made towards exempting innocent traffic on the seas from interruption during war.

4. The forces lawfully employed in war are, on land, Regular Armies, Militia, and Volunteers; and, on the sea, national ships and private vessels commissioned by national authority. But as privateering is necessarily attended with great evils, earnest efforts have been made to restrict or abolish it. In 1856 the parties to the Declaration of Paris adopted four rules concerning maritime warfare, one of which declares that "Privateering is and remains abolished." Other nations were asked to accept them on condition that they would be bound by them all; and almost all Christian States did agree to them. The United States withheld their assent because, as it is their policy to maintain only a small navy, the right to resort to privateering in case of war offers the only way by which they can cope with the large navies of other nations. They agreed, however, to adopt all the rules, provided the signers of the declaration would consent to exempt from capture all innocent traffic of enemies on the sea. In 1861 the offer was made to two of the principal European powers, by the Secretary of State, on the part of the United States, to come under the operation of the four rules; but as it was made for the whole Republic the rebellious as well as the loyal States—it was declined.

5 The rights and duties of neutral nations. In recent times the commercial intercourse among people of different nations has become so general and constant, that they are practically united almost into a confederacy so as to be entitled to a voice in deciding whether war between individual nations shall, in any particular case, be permitted. Sometimes, in view of peculiarities in its position, a territory is made permanently neutral so that armies cannot cross its boundaries nor can it engage in war. Switzerland and part of Savoy, since 1815, and Belgium, since 1830, have been in this condition. Sometimes several Powers unite in an armed neutrality in order to maintain certain maritime rights against both belligerents. But such a league is liable to result in war. A neutral State must be impartial in its dealings with both belligerents; must keep itself, its territory and subjects, as detached as possible from the war; and be equally humane to both parties when storm, disaster or hunger casts them on its shores or within its bounds. By the treaty of Washington, in 1871, Great Britain and the United States adopted three rules to be applied in settling difficulties then existing between them, to be observed by them in the future, and to be urged on the acceptance of other nations. These rules are—that "A neutral government is bound *first*, to use due diligence to prevent the fitting out, arming or equipping, within its jurisdiction, of any vessel which it has reasonable ground to believe is intended to cruise or to carry on war against a power with which it is at peace; and also to use like diligence to prevent the departure from its jurisdiction of any vessel intended to cruise or carry on war as above, such vessel having been specially adapted, in whole or in part, within such jurisdiction, to warlike use; *second*, not to permit or suffer either belligerent to make use of its ports or waters as the base of naval operations against the other; or for the purpose of the renewal or augmentation of military supplies or arms, or the recruitment of men; *third*, to exercise due diligence in its own ports and waters, and as to all persons within its jurisdiction, to prevent any violation of the foregoing obligations and duties."

6. The liabilities and rights of neutral trade. By the rules set forth in the Declaration of Paris, a "neutral flag covers the enemy's goods with the exception of contraband of war," and "neutral goods, with the exception of contraband of war, are not liable to capture under an enemy's flag." The term "contraband of war" is used to denote articles which directly aid warlike operations. According to a formula adopted by the United States, the list includes all kinds of guns, fire-arms, ammunition, weapons, armor, military clothing, equipments for men and cavalry horses, and all instruments, of any material, manufactured and prepared for making war by sea or land. The right of blockade in time of war is universally admitted, but in general is available only for harbors, mouths of rivers, and limited districts of coast. As a blockade begins and ends at definite times, previous notification, of both its beginning and ending, must be given to traders and neutral governments. To be legal, it must be maintained by armed force sufficient to show that it is actual, and to prevent all ordinary and open attempts to pass it. All merely formal, or, as they have been called, paper blockades, like Napoleon's Berlin and Milan Decrees, and the two counter British Orders in Council in 1807, are regarded by International Law as futile and void. When a vessel is captured and found guilty of attempting to enter or leave a blockaded port, the penalty it incurs is the confiscation of itself and its cargo. In carrying out the international rules adopted concerning contraband goods, enemies' goods on enemies' ships, and blockades, search is often necessary to determine the nationality of the vessel and the nature of its cargo. It must be submitted to by the vessel, but it must not be so conducted as to give unnecessary annoyance. The right of search is a war right, applicable to merchant vessels only in time of war, and to those suspected of piracy at any time, inasmuch as piracy involving attack on the peaceful and unarmed, is held as war against the human race.

INTERNATIONAL SALUTE.—A salute of 21 guns to a national flag. This salute is the only one which is returned, and this is invariably done as soon as possible. The time intervening must never exceed twenty-four hours. The failure to return such salute is regarded as a discourtesy or lack of friendship justifying the other party in asking explanation. In the presence of the President of the United States, however, no salute, other than the *national salute*, and that specified for him, is to be fired. It is the custom for saluting vessels-of-war, upon anchoring in presence of a fort, to hoist at the fore the flag of the Country in whose waters they are, and to fire the first salute. A failure to do so is a proper subject for explanation. Notice of an intention to salute the flag is usually given by the vessel direct to the fort; but as giving notice involves delay, vessels frequently salute without it. Vessels mounting less than ten guns do not fire salutes requiring the guns to be reloaded. Surveying vessels, store-ships, or transports do not salute. If there be several forts or batteries in sight, or within six miles of each other, one of them is designated in orders to return international salutes. Either of the others receiving notice from a saluting vessel of intention to salute the flag, immediately notifies the one designated as the saluting fort, and informs the vessel of the fact. If a vessel salutes without giving notice, the fort designated as the saluting fort returns it. United States vessels return salutes to the flag in United States waters, only where there is no fort or battery to do so. United States vessels do not salute United States forts or posts. Salutes to the flag are in no sense to be considered as personal. See *Salutes*.

INTERVAL.—In drill, the lateral space between men or corps. The following are the usual intervals in line between the different branches of the service: 1. Between files when formed in squadron, 6 inches from knee to knee. 2. Between the guns of a battery in line, full intervals, 19 yards. 3. Between squadrons in line, the breadth of a division, but never less than 12 yards. 4. Between cavalry regiments in line, or between cavalry and infantry in line, as for squadrons. 5. Between battalions in line, 30 paces. 6. Between batteries in line, or between artillery and other troops, 28½ yards. 7. Between cavalry regiments in contiguous columns, as for squadrons. 8. Between battalions in contiguous columns, 12 or 30 paces, as ordered.

INTO GEAR.—For most pieces, the motion of the top-carriage to and from battery is regulated by a pair of truck-wheels, one on each side; which work on an eccentric axle placed underneath and a little in front of the axis of the trunnions. The wheels are thrown *into gear* by means of handspikes inserted into sockets upon the ends of the eccentric axle; the wheels then rest upon the top of the chassis rails; and only the rear part of the soles of the top-carriage rest on the chassis rails and have sliding friction. The wheels are thrown *out of gear* in the same manner; the entire soles then having sliding friction upon the chassis rails, thus checking recoil. In the 15-inch gun-carriage there are two pairs of truck-wheels, one pair being placed in front, as just described, and the other pair near the rear end of the carriage; the rear wheels only are on eccentric axles, and when these are *out of gear* the soles of the top-carriage rest fairly on the chassis rails, and the motion is on sliding friction. When the rear wheels are *in gear* the front wheels also touch the chassis rails, and the top-carriage moves on rolling friction. To prevent the rear wheels from working *out of gear* while the gun is being run from the battery, or jumping *in gear* when the piece is fired, pawls are provided for locking the rear axle. When the rear wheels are *in gear*, motion is communicated to the carriage by means of a handspike on each end of the front axle. This handspike carries a double pawl, which works in ratchets or cogs on the truck-wheels. The handspike is arranged with a counterpoise, consisting of a heavy piece of iron placed on the short arm of the lever. See *Out of Gear*.

INTRENCH.—To secure a position or body of men against the attack of an enemy, by digging a ditch or trench. An army may intrench itself either by a *continued* or an *interrupted line;* in the former case, the line may be composed of parts so connected as to leave no uncovered space between them; in the latter, those parts may be isolated from each other, and uncovered intervals left between them.

INTRENCHED CAMPS.—Troops, when within striking distance of the enemy, should, to avoid the consequences of a surprise, be encamped always in order of battle. The modern practice of armies is to intrench, if encamped even for one night. Such intrenchments are usually of the slightest and most hastily-constructed kind, merely sufficient to afford shelter against a night attack. The artillery in this case is only that usually accompanying troops on the march, and for it gun-pits will suffice. These are made by simply throwing up the earth in front of each piece so as to form for it a crescent-shaped epaulment. If rails or any similar material are convenient, a slight revetment may be constructed to support the earth on the side towards the piece. In dry weather the earth may be dug from the inside and thrown up in front, thus forming a depressed position or hole for the piece to stand in. The chest of the limber will hold sufficient ammunition for immediate use. To protect it, the limber is turned with its pole *from* the piece, and is covered with an epaulment similar to that for the gun; or, removing the horses, it may be backed up near to and on one side of the piece, occupying with the latter a portion of the gun-pit. The caissons, horses, and other material of the battery may be placed in some sheltered position a little way to the rear. The positions occupied by artillery on such a line ought to be those that would be selected for it on any well-arranged line of battle. When, in consequence of attack by the enemy, or of his threatening attitude, the Army stands upon the defensive, the slight intrenchments of a temporary camp are increased and strengthened until they become a strong *intrenched line of battle.* See *Field-service, Intrenchment, Line of Circumvallation*, and *Line of Countervallation*.

INTRENCHING-TOOL.—An implement used for intrenching. The value of a hasty intrenchment was well understood by the Roman legions, for they executed works of this kind, in the presence of an enemy, with wonderful skill and rapidity. "It was by moving earth that they conquered the world." Napoleon said. "There are five things from which the soldier must never be separated; his ammunition, his haversack, his rations for four days and an *intrenching-tool.*"

Never has the utility of rapid field intrenchments been so clearly demonstrated, as in our last war, and never have they been used with greater success. The skill shown in improvising serviceable intrenchments was really very astonishing; frequently, for want of spades they used knives, cans, bowls—in one word, anything that came to hand. The art of utilizing cover is of great importance, and the soldier who carries in compact form the means of erecting cover at will is indeed fortunate. Whether the soldier shall carry his intrenching-tool, or have it carried for him; whether only a portion of the troops should carry tools, or whether each soldier should carry his own, are questions now under discussion. See *Clitz Intrenching-tool, Farrow Knife-trowel and Tent-peg, Trowel Bayonet*, and *Zalinski Intrenching-tool*.

INTRENCHMENT.—In a general sense an intrenchment is any work, consisting of not less than a parapet and a ditch, which fortifies a post against the attack of an enemy. As a means of prolonging the defense in a regular work of permanent fortification, intrenchments are made in various parts, to which the defenders successively retire when driven in from forward works. Bastions are ordinarily intrenched at the gorge by a breastwork and a ditch, forming either a re-entering angle or a small front of fortification. Such a work across the gorge of the redan at Sebastopol caused the repulse of the British attack in Sept., 1855. A cavalier, with a ditch, is also an intrenchment. An army in the field often strengthens its position by intrenchments, as by a *continued line* of parapet and ditch, broken into redans and curtains, or by a *line with intervals*, consisting of detached works of more or less pretention flanking each other.

INTREPIDITY.—An unqualified contempt of death and indifference to fortune, as far as regards personal safety; a fearlessness of heart, and a daring enterprise of mind. According to Rochefoucault, intrepidity, especially with regard to military daring, implies *firmness* of character, great *confidence* of mind, and extraordinary *strength* of soul. Buoyed up and supported by these qualities (which are sometimes natural and sometimes acquired), men become superior to every emotion of alarm, and are insensible to those perturbations of the heart which the prospect of imminent danger almost always engenders.

INUNDATIONS.—This obstacle is formed by damming back a shallow water-course, so as to make it overflow its valley. To be effective, an inundation should be six feet deep. When this depth cannot be procured, trous-de-loup, or else short ditches, placed in a quincunx order, are dug, and the whole is covered with a sheet of water, which, at the ditches, must be at least six feet in depth. The *dams* used to form an inundation are made of good binding earth, or of crib-work of logs filled in with stone, gravel, and earth, or of successive layers of fascines and gravel. If the dams are to stand for some time they may be faced on the upper side with boards. They cannot, in general, be raised higher than ten feet; they need not be thicker than five feet at top, unless they are exposed to a fire of artillery, in which case they should be regulated in the same way as a parapet. The slope of the dam down-stream should be the natural slope of the earth; but up-stream the slope should have a base twice that of the natural slope. *Sluices* are made in the dams, in a similar manner to the sluices of a mill-dam, for the purpose of regulating the level of the water in the pool above, in case of heavy rains. *Waste-weirs* are also serviceable for the same purpose, but unless carefully made they may endanger the safety of the dam. The distance of the dams apart will depend on the slope of the stream. The level of each pool should be at least eighteen inches below the top of the dam, and the depth of water below each dam should be at least six feet. These data will suffice to determine the center line, or *axis*, of each dam.

Artificial inundations seldom admit of being turned to an effective use, owing to the difficulties in forming them, and the ease with which they can be drained by the enemy. But when it is practicable to procure only a shallow sheet of water, it should not be neglected, as it will cause some apprehension to the enemy. In some cases, by damming back a brook, the water may be raised to a level sufficient to be conducted into the ditches of the work, and render some parts unassailable. The ditches in such cases should be made very wide, and to hold about a depth of six feet. During freezing weather the ice should be broken in the middle of the ditch, and a channel of twelve feet at least be kept open, if practicable. The ice taken out should be piled up irregularly on each side of the channel; and, as a farther precaution against a surprise, water should be thrown on the parapet to freeze. In a system of inundations the dams should, as far as practicable, be built at points the least exposed to the fire of the assailed. The head of each dam on the side of the enemy should be secured from surprise by a redan, stoccade, or other defense, and the dam itself and its approaches should be swept by musketry and artillery.

Inundations must be made with great care and forethought. The nature of the soil and the time necessary to effect the required inundation must be particularly noticed. When the supply of water is small, evaporation and filtration may become very prejudicial. The quantity of water V furnished per second by a stream is found from the formulas, $V = w \times d \times v$; and $V = -.07 + \sqrt{.005 + 3233 \frac{w d i}{w + 2d}}$; in which w represents the width of bed, d the mean depth, v the mean velocity per second, i the fall. The volume of water may also be calculated by measuring the section of the bed, and multiplying it by the mean velocity. The mean velocity V' is found from the formula $V' = \frac{V + (\sqrt{V} - 1)^2}{2}$, in which V represents, in inches, the velocity at the surface. In ordinary weather, the evaporation varies from $\frac{1}{18}$ to $\frac{1}{12}$ of an inch per day, and filtration in common soil may be reckoned at one inch in 12 hours. It is quite dangerous in winter time to fill the ditches of fieldworks with water; and when a garrison is compelled to remain a long time in an inundated country, fever does more damage than the enemy. See *Accessory Means of Defense*.

INVALIDES.—Wounded veterans of the French Army, maintained at the expense of the State. Many of these old soldiers are quartered at the Hotel des Invalides, an Establishment in Paris. See *Hotel des Invalides*.

INVALID ESTABLISHMENT.—An Establisment in the Indian Army for the transfer of officers who may be declared to be unfit for further service. It consists of —1. The Invalid Battalion: for officers who, although disqualified for further active service, are still equal to the discharge of garrison duties. 2. The Invalid Pension List: for officers disqualified for both active and garrison duties, either from age, wounds, or decline of health. They are transferred to this list, as stated in the government order, "Provided their conduct and habits are such as not to affect the character of that Institution, which is designed as an honorable retreat to the worn-out or disabled but deserving officers." The several orders issued on the subject of this Establishment will be found in the regulations applicable to the European officers in India, part III., by the late G. E. Cochrane, Assistant Military Secretary, India Office, and in the orders issued by the Government of India.

INVALIDING.—A term signifying the return home or to a more healthy climate, of soldiers or sailors whom wounds or the severity of foreign service has rendered incapable of active duty. The man invalided returns to his duty as soon as his restored health justifies the step.

INVALIDS.—Worn out or maimed soldiers, or those who from permanent sickness are unable to remain in the Army. There are some invalids who from change of climate recover their health; these men join the ranks again. In the British service, disabled men are periodically invalided and sent home from India and the Colonies. Besides Chelsea Hospital, for the reception of worn out and disabled men, the Corps of Commissionaires is open to pensioned soldiers; whilst so attached, they can add to their livelihood by giving their services as messengers or watchmen. Many invalids, known as *Out-pensioners*, are allowed to reside where they choose. See *Soldiers' Homes*.

INVASION.—The hostile entrance or attack of an enemy on the dominions of another; the passing of the regular line of frontier of any country, in order to take possession of the interior.

INVENTORY OF EFFECTS OF DECEASED OFFICERS AND SOLDIERS.—In the United States Service, in case of death of any officer, the Major of his regiment, or the officer doing the Major's duty, or the second officer in command at any post or garrison, as the case may be, immediately secures all his effects then in camp or quarters, and makes and transmits to the office of the Department of War, an inventory thereof. The Articles of War also provide that in case of the death of any soldier, the Commanding Officer of his troop, battery, or company shall immediately secure all his effects then in camp or quarters, and shall, in the presence of two other officers, make an inventory thereof, which he shall transmit to the office of the Department of War.

INVERSION.—In tactics, the subdivisions of the unit have their habitual position in the order of battle. This is necessary, in order that the mechanism of the unit may have that simplicity and uniformity in which there will be no difficulty in its being comprehended and retained by ordinary minds, to the end that every movement may be executed with promptitude. Still cases may occur in which the requisite rapidity to meet an attack, or to move in a given direction, cannot be attained without changing the habitual order. Such cases are provided for by what are termed *inversions*, in which the subdivisions temporarily change places and parts.

Inversions are very important in the field, and they offer such great advantages, that Bonaparte strongly advised their employment in many circumstances. Our tactics admit the employment of inversions in the formations to the right and left in line of battle, and also in the successive formations, except in that of *faced to the rear into line of battle*.

INVESTMENT.—The main objects of this operation are to cut off all communication between the garrison and the exterior; to prevent succors of every kind from being thrown into the work; to sweep off every thing in its vicinity that might, in any way, be serviceable to the garrison; and, finally, to cover a close reconnoissance of the defenses by engineer and other officers. For a successful attainment of these ends, the investing force, which should be mainly if not solely composed of cavalry, moves upon the work with celerity and secrecy; and, after surrounding and securing all avenues to it, sends out detachments to scour the environs up to the very gates of the work, if practicable, and bring off with them, or destroy, all persons, cattle, provisions, etc., met with. A chain of posts and sentinels is in the meantime established in the best positions to prevent all access to the work, or egress from it; care being taken to select for the posts points which are not exposed to the artillery of the work, or are beyond its range. The posts occupied by the troops during the day-time, and termed the *Daily Cordon*, are shifted at dark, and points nearer the work are taken up, to form the *Nightly Cordon* and hem the work in more closely. The posts and sentinels for this purpose should be pushed as far forward as they can find shelters from the musketry of the defenses; and under their protection the reconnoitering officers should spare no efforts to gain an exact idea of all the ground exterior to the work, and of the character of the defenses. The main body of the besieging army, with the engineer and artillery siege-trains, follows closely upon the investing corps, to prevent the line taken up by the latter, which, from its extent, is necessarily weak, from being forced either by the garrison, or by strong detachments from without. The positions for the camps of the various corps are designated by the Commanding General, after a careful reconnoissance. These are placed beyond the range of the heavy artillery of the works, with their color fronts facing from the works; and, as far as practicable, on points favorable to the health and comfort of the troops, and the defense. Whenever natural obstacles, of marshes, rivers, etc., occur between the camps they must be crossed by good lines of communication, so that no impediment may be offered to the speedy concentration of the troops upon any point threatened from without. See *Siege*.

IRELAND.—The insignia of Ireland have been variously given by early writers. In the reign of Edward IV., a commission appointed to inquire what were the Arms of Ireland found them to be three crowns in pale. It has been supposed that these crowns were abandoned at the Reformation, from an idea that they might denote the feudal sovereignty of the Pope, whose Vassal the King of England was, as Lord of Ireland. However, in a MS. in the Herald's College of the time of Henry VII., the Arms of Ireland are blazoned azure, a harp or, stringed argent; and when they were for the first time placed on the royal shield on the accession of James I. they were thus delineated; the crest is on a wreath or and azure, a tower (sometimes triple-towered) or, from the port, a hart springing argent. Another crest is a harp or. The national flag of Ireland exhibits the harp in a field vert. The Royal Badge of Ireland, as settled by sign-manual in 1801, is a harp or, stringed argent, and a trefoil vert, both ensigned with the Imperial Crown.

IRISH BRIGADE.—A body of men who followed the fortunes of James II., and were formed into regiments under the Monarchy of France.

IRON.—This most important metal in ordnance constructions will be most conveniently considered under the two following heads: 1. *Chemistry of Iron.* Chemically pure iron is of so little general interest that we shall confine our remarks on the properties of this metal to those which are exhibited by bar or wrought iron. Its color is gray or bluish-white; it is hard and lustrous, takes a high polish, is fibrous in texture, and when broken across, exhibits a ragged fracture. It requires a very intense heat for its fusion, but before melting passes into a soft pasty condition, in which state two pieces of iron may, by being hammered together, be united or welded so completely as to form, to all intents and purposes, a single portion. At a red heat, it may be readily forged into any shape; but at ordinary temperatures it possesses very little malleability, as compared with gold and silver. In ductility, it stands very high, being barely exceeded by gold, silver, and platinum; and in tenacity, it is only exceeded by cobalt and nickel. Its susceptibility to magnetism is one of its most remarkable characteristics. At a high temperature, it burns readily, as may be seen at the forge, or (more strikingly) when a glowing wire is introduced into a jar of oxygen. In dry air, and at ordinary temperatures, the lustrous surface of the metal remains unchanged; but in a moist atmosphere the surface rapidly becomes oxidized and covered with rust, which consists mainly of the hydrated oxide of iron. At a red heat, iron decomposes water, and liberates hydrogen, the oxygen combining with the iron to form the black or magnetic oxide (Fe^3O^4), which occurs in minute crystals. This is one of the ordinary methods of obtaining hydrogen. The affinities of iron for most of the non-metallic elements are very powerful. The chief of the iron compounds are—

a. Oxides of Iron—Iron forms four definite compounds with oxygen—viz. (1), the *protoxide* (FeO), which is the base of the green or ferrous salts of iron; (2), the *sesquioxide* or *peroxide* (Fe_2O_3), which is the base of the red or *ferric salts;* (3), the *black* or *magnetic oxide* (Fe_3O_4), which is regarded by some chemists as a compound of the two preceding oxides; and (4), *ferric acid* (FeO_3). The *protoxide* cannot be obtained in an isolated form, but it forms the base of various ferrous salts, and combines with water to form a hydrate (FeO,HO), which, on the addition of an alkali, falls in white flakes. The most important protosalts of iron, or ferrous salts, are the carbonate, the sulphate, the phosphate, and the silicate. *Carbonate of Iron* (FeO,CO_2) exists naturally in various minerals, and may be obtained artificially by precipitating a soluble protosalt of iron with carbonate of potash or soda, when the carbonate falls in white flakes. On exposure to the air, it absorbs oxygen, and gives off carbonic acid, and is thus converted into the hydrated peroxide. *Sulphate of iron* (FeO,SO_3+7HO) is obtained by the solution of iron, or its sulphide, in dilute sulphuric acid; in the former case,

ATLANTIC
ST. GEORGE'S CHANNEL
LEINSTER
MUNSTER
KING'S COUNTY
QUEENS COUNTY
KILDARE
WICKLOW
CARLOW
KILKENNY
WEXFORD
WATERFORD
TIPPERARY
LIMERICK
CLARE
KERRY
CORK
GALWAY BAY
ARAN IS.
St. Johns (Newfoundland) 2165 Miles
New York 2700 Miles
Cork to Liverpool 263 Miles
Cork to London 605 Miles
From New York
WALES
St. Davids Hd.
St. Brides Bay
Longitude West 8 of Greenwich
10
9
7
6
53
52


IRELAND
SCALE OF MILES
0 5 10 20 30 40 50
Towns of upwards of 100,000 inhabitants shown thus
from 50,000 to 100,000
from 10,000 to 50,000
below 10,000
County Towns underlined
Railways shown thus
O C E A N
IRISH SEA
NORTH CHANNEL
SCOTLAND
DONEGAL
LONDONDERRY
ANTRIM
TYRONE
FERMANAGH
MONAGHAN
ARMAGH
DOWN
CAVAN
LOUTH
MEATH
WEST MEATH
LONGFORD
ROSCOMMON
SLIGO
LEITRIM
MAYO
ULSTER
CONNAUGHT
Belfast to Glasgow 129 Miles
Londonderry to Liverpool 235 Miles

there is an evolution of hydrogen, and in the latter, of sulphureted hydrogen. On evaporation of the solution, the salt is obtained in clear bluish-green rhomboidal crystals, containing seven atoms of water. This salt is commercially known as copperas or green vitriol. *Phosphate of iron* is obtained by precipitating a solution of a protosalt of iron with phosphate of soda, when a white precipitate of phosphate of iron is thrown down. All these salts, especially the carbonate and sulphate, are extensively used in medicine. *Silicate* and phosphate of iron occur naturally in several minerals. The *peroxide of iron*, termed also sesquioxide, red oxide, or ferric oxide, is obtained in an anhydrous form by igniting the protosulphate, and is known in the arts under the names *colcothar*, *crocus of Mars*, or *rouge*, according to the degree of levigation to which it has been submitted. It is employed for polishing glass, jewelry, etc., and is also used as a pigment. It occurs both in the anhydrous and in the hydrated form in various minerals. The *hydrated peroxide* ($2Fe_2O_3.3HO$) is obtained by precipitating a solution of a persalt of iron, or of a ferric salt, with an excess of potash, ammonia, or alkaline carbonate. It falls as a yellowish-brown flocculent precipitate, which when dried forms a dense brown mass. This hydrated peroxide of iron, when freshly prepared and suspended in water, is regarded as an antidote in arsenical poisoning. Rust, as has been already mentioned, is a hydrated peroxide, combined with a little ammonia. The most important of the persalts of iron, or ferric salts, are the neutral and the basic sulphate, whose formulæ are $FeO_2, 3SO_3$ and $Fe_2O_3, 3SO_2.5Fe_2O_3$ respectively, the nitrate ($Fe_2O_3.3NO_5$), the phosphate, and the silicate. The nitrate which is obtained by the solution of iron in nitric acid, is a useful medicinal agent. The *black* or *magnetic oxide* and *ferric acid*, which has not been obtained in a free state, and is only known as a constituent of certain salts, must be passed over without comment.

b. Haloid salts of iron—the chlorides, bromides, and iodides—next require notice. There are two chlorides—viz., a protochloride (FeCl) and a perchloride or sesquichloride (Fe_2Cl_3). The latter may be obtained by dissolving peroxide of iron in hydrochloric acid. The tincture of the sesquichloride of iron is perhaps more generally employed in medicine than any other preparation of this metal. The protiodide is an extremely valuable therapeutic agent.

c. There are probably several *sulphides* or *sulphurets of iron*. The ordinary sulphide is a protosulphide (FeS). It occurs in small quantity in meteoric iron. It may be obtained artificially by the direct union of the two elements at a high temperature, or by the precipitation of a protosalt of iron by sulphide of ammonium. It exists in glistening masses, varying in color from a grayish yellow to a reddish brown. It is insoluble in water, but in moist air becomes rapidly oxidized into protosulphate of iron. With acids, it develops sulphureted hydrogen. The bisulphide of iron (FeS_2) is the *iron pyrites* of Mineralogists, and the *mundic* of commerce. Under the latter name, it it used extensively in the preparation of oil of vitriol. There are also other sulphides of less importance.

2. *Manufacture of iron*—The increasing use of iron is a prominent characteristic of the present age, and every day sees some new application of it in the arts of life. Although the most useful of the metals, it was not the first known. The difficulty of reducing it from its ores would naturally make it a later acquisition than gold, silver, and copper. The reduction of the ore known as the black oxide of iron, however, has been carried on in India from a very early time. In Europe the rich specular and other ores of Spain and Elba were much used during the Roman period; in Greece, also, iron was known, though, as among the Romans, its use was subsequent to that of bronze. We are informed, too, by the Roman historians that this metal was employed by the ancient Britains for the manufacture of spears and lances. The Romans, during their occupation of Britain, manufactured iron to a considerable extent, as is evidenced by the cinder-heaps in the forest of Dean and other places. The rude processes then in use left so much iron in the cinders that those of Dean forest furnished the chief supply of ore to 20 furnaces for between 200 and 300 years. In those early times, the iron ores were reduced in a simple conical furnace, called an air-bloomery, erected on the top of a hill, in order to obtain the greatest blast of wind. The furnaces were subsequently enlarged and supplied with an artificial blast. Charcoal was the only fuel used in smelting till 1618, when Lord Dudley introduced coal for this purpose; but the iron-masters being unanimously opposed to the change, Dudley's improvement died with himself. It was not reintroduced till Abraham Derby, in 1713, employed it in his furnace at Coalbrook Dale. But as this method was not properly understood, the production of English iron declined with the change of fuel, till, in 1740, it was only three-fourths of what it had formerly been. About 10 years after this, however, the introduction of coke gave renewed vigor to the iron-trade, and then followed in rapid succession those great improvements in the manufacture which have given to the history of iron the interest of a romance. The introduction of Watt's steam-engine in 1770, the processes of puddling and rolling invented by Henry Cort in 1784, and the employment of the hot-blast by Neilson of Glasgow in 1830, have each been of inestimable service. The greatest improvement introduced into the iron manufacture in recent times is the process of Mr. Bessemer for the production of steel, patented in 1856. The "Siemens-Martin" method of making steel has also of late come into extensive use.

Iron ores are abundantly distributed all over the globe; the chief kinds being—1. Magnetic iron ore; 2. Red hematite, specular, or red iron ore; 3. Brown hematite, or brown iron ore; 4. Carbonate of iron, including spathic ore, clay ironstone, and blackband ironstone. The ore richest in the metal is the *magnetic*, or *black oxide of iron*. When pure it contains nothing but oxygen and iron, its chemical formula being Fe_3O_4, which gives 73 per cent. of iron by weight. It occurs in dark heavy masses of black crystals, and is found in the old primary rocks. Sweden is famous for this ore, and for the iron produced from it, which is esteemed the best in Europe. The celebrated mines of Dannemora, in that country, have been constantly worked since the 15th century. Russia, too, has great iron works in the Ural Mountains, which are supplied with this ore. So, also, have Canada and several of the American States, as Virginia, Pennsylvania, New Jersey, etc. The rock formations in which magnetic iron ore occurs very rarely contain coal, hence it is almost always smelted with wood-charcoal, which, as it contains no sulphur, is one great cause of the superiority of the iron produced from it. *Red hematite* differs from the last only in containing proportionally a little more oxygen, its formula being Fe_2O_3, that is to say, 70 per cent. of iron by weight. There are several varieties of this ore, but only two need be referred to. The first of these, *specular iron*, so called from its bright metallic luster, occurs in large and beautiful crystalline masses in the Island of Elba, where it has been worked for more than 2,000 years, and is likewise found in many other parts of the world. It is of a steel-gray color, assuming a red tint in thin fragments and when scratched. The other variety is *kidney ore*, whose origin is still a curious problem, as its deposits occur sometimes in veins and sometimes in apparently regular beds. Its characteristic form is in large kidney-shaped nodules, with a fine radiated structure. This shape, however, is only assumed in the cavities of massive deposits. Red hematite is sometimes called blood-stone. It is used for polishing metals, and yields a blood-red powder, used as a pigment. This valuable iron ore is found in many Countries, but in few places in greater abundance than at Whitehaven and Ulverstone, in England, where splendid masses of it occur, 15, 30, and even 60 feet in thickness.

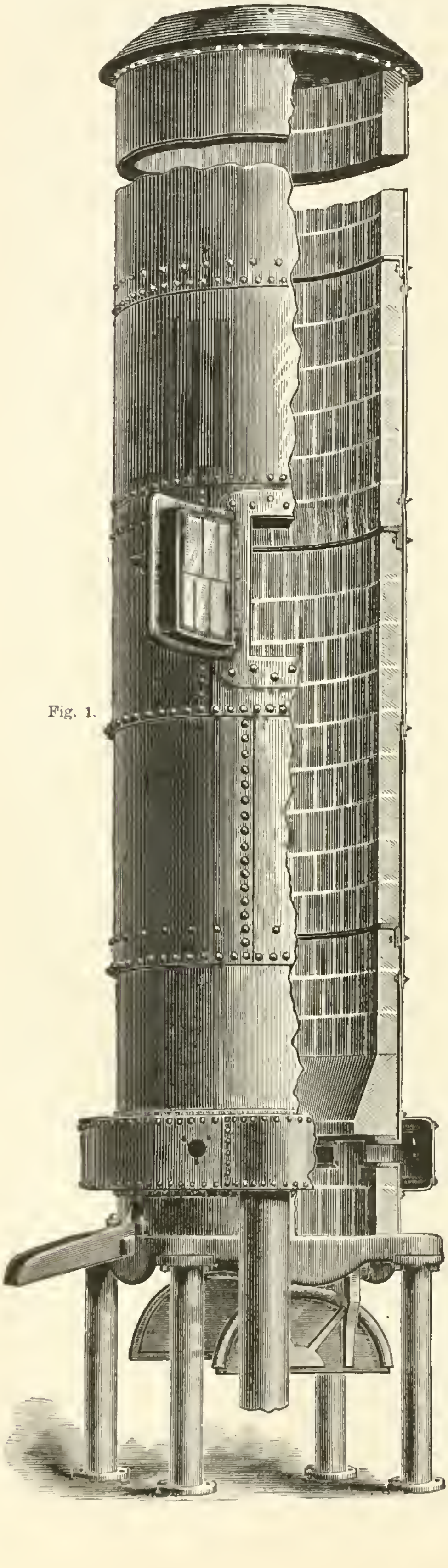


Fig. 1.

Brown hematite, or brown iron ore, is hydrated peroxide of iron, and has the same composition as red hematite, except that it contains about 14 per cent. of water. It is generally found massive, more rarely crystalline, and a variety occurring in small rounded nodules is called pea iron ore. When mixed with earth or clay, it forms the pigments yellow ocher and brown umber. Brown hematite is now an important ore in Great Britain, about 2,000,000 tons being annually raised. It occurs in different geological formations, chiefly in Devonshire, the forest of Dean, South Wales, and in Antrim, in Ireland ; also in an earthy form in Northamptonshire. It is the ore chiefly smelted in France and Germany. *Bog iron ore* is a variety of brown hematite, usually containing phosphorus, which occurs in marshy districts of recent formation. *Carbonate of iron*, when found in a comparatively pure crystallized state, is known as *spathic*, *spathose*, or *sparry iron ore ;* but when impure and earthy,as *clay ironstone* and *blackband ironstone*. Spathic ore was little worked in England previous to 1851, soon after which it was discovered in Somersetshire. It forms mountain masses in various parts of Prussia and Austria, and is now much in demand to yield the spiegeleisen required in the Bessemer process. In its purest form it contains 48 per cent. of iron; and in color it varies from white to buff or dark brown, some specimens of it taking a beautiful polish and looking like marble. The clay and blackband ironstones are essentially mixtures of carbonate of iron with clay, blackband having also a considerable proportion of coaly or bituminous matter. These dull earthy-looking ores occur abundantly in Great Britain, and form, after coal, the greatest of her mineral treasures. Fully one-third of all the ore mined in the country is obtained from the coal-measures, where fortunately both the fuel and the limestone, indispensable for the reduction of the iron, are also found. The ore occurs as balls or nodules in the shales, or in continuous beds. Some of these seams are full of fossil shells, and the ore is then called " musselband " ironstone.

Iron ore is still reduced to some extent in Europe by the old and imperfect process of the Catalan forge, not unlike a common smith's forge. In America. however, as well as in all other Countries where iron is largely smelted, the blast-furnace is now universally employed, by means of which the metal is obtained in the state of crude or cast iron. For the finer kinds of iron, charcoal is the fuel employed, because, unlike coal or coke, it contains no sulphuret of iron or other injurious ingredients. The Russian and Swedish furnaces smelt with charcoal, and on this, as much as on their pure ores, depends the high reputation of their iron. A solitary charcoal-furnace at Ulverstone in England, and another at Lorn in Scotland, are still working—the only relics of times past, when this was the only fuel employed.

As a preliminary process to the actual smelting in the blast furnace, clay and blackband ironstones are generally roasted. This is accomplished by breaking the ore into small pieces, spreading it in open heaps on the ground, and mingling it more or less with small coal according to the nature of the ore. Blackband commonly contains enough of carbonaceous matter to burn without the addition of coal. The pile, which may contain from one to several thousand tons of ore, is lighted at the windward end, and burns gradually along, aided by occasional fires in the sides, until the whole heap has undergone calcination, the time required for this purpose being generally about a month. Sometimes the operation of roasting is performed in close kilns instead of open heaps, a mode by which the ore is considered to be more uniformly roasted, and with considerably less fuel. Of late years, the kilns are often heated by the waste gases of the blast-furnace. By calcination, clay ironstone loses from 25 to 30, and blackband from 40 to 50 per cent. of its weight, the loss consisting chiefly of corbonic acid and water, but sulphur and other volatile substances are also dissipated in the process. The roasting also converts the protoxide and corbonate of iron into peroxide, which prevents the formation of any slags of silicate of iron, such slags, owing to the difficulty of reducing them, causing a loss of iron. In England the rich ores like the magnetic or red hematite are not subjected to calcination, but they are so in Sweden. The older type of blast-furnace consists of a massive tower of stone or brick-work strengthened with iron binders; the newer plan is to build it of comparatively thin brick-work, and surround it entirely with strong iron plates. In either case an inner lining of refractory fire-brick is given to it, which is separated from the outer portion of the wall by a narrow space filled with sand. Internally they vary very much in form, but perhaps the barrel shape is the most prevalent, and most of them contract towards the bottom in the shape of an inverted cone. Recent ones have been built from 80 to 100 feet in height, instead of not more than 60 as formerly. The blast-pipe, with its tuyere-branches, surrounds the hearth, and on one side there is a recess and openings for running off the metal and slag. Fig. 1. shows the construction of the Bigelow furnace or cupola, and will serve to illustrate the modern advancement in this line.

The operation of smelting is thus performed: The roasted ore, coal and lime (flux) are either hoisted, or, if the nature of the ground permits, moved along a platform or gangway to the gallery near the top of the furnace, and fed into it at intervals through the openings in the side, when the mouth is open, or by lowering the cone, when the mouth is closed. We may here state that the furnace is kept continually burning except when under repair. The materials are of course raised to a very high heat, and gradually fuse into a softened mass. The clay of the ironstone then unites with the lime to form a coarse glass or slag, the oxide of iron at the same time gives up its oxygen to the fuel, and allows the metal itself to collect on the hearth at the bottom of the furnace, united with from 3 to 5 per cent. of carbon, which it takes from the fuel, forming the variety called cast-iron. Every 12, and sometimes every 8 hours, the metal is run off from the furnace, by means of a tap-hole at the bottom of the hearth, into rows of parallel molds, called pigs, which are formed in the sand, hence the name "pig-iron." The slag which floats on the melted iron is run off by an opening at the top of the hearth. If the furnace is working well, the slag should be of a light-gray color; any dark-brown or black color shows that too much iron is passing into it. The quantity of materials necessary to yield a ton of pig-iron may be taken roundly as follows: 2 tons of calcined ironstone; 2½ tons of coal, of which about 8 cwts. are taken for the blowing-engine and hot-air pipes; and 12 to 16 cwts. of broken limestone. The proportions, however, vary in different districts according to the nature of the fuel and ore. The weekly produce of a single blast-furnace varies extremely —from under 100 to more than 500 tons in some of the larger furnaces.

Different districts classify their pig-irons in slightly different ways, but, as a rule, No. 1 to No. 4 are known as gray iron. No. 1 is largest and brighest in the grain, brings the highest price, and is best adapted for fine castings. Nos. 2, 3, and 4 become successively less in the grain, of a duller luster, and lighter in color, but up to No. 3 are known as foundry pigs. After No. 4 the metal ceases to be gray, and though higher numbers are sometimes employed, the other qualities are more usually known as forge, mottled, and white pig-iron. Gray iron has its carbon partly in the chemically combined, but chiefly in the uncombined or graphitic state, and requires a higher temperature to melt it than white iron, though very fluid when melted. White iron has its carbon wholly in the combined state, and is chiefly available for conversion into malleable iron. Hematite pig-iron suitable for making Bessemer steel has an exceptionally high value. The hot-blast process which has been described before was introduced in 1830 by Mr. James B. Neilson, of Glasgow, and has been productive of very remarkable effects on the iron trade. The whole invention consists in simply heating the air blown into the furnace, and yet the saving of fuel by this is about one half, and the production of iron, since it came into use, has enormously increased. The "cold-blast" is still, however, to a limited extent employed, and produces the strongest iron, though necessarily at a much higher cost. The difference in quality appears to be caused by the greater heat in the case of the hot blast facilitating the passage of impurities into the iron. Of late years much attention has been given to plans for saving fuel in the blast-furnace. Previous to the introduction of the hot-blast as much as 8 tons of coal, as coke, were consumed for every ton of pig-iron made. Even when this is reduced to under 3 tons of raw coal per ton of pig-iron, fully three-fourths of all the heat produced is still wasted in open-mouthed furnaces. The method of saving the waste gases by closing the mouth of the furnace, now generally adopted when coke is used is attended with so much economy, that, in the Cleveland district alone, over 600,000 tons of coal yearly are saved by adopting it. There being a difficulty in closing the mouth of the furnace when raw coal is used, Mr. Ferrie, of Monkland, a short time ago, patented a self-coking blast-furnace, by which, among other advantages, the gases can be saved. It has now been in use for some years in Scotland, and produces a ton of pig-iron with 34 instead of 53 cwts. of coal previously required. Raising the temperature of the blast from 900° to 1000° F. has also been attended with a saving, and so likewise, in some districts, has an addition to the height of the furnace.

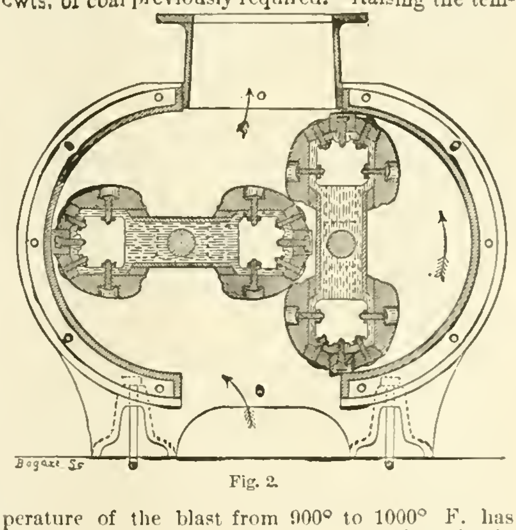


Fig. 2.

It will be readily understood that there is a certain degree of heat necessary to be maintained in a cupola to melt the largest amount of iron in the shortest time, with the least amount of fuel, as a ton of coal might be consumed without melting a single pound of iron if the temperature is not sufficiently elevated. It will be equally apparent, that any departure from the proper temperature, will just to that degree occasion loss in all these respects. To secure the best results, the proportions between the amount of iron to be melted, the fuel used, and the quantity of air supplied in a given time, should be fixed and unvarying. This can only be done by a machine giving a force blast, as with Blowing Cylinders, or Root's Rotary Blower, which measures and forces forward a definite quantity of air every revolution, so that when by experiment the maximum result is obtained, it can always be maintained at that point without any variation whatever. As a fan does not give a force blast, the quantity of air delivered varies with every change of condition, with the manner of charging the cupola, the kind of iron or fuel used, and the amount of stock in the cupola—but, more than by all other causes combined, the slag or cinders in the cupola. As it becomes foul, and the tuyeres become obstructed, the blast constantly diminishes, until melting in many cases entirely ceases, and it becomes necessary to drop the bottom. Thus the conditions absolutely necessary to secure uniform results can never be obtained with a fan blast, as no certain supply of air can ever be predicated upon the operation of a fan. A force blast, on the contrary, helps to keep the tuyeres open and free from obstruction; but in case of their being obstructed, the pressure is increased by the obstruction, and the same amount of air still continues to be forced through the diminished openings, and must continue to do so, or the machine must stop. With a fan this is not the case. Only a limited pressure can be obtained, and when this is reached, diminishing the outlet does not in the least degree increase the pressure, but rather the reverse. The Piston Blower undoubtedly gives a force blast, and, when properly arranged, is far superior to any species of fan whatever, but not nearly so good as the Rotary Blower for cupolas, for the following reasons, viz.: The blast is irregular and comes in puffs with every motion of the piston, and requires a large receiver to equalize the blast; this is both bulky and expensive. In addition to this, the machinery and fixtures are heavy and cumbrous, requiring a large amount of power to operate them. Besides, their cost is so great as to place them beyond the range of the large majority of establishments.

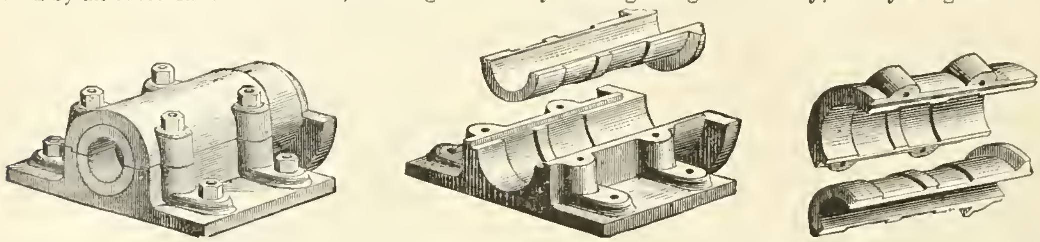


Fig. 3.

The importance of a force blast will be more fully realized when we consider the enormous amount of air required in the combustion of coal in melting iron. Accurate experiments have shown that about 33,000 cubic feet of air are consumed in melting a ton of iron, which, if reduced to a solid, would weigh about 3,600 pounds, or 1,200 lbs. more than both the iron and coal. The melting point of cast iron is about 2,800°, and a considerably higher temperature than this is required to render the iron perfectly fluid. Root's Rotary Blower is shown in section in Fig. 2. These famous Blowers have the improved arrangement for journal boxes, shown in Fig. 3. The box consists of two parts—the thimble or bearing, and the box proper. The bearings are made of phosphor or carbon-bronze. The thimble or lining is bored out to fit the journal with perfect accuracy, and is also turned off on the outside so as to be precisely concentric with the shaft. The box which holds the lining or bearing is also bored out to the exact size to receive the bearing, which is held from turning by set-screws in the cap. The advantages of this arrangement are that, if from gross neglect or inattention the journal-boxes have been allowed to cut or wear, and need renewal, it is only necessary to remove the cap and push the lower half of the bearing out, inserting the upper half or a new one in its place. This brings the shaft exactly in its original position, without any adjustment whatever. This arrangement obviates the necessity of taking the blower apart to renew the journal-boxes, as was necessary with machines built at an early date, thus saving much trouble and expense. It will be observed by an examination of the internal parts of this Positive Blower, as shown in Fig. 2, that it does not operate at all on the principle of a fan, that is, by imparting momentum to the air by running at a great velocity, but by a regular displacement of the air at each revolution, whether it runs fast or slow. When the air enters the case at the opening for induction, and is closed in by the wings of the revolvers, it is absolutely confined, and positively forced forward until brought to the eduction pipe, where it must be discharged or the machine stop if perfectly tight, as there can be no backward escapement of the air after it once enters the case, the contact being kept up at all times in the center of the blower between the pistons, or revolvers, thus preventing any escape of the air in that direction.

We pass now to the consideration of malleable or wrought iron. It differs from cast-iron in being almost free of carbon. The great object in the processes adopted for the conversion of cast into malleable iron, accordingly, is to deprive the former of its carbon. But it is also very desirable to get rid of deleterious ingredients, such as silicon, sulphur, and phosphorus, which latter are generally present in minute quantities in the cast-iron. The ordinary processes for the manufacture of malleable iron are *refining*, *puddling*, *shingling* or *hammering*, and *rolling*. The refinery consists of a flat hearth, covered with sand or loam, and surrounded with metal troughs, through which a stream of water is constantly flowing, to keep the sides from melting. The cast-iron is melted with coke on the hearth, and a blast of air kept blowing over it, which causes its carbon to unite with the oxygen of the air, and pass off as carbonic oxide gas. Oxygen also unites with silicon to form silica, and with iron to form the oxide. The silica of the sand uniting with oxide of iron, produces a slag of silicate of iron. The refined metal is finally run out in cakes on a bed of cast-iron, kept cool by a stream of water. Being only partially decarbonized by this process, it is next broken up for the puddling furnace. About 10 per cent of iron is lost in the refinery.

White pig-iron, or at least such kinds as contain carbon in the combined state only, are best suited for puddling, because they become pasty, and so more easily worked than gray iron containing graphitic carbon, which does not soften into this condition previous to fusion. It is only in some districts that the "refining" process is much used, in others a portion only of the puddling furnace charge is refined; and in making inferior kinds of malleable iron, the pig-iron is not previously refined at all. There are two ways of puddling now practiced; the first or older way best applicable to refined iron, is called *dry puddling*, and in it the decarburization is produced chiefly by a strong current of air passing through the furnace; the second or newer process, is called *wet puddling* or *boiling*, in which case the oxidizing of the carbon is effected chiefly by hematite, magnetic ore, basic slags, and other easily reduced materials, but to some extent also by the air. The operation of puddling, though differing in details according to circumstances, is in a general way conducted as follows: A charge of from 4½ to 5 cwts. of metal, including some hammer slag and iron scale, is placed on the bed of the furnace while still hot from previous working. In about half an hour, when the furnace is in working order, the charge is melted, and is then stirred or "rabbled" for a considerable time, when it begins to "boil" by the formation and escape of carbonic oxide, which forms jets of blue flame all over the surface. Gradually, as the carbon of the pig-iron is more and more oxidized, pasty masses of malleable iron separate, and these are removed in balls commonly weighing about 80 lbs., but sometimes larger. About an hour and a half is required to work off a charge, and it takes from 22 to 26 cwts. of pig-iron to produce a ton of malleable iron. Siemen's regenerative gas-furnace, in which inferior fuels can be utilized, is applied to puddling as well as to other metallurgical processes; and the more recent revolving puddling furnace of Mr. Danks is the most promising of any of the attempts yet made to puddle iron by mechanical means. The process immediately following the puddling or boiling is called "shingling," and consists in hammering the puddled balls with either the helve or steam-hammer, or in passing them through a *squeezer* till they are sufficiently consolidated, and the greater part of the cinders forced out. For a description of the steam-hammer, which is much used for heavy forgings as well as for shingling, see that head. Puddled balls which have undergone the process of shingling are called *slabs* or *blooms*. These are next passed through heavy rollers termed "forge" or "puddle-bar rolls," and reduced to the form of a flat bar. For all the better kinds of iron the bars thus treated are cut into short lengths, piled together, reheated in a furnace, and again passed through the forge rolls. Once more the iron is cut, piled, and heated, and is then passed through the "mill-train," consisting of what are termed the "bolting" or "rough rolls," and finally through the "finishing rolls." Both these sets of rolls in the case of plates and sheets are plain, but in the case of bars are grooved, so as to form them into the required shape, such as flat, square, round, octagonal, or T-shaped iron.

There is still another important variety of iron, viz., *steel*, the manufacture of which remains to be described. Steel differs from malleable iron in containing a varying proportion of carbon, usually from .5 to 1.8 per cent. When rich in carbon, it closely resembles cast-iron in composition, except that it is more free from impurities. Steel can be made by adding carbon during the direct reduction of a pure iron ore in a furnace or crucible, but the results of this method are scarcely ever uniform. The finer kinds of steel are still made by the old cementation process—that is, by the roundabout plan of first converting cast into malleable iron, by depriving the former of its carbon, and then adding carbon again by heating the iron with charcoal. In making any kind of steel, however, the getting rid of silicon, phosphorus, and sulphur is as important, and a matter of more difficulty than the securing of any required proportion of carbon. As blistered steel is full of cavities, it is necessary to render it dense and uniform, especially for the finer purposes to which steel is applied. By one method it is converted into what is called "shear steel." This is done by breaking the bars of blister steel into short lengths, heating them in bundles, and partially welding with a forge-hammer. The rod so formed is heated again, and now brought under the action of the tilt-hammer. Here, by a succession of blows, it is formed into bars, which are much more compact and malleable than blister steel, and consequently better fitted for edge-tools and the like. If the single-shear steel is doubled upon itself, and again welded and drawn into bars, it is called double-shear steel. By another method, viz., that of melting the blister steel in fire-clay crucibles, and casting it into ingots, "cast-steel" is made. This is the best kind of steel, being finely granular, homogeneous, dense, and well adapted for the finest cutting instruments.

Steel is now largely made directly from pig-iron by puddling, much in the same way as that process is applied to the production of malleable iron. By another plan (Uchatius's process), pig-iron is granulated and heated in a crucible with the oxides of iron and manganese, and fire-clay, the result being cast-steel. This process has succeeded well in Sweden. The Siemens-Martin process consists in melting pig-iron along with malleable iron and Bessemer steel scrap, about 7 per cent of spiegeleisen being added towards the end of the process. The operation is conducted in the Siemens regenerative furnace, and the product in this case is also cast-steel. There are also several modes of manufacturing steel direct from the ore, such as by the old way in the Catalan forge, and by Chenot's process, in which hydrocarbons are used. It would appear from the results of recent experiments made on the large scale at Middlesborough, that Messrs. Thomas & Gilchrist have succeeded, by a comparatively simple device, in practically eliminating the phosphorus from Cleveland pig-iron during the conversion of the latter into steel in the Bessemer converter. The great importance of this discovery will be at once understood when we state that the Cleveland iron is the cheapest in Great Britain, and that the Cleveland ore yields one-fourth of all the iron made in the Country. Hitherto it has not been remunerative to make steel from this pig-iron on account of the exceptionally high percentage of phosphorus it contains, and the difficulty there has been of removing an ingredient so deleterious to steel. Success, however, has at length been achieved by obtaining, through the use of lime and oxide of iron, a basic slag in the converter, and by lining this vessel with bricks made chiefly of magnesian limestone, fired at a very high heat. A basic lining is given to the converter instead of the ordinary siliceous one, which is acid, and so a base is furnished with which the phosphoric acid can combine without the certainity of the lining being eaten away by the basic slag, as would be the case when this lining is siliceous. It is only as respects the nature of the slag in the converter, and the kind of lining used for this vessel, that Thomas & Gilchrist's mode of making steel, as far as it has yet been tried, differs from Bessemer's; except that for the latter a high-priced pig-iron is required. Of course steel can be made by the new process from other low-priced irons besides Cleveland.

We will now take a glance at the properties of each of the three principal kinds of iron, and the purposes to which it is chiefly applied. *Cast-iron*, as the crudest, cheapest, and most fusible, is used, as a general thing, for the heavy portions of all engineering and ordnance work, such as the bed-plates for machines, cylinders, columns, cisterns, low-pressure boilers, water and gas pipes, rollers, girders, and a large variety of the like. A large quantity is also consumed in the manufactnre of "hollow-ware," which includes pots, pans, and other cooking vessels. For all kinds of ornamental objects, again, it is almost exclusively used, because here its property of being readily cast into molds gives it a great advantage on the score of cheapness. *Malleable* iron differs considerably in its properties from cast iron. The latter is practically incompressible, but it can be comparatively easily torn asunder. Malleable *iron*, on the contrary, possesses great tenacity; it is, moreover, very malleable and ductile, especially at a high temperature, so that it can be rolled into sheets as thin as paper, or drawn into the finest wire. Further, it possesses the valuable property of welding—that is, two pieces can be completely united together by hammering at a white heat. Malleable iron is largely employed for the innumerable variety of articles included under the general term "hardware," such as locks, keys, hinges, bolts, nails, screws, wire-work, and the so-called tin-plate, which is merely sheet-iron dipped in melted tin. It is the mainstay of the railways and the electric telegraph, and has almost displaced timber as a material for steamships and sailing-vessels. It is also much used for roofs and bridges of large size. Rolled armor-plates for war-ships and fortifications are now made of malleable iron from 5 to 22 inches thick. *Steel* possesses several valuable properties which do not belong to either cast or wrought iron. It is harder, denser, and whiter in color. It is also more elastic, takes a higher polish, and rusts less easily. Like malleable iron, it is also weldable. But its most characteristic property consists in its admitting of being tempered at will to any degree of hardness. If, for instance, a piece of steel be heated to redness and plunged into water, it is made hard and brittle; but if it be again heated and slowly cooled, its original softness is restored. By gently reheating the steel it will acquire a gradation of tints indicating various degrees of hardness, beginning with pale straw color, and passing successively to full yellow, brown, purple, and finally blue. The straw color is the result of a temperature of 440°, and the blue 570° F., the former being the hardest and the latter the softest tempering. The use of steel is no longer confined to such small articles as files, edge-tools, knives, etc. By means of improved machinery and processes, steel is at present manufactured on a scale that was little dreamed of thirty years ago, so that such objects as field-guns, heavy shafting, tires, rails, armor-plates, and the like are now being made of this material. The superior tensile strength of steel, which is about double that of malleable iron, gives it a great advantage where lightness is required. Large numbers of steamships are now building of steel. See *Cannon-metals*, *Cast-iron*, *Metallurgy*, *Piling*, *Puddling*, *Rolling-mill*, *Smelting*, *Steel*, *Welding*, and *Wrought-iron*.

IRON-CLAD OATH.—An oath of allegiance prescribed by Statute of the United States, for those taking office under the National or State Government, in accordance with the provisions of the 14th Amendment to the Constitution. The oath as administered reads as follows:

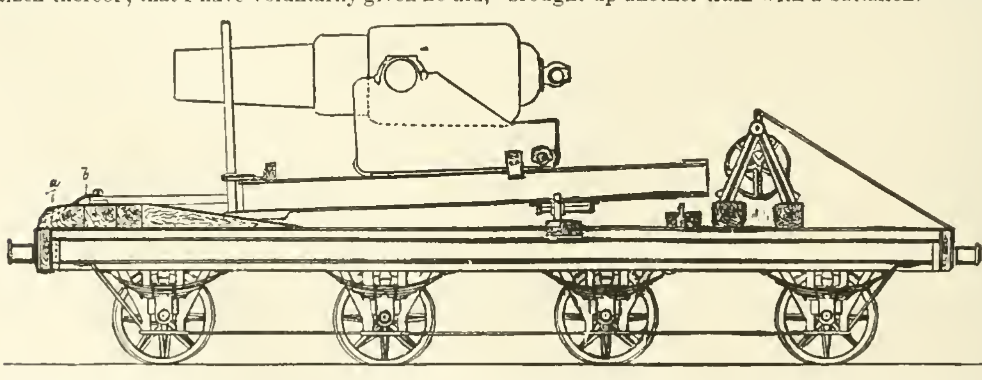
"I, ————, residing at ————, do solemnly swear that I have never voluntarily borne arms against the United States since I have been a citizen thereof; that I have voluntarily given no aid, countenance, counsel, or encouragement to persons engaged in armed hostility thereto; that I have neither sought, nor accepted, nor attempted to exercise the functions of any office whatever under any authority or pretended authority in hostility to the United States; that I have not yielded a voluntary support to any pretended government, authority, power, or constitution within the United States, hostile or inimical thereto. And I do further swear that, to the best of my knowledge and ability, I will support and defend the Constitution of the United States against all enemies, foreign and domestic; that I will bear true faith and allegiance to the same · that I take this obligation freely, without any mental reservation or purpose of evasion; and that I will well and faithfully discharge the duties of the office on which I am about to enter. So help me God."

Sworn to before me, this —— day of ——, 188—.

U. S. Commissioner.

This oath is still administered to officers under the U. S. Government, but its application has been restricted by special Acts of Congress, relieving, in certain instances, classes and individuals from the effect of its provisions.

IRON-CLAD TRAINS.—Trains were utilized as a means of reconnoitering during the American war of Secession, and during the war of 1870-71, in Europe, but no heavier guns than those usually employed as field artillery were mounted on them. Recently, however, it has been demonstrated that guns as heavy as a 40-pounder may be mounted and fought on trains with satisfactory results, there being little or no straining in either the trucks or rails. Experience has shown the following to be the best way of making up the train: 1st truck, empty, so as to guard against the line being mined. 2d truck, a machine-gun in front, spare rails for repairing the line. 3d truck, spare rails, bowls, chairs, etc., for repairing the line. 4th truck, 40-pr. gun and crew. 5th truck, ammunition wagon. This is protected all round by thin iron, and the magazine is covered in front by a pile of short railway iron a little higher than a powder-case. On each side is a baulk of timber, and on top a layer of rails, three or four of which are bolted down. The powder is in half metal-lined cases. This truck also contain fuses, tin cups, tools, four cases of wet and one of dry gun-cotton, Bickford's fuse, detonators, lantern and candles, slings for lifting the guns and carriage, bearers for the gun, a collapsible boat, stretchers, and arm-racks for the covering party of twenty-eight men. 6th truck, protected with thin iron plates, carrying two Gatlings with their crews. 7th truck, two 9-prs. with their limbers, two 7-prs. and their crews. 8th truck, steam-crane. 9th engine, protected with railway iron laid horizontally along the boiler, $\frac{1}{4}$-inch and $\frac{3}{4}$-inch iron plates round the working parts, and sand-bags. 10th truck, protected by iron plates, carrying the covering party, and with a Gatling in rear. A reserve engine always followed, usually on the other line, and if necessary brought up another train with a battalion.



During the recent Egyptian Campaign, the English mounted a 9-inch Armstrong M. L. R. gun in the manner described, and shewn in the drawing. A truck, which had been constructed some time back to transport a 26-ton boiler from Alexandria to Suez, was found in the store and appropriated. It was longer than the ordinary trucks, and much stronger built, running on eight wheels close together, and with especially constructed springs. Three baulks of timber were placed across the front part of the truck, and bolted through the floor. A $\frac{3}{4}$ inch iron plate, two feet wide, was bent over these, and bolted to the bottom of the truck, and in the center fo this platform the pivoting bolt *a* was placed. As a support a piece of ¾-inch iron, four inches wide was fixed to the top of the bolt, when the bars were in position, and also bolted under the carriage, *b*. The slide, which was of the land service pattern with high rollers, had to be cut down so as to bring the weight as low as possible. The rollers were taken off and the axeltrees cut. An extempore rear-axle was made out of a bar of iron, and the rear rollers of a 10-inch gun carriage were used as rear-slide rollers, the fore part of the slide working without rollers, on an iron skid plate. The rear rollers were so far forward that the slide was very liable to tip up when the gun recoiled —in fact, several guns were disabled in the forts during the bombardment in this manner. An arrangement was therefore fitted to the fore part of the slide which prevented this, and, at the same time, allowed lateral motion to the slide for training. In rear of the rear-slide rollers a baulk of timber was placed, projecting about two feet on either side, with bolts for the training tackles, *c*. When the gun was out and the training on, a wedge was driven in between this baulk and the rear of the slide, so as to take some of the weight of the gun on recoil off the rear axle, which was rather weak, and also to distribute the weight more evenly over the truck. In order to run the gun in, some sort of a purchase was necessary, and nothing could be found to answer the purpose better than the crab of the Moncrieff gun at Fort Ras-el-tin. The gun was then mounted by a crane, and everything worked satisfactorily. About 58 of training was obtained on either side, which in this case was sufficient to cover the principal works at Kafr-Dowar, particularly as there was a sharp bend in the line, and a very much larger arc could be covered by a judicious selection of points to fire from. See *Railway Communications*.

IRON CROSS.—A Prussian order of knighthood, instituted on Mar. 10, 1813, by Frederick William III., and conferred for distinguished services in the war which was then being carried on. The decoration is an iron cross with silver mounting. The grand cross, a cross of double the size, was presented exclusively for the gaining of a decisive battle, or the capture or brave defense of a fortress.

IRON CROWN.—The crown of the ancient Longobardian Kings, given according to an unauthenticated tradition, by Pope Gregory the Great to Queen Theodolinda, and preserved till lately in the Cathedral of Monza. Henry, in 1311, is the first German Emperor who is known to have worn it. It was removed by the Austrians to Vienna after 1859, but was presented to the King of Italy in 1866. The outer part of the crown consists of a golden hoop, with enameled flowers and precious stones, in form like an ancient diadem, within which is a thin plate or fillet of iron, which is declared by a tradition long opposed by the Church at Milan, but adopted by the Congregation "*dei sacri riti*" at Rome, to have been hammered from one of the nails of the true cross. When Napoleon I. was elected King of Italy in 1805, he took this relic and crowned himself with it, disdaining to receive it from the hands of a Bishop; and at the same time he founded an order of knighthood, taking its name from the Iron Crown. The order—forgotten after the fall of Napoleon—was restored and remodeled in 1816 by the Emperor Francis I., who gave it the name of the Austrian Order of the Iron Crown.

IRON CYLINDER GAUGE.—An instrument adapted for testing the body, studs, and pitch of rifling of muzzle-loading projectiles, at one operation. When

	Diameter over body.	Diameter over studs.	Diameter low over studs.
	Inches.	Inches.	Inches.
16-pr.	3·58	3·812	3·795
9-pr.	2·98	2·212	—
7-pr.	2·98	3·182	3·165

the present number of this nature of gauge is used up, *iron ring gauges* will be introduced for general issue; the cylinder gauges being restricted to stations of inspection. The foregoing are the dimensions of the gauges for rifled field guns.

IRON FILINGS.—Small portions or particles of iron rubbed off by the act of filing; they are used in the manufacture of fireworks and for other purposes.

IRONS.—Shackles of iron into which the ankles of a prisoner are fixed, and which slide on a long iron bar. Refractory soldiers, who evince violent behavior, and become unmanageable, are commonly put in irons, several being placed side by side along the same bar. In cases of extreme violence the wrists may be similarly treated, but instances of this latter punishment are rare. The punishment of "putting in irons" is more common in the Navy than in the Army. Commonly called *Bilboes*.

IRONSIDES.—A Cuirassier. The term is specially applied to Cromwell's Cavalry. As Captain of a troop of horse, Cromwell exhibited astonishing military genius; and against the men trained by himself —"Cromwell's Ironsides" the battle-shock of the fiery Rupert, which at the beginning of the parliamentary struggle none else could withstand, spent itself in vain.

IRREGULAR FORTIFICATION. Those in which, from the nature of the ground or other causes the several works have not their due proportions according to rule; irregularity, however, does not necessarily imply weakness.

IRREGULARITY.—A violation of the customs of service—a deliquency which is subject to censure, but not serious enough to be brought before a Court-Martial.

IRREGULAR SITES.—The problem presented for solution to the engineer in irregular sites is frequently one of no ordinary complexity; demanding a minute and laborious study of the natural features of the position in their relations to the defense; connected with a tentative process of which the object is so to modify the plan, relief, and details ordinarily adopted, as to adapt them in the best manner to the given position. No rules but of a very general character can be laid down for the guidance of the engineer in such cases. The more plunging the fire of the work, the more efficacious will it prove to be. The efficiency of this fire will depend upon two causes: 1. The command of the work over the point to be attained. 2. The direction of the ground with respect to the lines by which it is swept.

As to the command of the work over the exterior ground, it has already been shown that motives of economy restrict it, in most cases, within very narrow limits, where, to obtain it, artificial embankments have to be employed.

To augment, therefore, in the greatest degree this element of the defense, advantage should be taken of the natural features of the locality, by placing the principal lines, from which the exterior ground can be seen, on the most commanding points of the site.

If, with this position given to the principal lines, the ground swept falls or slopes towards them, a most favorable combination for an efficacious plunging fire will be obtained; for, with this direction of the ground, the enemy will meet with far greater difficulty, to put himself under shelter by his works, than where the ground falls or slopes from the line by which it is swept; as the surface, in the latter case, descending in the rear of the cover thrown up by the enemy, will be screened to a greater extent than in the former, where it rises in rear of the cover. When this, however, cannot be effected, the next best thing to be done is so to place the principal lines with respect to the surface to be swept that it shall be seen by a part of these lines, thus bringing to bear upon it a flank fire from these parts.

The general rule, therefore, which the engineer is to take as a guide, in order to satisfy the condition of bringing the exterior ground under an efficacious fire from the work, is:

1. To place the principal lines of his work on the

most commanding points of the site, and in such directions as to bring the exterior ground to be swept in a position sloping towards these lines in such a manner that they can bring their entire fire to bear upon it, or else bring a portion of it to sweep it in front.

This will generally be best effected by placing the salient points of the work on the most commanding and salient points of the site; as, in this position of the salients, the faces, which are usually the principal lines bearing on the exterior ground, will occupy the salient and commanding portions of the site, whilst the re-enterings, being thrown on the re-entering and lower portions of the site, will be in the best position for sweeping the ground immediately in the advance of the faces by a flank fire: and at the same time these re-enterings will be masked by the faces from the enemy's view, and thus preserved from serious injury up to the moment when their action may be rendered most effective; that is when the enemy, despite the fire from the faces, has succeeded in planting himself upon point on which this fire cannot longer be brought to bear. To carry these precepts into practice, a wide margin is left to the engineer's judgment in which he will find it necessary in some cases to extend the lines of his works beyond what a strict regard to economy might prescribe, so as to include within his defenses ground from which he can best sweep what is exterior to it, or which, being occupied by the assailant, might make his own position less tenable, in this way necessarily forcing him to extend out his lines so as to embrace all the crests within them that overlook the valleys beyond them; and in very many cases to throw his own lines further back in order to avoid enfilading or plunging views from points which are too, far to be brought within his defenses. 2. The condition of leaving no dead spaces, that is, no point of the defenses unguarded by their fire, will depend in a great degree for its fulfilment on the same rule as the preceding. But where both conditions cannot be satisfied, the distant defense should be sacrificed to the near; as upon the latter the more or less of obstinacy of resistance depends; since the fire of the work and the action of the garrison are the more effective as the point to be guarded is the nearer to the defenses. 3. The condition that the troops and materiel within the defenses shall be sheltered from the enemy's fire, from all commanding points without, will depend upon the relative positions of the principal lines and the exterior commanding points; and as far, therefore, as it can be done, without sacrificing either of the preceding and more important conditions, the plan of the work should be so arranged that the principal lines shall present themselves in the most favorable direction to the exterior ground to avoid plunging, enfilading, or reverse views upon their terre-pleins from any point of it. To effect these objects, when the work is in the vicinity of commanding heights within cannon range, and the crests of these heights, as seen from the work, present a nearly horizontal outline, the principal lines of the work, fronting the heights, should receive a direction as nearly parallel as practicable to that of the commanding crests. When the outline of the crests presents a nearly continuous line, but one which declines or slopes towards the site of the work, the principle lines towards the height should receive a direction converging toward the point where the line of the crests, as seen, if prolonged, would join the site. The reasons for the positions assigned to the principle lines in these cases respectively, may not, at a first glance, be obvious; but by examining the relative positions of the crests of the heights and of the principal lines, as here laid down, it will without difficulty be seen that they can be brought in the same plane, and the latter be so placed as to give a nearly uniform command to the parapets of the principal lines over the site; and that by keeping the terre-pleins of these lines in planes parallel to the one in which the crests of the heights and those of the parapets are held, and at suitable levels below it, the parapets will be made to cover the terre-pleins from the fire of the heights in the simplest manner. The foregoing general methods for determining the direction of the principal lines fronting commanding heights, so as to cover from direct fire, in the easiest manner, by their parapets, the space to the rear, occupied by the troops and *materiel*, present, at the same time, the simplest cases of the adaptation of the plan of a work to the features of the locality, to subserve the object in view. In most cases, all that can be done is to avoid giving such directions to any of the principal lines, as shall be favorable to enfilading or reverse views of the enemy; which may be effected by so placing them that their prolongations shall fall on points where the enemy cannot establish his works; or those which, if occupied by him, will afford disadvantageous positions for his batteries either for enfilading or reverse fires. As the attack derives its great advantage from its enveloping position, by which enfilading views and a concentrated fire can be brought to bear on the assailed point, so, in the general disposition of his defenses, the engineer should endeaver ro reduce these salient and assailable points to the fewest number, and to accumulate upon them such surplus strength that in spite of their natural weakness they will cost their assailant a great deal of time and a large sacrifice of means to get possession. This consideration has led engineers to propose for the general outline of their defensive polygon a triangle in which the principal development of their work being a number of fronts on a right line, they can neither be enveloped nor their principal lines be enfiladed by the assailant's trenches, thus leaving only the three angular points as assailable, and which they propose to strengthen by an accumulation of works upon them. See *Fortification*, and *Permanent Fortification*.

IRREGULAR TROOPS.—Troops which, though in the pay of a nation, do not belong to the regular forces. In the British army there are no such troops. In India there are two or three irregular forces, composed of cavalry and infantry, for the protection of native states. The present native cavalry regiments in her Majesty's Indian army were originally raised as irregular troops. They found their own horses, arms, clothing, etc., for which they received a certain monthly sum; but this has been modified of late years, and they are no longer styled irregular cavalry.

ISABELLA.—The Order of Isabella the Catholic is a Spanish Order of Knighthood founded by Ferdinand VII. in 1815, as a reward of loyalty, and for the defense of the possessions of Spanish America. It is now conferred for all kinds of merit. The Sovereign is the head of the Order, which is divided in to the three classes of Grand Crosses, Commanders, and Knights.

Order of Isabella the Catholic.

IHSOCHRONISM.—A pendulum is isochronous when its vibrations are performed in equal times, whether these vibrations be large or small; but it can only possess this property by being constrained to move in a cycloidal arc. This is managed by causing the string to wrap and unwrap itself round two equal cycloidal cheeks, the diameter of whose generating circle is equal to half length of pendulum. Isochronism is closely approximated in practice by causing the pendulum to describe a very small circular arc.

ISOLE.—A word used among the French, to express any thing which is detached from another. It is variously applied in fortification: As, for instance, a parapet is said to be *isole* when there is an interval of 4 or 5 feet existing between the rampart and its wall, which interval serves as a path for the rounds.

ISOMERISM.—Isomeric bodies may be considered as naturally divided into physical isomers and chemical isomers. The physical are more strictly or perfectly isomeric than the chemical, and on account of their similar molecular or radical composition when they are subjected to the action of different forces or reagents exhibit the same behavior. Thus there are several hydrocarbons known as terpenes, having the composition $C_{10}H_{16}$, as the oils of lemon, bergamot, and turpentine, which show the same reactions under the influence of chemical agents, except their difference of odor and action or polarized light. Chemical isomers merely, do not carry their isomerism so far, for although they may have the same proportion of elements, and also the same molecular weight, they do not exhibit the same behavior under reagents. Thus, the molecular formula, $C_3H_6O_2$ represents three different bodies which decompose differently when acted upon by caustic alkalies, proprionic acid, C_3H_5O,HO, being converted at common temperatures into proprionate of potassium, C_3H_5O,KO. Acetate of methyl, C_2H_3O,CH_3O, is not changed at ordinary temperatures by caustic potash, but when heated with it, acetate of potassium and methylic alcohol are produced. Again, formate of ethyl, CHO,C_2H_5O, when heated with caustic potash, is changed into forate of potassium, CHO,KO, and ethyl alcohol, C_2H_5HO. These chemical isomers are the metameres mentioned in the preceding article, their behavior depending upon the manner in which organic radicals enter into their composition. Another class of these bodies are called polymeres.

ISOMETRIC PROJECTIOM.—A kind of drawing used by engineers for purposes of construction. It is an orthographic projection in which one plane or projection is employed, and therefore the measurement is without regard to the rules of perspective, the plane of the drawing being supposed to be at an infinite distance from the eye. It is used to delineate structures whose principle lines are parallel to three rectangular axes, and the plane of projection makes equal angles with these axes, which are called coordinate axes, and the planes, taken two and two, are called co-ordinate planes. The plane of projection passes through the point of intersection of the three axes, and this point is the center of projection. The projections of the co-ordinate axes are the directing lines of the projection, and form equal angles of 1208 with each other.

ISSUE.—A term applied to the distribution of rations and supplies. In the British service, *issues* are certain sums of money which are, at stated periods, given to public accountants for public service; and for the honest distribution of which, every individual so intrusted is responsible to Parliament. *Regimental issues* are moneys paid by regimental agents, acting under the authority of their respective Colonels, for regimental purposes.

ITALIAN ARMY.—Italy, like most of the Continental Nations, has adopted the compulsory system in raising her Army, similar to France and Germany. The yearly contingent is put down at 100,000 men, 70,000 of which serve in the first category or active army. In this, they remain for 3 years (in the cavalry 5 years); 5 in the reserve of the active Army, and 4 in the *mobile milizia*. The length of service therefore is altogether 12 years, and the age of joining the colors is 18 years. The men who have not been called to do duty in the active service form the second category, in which they have to serve 5 years in the reserve of the active army and 4 in the militia. They are only assembled for a few months every year. By the law of the 30th September, 1873, Italy is divided into 7 military commands or army corps, five of which have 2 and two 3 military territorial divisions. Each military division consists of from 1 to 6 military districts, giving a total of 16 territorial divisions and 62 military districts. Further, the kingdom is divided into 6 commands of artillery, of 1 or 2 divisions each (total 12) and into 6 commands of engineers of 2 or 3 divisions (total 16). The land territorial forces comprise the *permanent army* and the *mobile milizia*. The *permanent army* consists of the staff, the artillery, and engineers, the infantry, the cavalry, a corps of *gendarmerie*, and the civil departments (commissariat, medical administratives, etc.) The *mobile milizia* comprizes 232 battalions of infantry, 24 companies of rifles, 15 companies of *bersaglieri*, and 40 companies of field and 20 batteries of siege artillery, together with 10 companies of engineers. By this system, it is computed that Italy can place under arms the following numbers: Active army, 395,951; Reserve, 148,004; *Mobile milizia*, 279,-872; total, 823,827 men. These forces in war time are organized into 20 divisions, forming 10 *Corps d'Armée*.

ITALIAN SYSTEM OF FORTIFICATION.—A system of fortification constructed on the interior polygon. The front, from 250 to 300 yards, was divided into six equal parts: the flanks perpendicular to it were equal to ⅙, and the curtain to ⅝ of the whole length. The flanks were perpendicular to the curtain because fortresses were not unfrequently attacked on the curtain before the invention of the ravelin; and the faces of the bastions were directed so as to receive flank defense from the curtain. The ditches were deep and wide, with counterscarp parallel to the faces of the bastions and marking part of the flank defense. The revetments were high, from 40 to 50 feet, rather massive and much exposed, since the besiegers could see from 15 to 17 feet of the masonry from a distance.

ITINERARY.—A rough sketch of the country through which troops have to march; giving the roads and villages; noting the number of inhabitants and houses, whether of stone, brick or wood; and conveying as much information of the country as can be gathered in a short space of time.

In the United States Army, the Commanding Officer of every body of troops ordered to march selects a competent person—preferably a Commissioned Officer—to whom is intrusted the special duty of making the field-notes and sketches, and keeping the journal necessary for the preparation of a map and report of the route traversed. The person so selected is, if possible relieved of a part of his routine duties to enable him to give due attention to this subject. The Commanding Officer daily, or more frequently if necessary, inspects and verifies the notes and journals. If there be no competent subordinate to perform the duty, the Commanding Officer himself makes the notes and keeps the journal. When a detachment leaves the main column, the point on the "*route*" is noted, and the reason given in the *remarks*. The Commander of the Detachment sees that the notes and journals are continued over his new line of march, and after its completion transmits them to the Commanding Officer of the main body. On the completion of the march, the notes and journals are sent, through the regular channels, to the Department Headquarters, where their contents are embodied upon the maps in course of preparation there. The notes and journals are then forwarded to the Chief of Engineers at Washington. Suitable instruments and note-books for use in keeping itineraries of march are obtained through the officer on Engineer duty at the Headquarters of Geographical Departments, who from time to time renews his supply by requisition on the Chief of the Corps of Engineers.

The name Itinerary was given by the Romans to a table of the stages between two places of importance, with the distances from one to another. The itineraries of the ancients contribute much to our acquaintance with ancient geography. Of these, the most important are the *Itineraria Antonini* and the *Itinerarium Hierosolymitanum*. The *Itineraria Antonini* are two in number, the *Itinerarium Provinciarum* and the

Itinerarium Marinum, the former containing the routes through the Roman provinces in Europe, Asia and Africa; and the latter the principal routes of navigators, who then sailed only along the coasts. They take their name from Antoninus Caracalla, by whom they were published, as corrected up to his time, but they seem to have been originally prepared at an earlier date. The *Itinerarium Hierosolymitanum* was drawn up 333 A. D., for the use of pilgrims from Burdigala (Bordeaux) to Jerusalem. Of these itineraries, various editions have been published. See *Journals of March.*

J

JACARANDA WOOD.—A very hard, heavy, brown wood, also called *rosewood*, from its faint agreeable smell of roses. It is brought from South America, and is produced by several trees of the genus *jacaranda*, of the natural order *bignoniaceæ*. Several species of this genus are called *caroba* in Brazil, and are there accounted anti-syphilitic. Several species of the nearly allied genus *tecoma* also have an extremely hard wood, as *T. pentaphylla*, a native of the Caribbean Islands. The Brazilian Indians make their bows of the wood of *T. toxiphora* or *pao d'arco*. All varieties are very desirable for gun-stocks, etc.

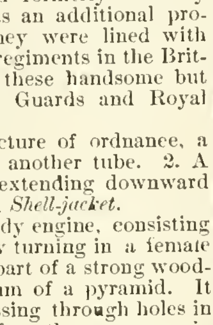
JACK.—A pompoint, or quilted tunic, made of leather and well padded. It was worn by foot soldiers in the 14th century. Also written *Jaque*, and the name of a form of *habergeon* worn in the 16th century.

JACK BOOTS.—Tall boots of tough, thick leather, reaching above the knee, and formerly worn by cavalry. In some instances, as an additional protection against sword-cuts, they were lined with thin plates of iron. The only regiments in the British service which still retain these handsome but cumbrous boots are the Life Guards and Royal Horse-Guards.

JACKET.—1. In the manufacture of ordnance, a tube inclosing and reinforcing another tube. 2. A short and close military coat, extending downward to the hips. Commonly called *Shell-jacket*.

JACK IN THE BOX.—A handy engine, consisting of a large wooden male screw turning in a female screw, which forms the upper part of a strong wooden box, shaped like the frustum of a pyramid. It is used, by means of levers passing through holes in it, as a press in packing, and for other purposes in the arsenal and laboratory.

JACK SCREW. — A machine for raising heavy weights, chiefly buildings of various kinds, as houses and ships. It has various forms, the most powerful being a differential screw. The most convenient form, however, is a single screw and net, the inclined plane of the screw being as near a horizontal as is consistent with the thickness of the thread and diameter of the screw. Other devices of the kind are employed, as the hydraulic jack. The drawing shows what is known in the arsenal as the "Rapid Moving Screw Jack," so called, because the screw, when the load is off, can be raised immediately to any desired point, and when up can be as quickly let down; thus saving the tedious operation of turning the screw up and down as in all the other screw jacks. To raise the screw to any desired height for the work, it is only necessary to lift the same by taking hold of the lever; to lower it, take hold of one of the handles with the left hand, and inclining the jack to an angle of about 45 degrees, with the other hand holding the lever, let the screw down.



The two segmental nuts are made of gun metal, and are supported on steel pins moving in angular slots so as to allow them in and out of the gear. The frame, lever, ratchet and cap are made of malleable iron, and the pawl of cast steel. The following sizes and weights are usually employed for artillery purposes:

No.	Height.	Raise.	Bar.	Weight.	Caacity .
24	22	11	2 in.	48 lbs.	8 tons,
25	27	15	2½ "	90 "	30 "
27	36	24	2½ "	137 "	30 "
26	29	14	3 "	210 "	50 "

No. 26 is provided with a detachable hook for ground lifting and bridge-work. See *Hydraulic Jack*.

JACK TREE.—A well-known tree in India. It yields an excellent timber, first yellow, fading to brown, hard and brittle, resembling satin; warps if not properly seasoned. A cubic foot of unseasoned wood weighs 50 lbs. The timber is used in the Bombay arsenals for packing-cases. The fruit of this tree is very much esteemed by the natives in the southern parts of India.

JACK WAMBASIUM.—A sort of coat armor, formerly worn by horsemen, not of solid iron, but of many plates fastened together, which some persons by tenure were bound to furnish upon any invasion.

JACOBINS.—The members of a political club which exercised a very great influence during the French Revolution. It was originally called the *Club Breton*, and was formed at Versailles, when the States-General assembled there in 1789. It then consisted exclusively of members of the States-General, all more or less liberal or revolutionary, but of very different shades of opinion. On the removal of the Court and National Assembly to Paris, this club began to acquire importance. It now met in a hall of the former Jacobin Convent in Paris, whence it received the name of the Jacobin club, which was first given to it by its enemies; the name which it adopted being that of the *Society of Friends of the Constitution*. It now also admitted members who were not members of the National Assembly, and held regular, and public sittings. It exercised a great influence over the agitation, of which the chief seat and focus was in the capital, and this influence was extended over the whole country by affiliated societies. Its power increased until it became greater than that of the National Assembly. It formed branch societies of clubs throughout France, of which there were soon not less than 1200. When the National Assembly dissolved itself in September, 1791, the election of the Legislative Assembly was mainly accomplished under the influence of the Jacobin Club. Almost all the great events which followed in rapid succession were determined by the voice of the Club, whose deliberations were regarded with more interest than those of the Legislative Assembly. It reached the zenith of its power when the National Convention met in Sept., 1792. The agitation for the death of the King, the storm which destroyed the Girondists, the excitement of the lowest classes against the *bourgeoisie* or middle classes, and the reign of terror over all France, were the work of the Jacobins. But the overthrow of Robespierre on the 9th Thermidor, 1794, gave also the deathblow to the Jacobin Club. The magic of its name was destroyed; and the Jacobins sought in vain to contend against a reaction which increased daily both in the Convention and among the people. A law of Oct. 16 forbade the affiliation of clubs, and on Nov. 9, 1794, the Jacobin Club was finally closed. Its place of meeting was soon after demolished.—The term Jacobins is often employed to designate persons of extreme revolutionary sentiments.

JACOBITES.—The name given to the adherents of the male line of the House of Stuart in Great Britain and Ireland after the Revolution of 1688. Many of the most devoted royalists followed James II. into France; but the greater part of the Jacobites remaining in their native land made a greater or less show of submission to the new government, while they secretly supported the cause of the Pretender. Their intrigues and conspiracies were incessant till the middle of the 18th century. Their hostility to the House of Hanover broke out in rebellions in 1715 and 1745, in consequence of which not a few of them lost their lives upon the scaffold, titles were attainted, and estates confiscated. After 1745 their cause became so obviously hopeless that their activity in a great measure ceased; and it was not long till it ceased altogether, and those who still retained their attachment to the exiled family acquiesced in the order of things established by the Revolution. In Scotland, the hopes and wishes of the Jacobite Party were expressed in many spirited songs, which form an interesting part of the national literature. The Jacobites of England were also *Tories*. They were generally distinguished by warm attachment to the Church of England, as opposed to all dissent, if they were not members of the Church of Rome, and held very strongly the doctrine of *non-resistance*, or the duty of absolute submission to the King. The Jacobites of Scotland were also generally Episcopalians and Roman Catholics. Macaulay, however, points out that the Highland clans which espoused the Jacobite cause did so on other grounds than the English Jacobites, and were far from having previously received the doctrine of non-resistance. In Ireland, the Jacobite cause was that also of the Celts, as opposed to the Saxons, or the native race against the English *Colonists*, and of the Roman Catholics against the Protestants. These diversities prevented a complete union, and greatly weakened the Jacobites.

JACOB'S LADDER.—1. A term originally applied on shipboard to a short rope-ladder with wooden steps, to give easy access to the shrouds and tops, but latterly applied to any short ladder of similar construction used in fortification for passing from one level to another, in the absence of ramps, etc. 2. An apparatus for raising light weights a considerable height. One form much used in arsenals and laboratories is shown in the drawing and consists of an endless chain of buckets, filling themselves at the bottom of the chain, and emptying at the top.

JACQUERIE.—The name given to the insurgent peasants in France in the middle of the 14th century, in the reign of John. The insurrection of the Jacquerie broke out in the year 1358, when the French King was a prisoner in England, and France in a state of the greatest disorder and anarchy. The immediate occasion of it was the enormities perpetrated by Charles the Bad, King of Navarre, and his adherents; but it was really caused by long-continued oppression on the part of the Nobles. Suddenly rising against their Lords, the peasants laid hundreds of castles in ruins, murdered the Nobles, and violated their wives and daughters, practicing every enormity, and acting, as they said, on the principle of doing as had been done to them. The insurrection broke out in the neighborhood of Paris, but extended to the banks of the Marne and the Oise. For some weeks this part of France was entirely at their mercy; but the magnitude of the danger induced the quarrelsome Nobles to make common cause against them, and on June 9 the peasants were defeated with great slaughter near Meaux by Captal de Buch and Gaston Phebus, Count of Foix. This put an end to the insurrection.

JADE.—A name somewhat vaguely applied to a number of minerals not very dissimilar—nephrite, axestone, serpentine, etc. Nephrite and axestone appear to be the minerals of which *jade* ornaments are generally made. But Yu, or Chinese jade, of which very beautiful vases and other articles are made in China, is supposed to be prebnite. Jade of all kinds has a greenish color, and when polished, has a rather dull and greasy aspect. Jade is much used in Poland and Turkey for the handles of swords and sabers.

JAGHIRE.—An Indian term, signifying the assignment of the revenues of a district to a servant or dependent of government, who is called *Jaghirdar*. Jaghires are frequently given in India to persons as a reward and compensation for their military services. *Jaghire Asham* is a term signifying land granted for the support of troops.

JALONS.—Long poles with wisps of straw at the top. They are fixed at different places and in different roads, to serve as signals of observation to advancing columns, when the country is inclosed, etc. They are likewise used as camp colors to mark out the ground on days of exercise.

JAMBEAUX.—Armor for the legs, made of waxed leather or metal, and much worn in the Middle Ages. Commonly written *Jambes*. See *Greaves*.

JAMES OF THE SWORD.—The Military Order of Saint James of the Sword was first instituted in Spain, in the reign of Ferdinand II. King of Leon and Gallicia. In the first instance it was organized with a view to stopping the inroads of the Moors, and its members pledged themselves to secure the safety of the roads. They entered into a league with the Brethren of St. Eloy, and the Order was confirmed by the Pope in 1175. The highest rank in the Order is that of Grand Master, which is united to the Crown of Spain. The Knights were obliged to prove their noble descent at least four generations back, and to show that they numbered among their ancestors no Jews, Saracens, or Heretics, and had never been cited by the Inquisition.

JAMES PROJECTILE.—A cylindro-conoidal missile of cast-iron, having a compound envelop of canvas-sheet-tin, and lead, called packing, encircling nearly the entire length of the body of the cylinder. The canvass being the external portion of the packing, is well saturated with a tallow lubric, which renders the loading easy, and cleans the gun at each discharge. The head of the projectile may be solid, or, if it has a prepared cavity, the missile then becomes a shell. The average weight of the projectile for a 42-pounder gun is, if a solid, 81¼ lbs., if a shell, 64¼ lbs., of which in either case 6½ lbs. is the weight of the packing. Its length is 13 inches, of which 6¼ inches is the measurement of the conical head, and 6¾ inches is the length of its cylindrical body. The diameter of the cylinder is designed to be 6¾ inches, or ¼ of an inch less than the bore of a 42-pounder gun. It retains its full diameter with accuracy for ¾ of an inch of its length at each end; then for the intermediate space, the diameter is shortened half an inch, thereby forming a recess round the body of the cylinder, between the ends, Fig. 1. The shortening of the diameter, and consequent loss of iron to the circumference of the body of the cylinder, is replaced by the before-named packing, when the projectile is prepared for use, Fig. 2. The solidity of the conical head is continued into, and forms the solid end of the cylinder. The base, or opposite end of projectile, has a central orifice, of 3½ inches in diameter, which extends 2½ inches into the cylinder; and from which *ten* rectangular openings diverge (like the mortises for spokes in the hub of a wheel), through the body, to the periphery of the cylinder, in the recess of its circumference. The packing is formed by a plate of sheet tin, of the length of the greatest circle of the cylinder; and in width, equal to the length of the recess caused by the shortening of the diameter.

This plate of tin is laid on a piece of strong canvas, which is two inches wider, but of the same length of the plate; and the canvas is folded over the side edges of the plate, and firmly secured by cross sewing. The tin plate, when so prepared, or half covered, is folded round the body of the missile in the recess, and retained in position by an iron collar clamp. The space between the inner surface of the envelop and the body of the cylinder is filled with melted lead, which, adhering to the tin and iron, forms a compact mass round the body of the projectile. When the charge is fired, the power or gas generated by the burning of the powder, in its effort to expel the projectile and to escape from the gun, is forced into the orifice in the base of the missile, and through the *ten* openings against the packing,

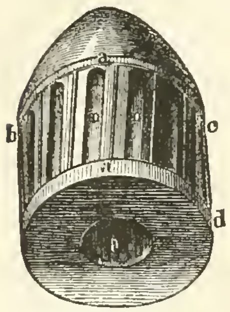


FIG. 1. BEFORE THE APPLICATION OF THE PACKING.

a. Band ¾ inch wide at ends of cylinder.
b,c,d. Recess round body of cylinder.
m. Rectangular openings through to recess.
n. Orifice in base, leading to the recess.

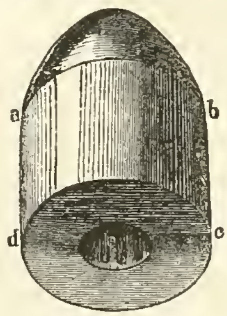


FIG. 2. AFTER THE APPLICATION OF THE PACKING, AND READY FOR USE.

a,b,c,d. Belt of canvas, tin, and lead, called packing.
e. Orifice in base, leading to recess.

which is thereby pressed into the grooves, in the gun's bore, and by its firm hold in them the rifle motion is imparted to the projectile.

When the projectile is a shell, its fuse-orifice is in its head and axis. The length of the orifice for a 42-pounder shell is 2½ inches. For two inches of its length, its diameter is 1 inch, and for the remainder of the length, the diameter is reduced to ¾ of an inch; forming a shoulder in the fuse-orifice, to prevent the fuse-plug from being driven into the cavity of the shell, when, by firing, the missile is expelled from the gun. The threads of a female screw are cut in the head of the fuse-orifice for the reception of the body of the fuse-orifice cap. This cap is of brass. Its diameter is an inch, its length half an inch; its head is convexed, and has a slot cut in it for the reception of a screw-driver; the base end is deeply cupped to admit the nipple of a musket cone, and to give more play to the fuse-plug. The fuse-plug is of wrought iron, surmounted by a musket cone; and its action in the fuse-orifice is like the ordinary working of a piston. Its length is 1¼ inches, of which the quarter is the length of its shoulder. The diameter of its shoulder and body, is very nearly the same as the two diameters of the fuze-orifice. Its vent is in its axis, and in size to receive the male screw of the musket cone. The threads of a female screw are cut in the head end of the vent of sufficient length to receive the screw end of the said cone. When the shell is loaded, care should be taken not to overfill its cavity, and thereby prevent the working of the fuse-plug. The powder should be cleaned from the fuse-orifice; the plug should be oiled to ensure its free and sure action. Its cone should be capped, but before the application the percussion cap should be carefully examined to see that it is perfect, and of the best quality. The fuse-plug, when so prepared, is then inserted into the fuse-orifice, and it should enter freely, but not by its own weight until the shoulders of the fuse-plug and orifice are in contact. The cap for the fuse-orifice should be then firmly screwed in, which completes the charging of the shells. If after the shell is loaded the fuse-plug should be disturbed by handling; that is, if the plug has slidden forward, it will be forced back to its proper position by the impulse given to the missile, by the firing of the gun charge; and it will so remain during the flight, until the shell impinges against any hard substance; as ground, wood, etc., which, by obstructing the progress of the missile, causes the fuse-plug to slide forward with violence, and by the collision of the cone's point against the bottom of the fuse-orifice cap-plug, the percussion cap on the cone will be exploded, and the bursting charge of the shell fired. See *Expanding Projectiles.*

JAM-NUT.—A nut of frequent occurrence in the construction of artillery carriages, the elevating gears, etc. See *Lock-nut.*

JANGAR.—A kind of ponton constructed of two boats with a platform laid across them, which is used by the natives in the East Indies to convey horses, supplies, etc., across rivers.

JANISSARIES—JANIZARIES.—A Turkish military force, originally formed by the Osmanli Sultan Orkhan, about 1330, of young Christian prisoners compelled to embrace Mohammedanism; and more perfectly organized by Sultan Amurath I. after 1362, when the number was raised to about 10,000, and especial privileges were conferred on them. They were for some time recruited from Christian prisoners, but their privileges soon induced many young Turks to seek admission into their body. There were two classes of Janizaries, one regularly organized, dwelling in barracks in Constantinople and a few other towns, and whose number at one time amounted to 60,000, but was afterwards reduced to 25,000; and the other composed of irregular troops, called *Jamaks*, scattered throughout all the towns of the Empire, and amounting in number to 300,000 or 400,000. At the head of the whole Janizary force was the *Aga* of the Janizaries, whose power was limited only by the danger of revolt, and extended to life and death. The Janizaries were always ready to break out into deeds of violence if their pay or perquisites were withheld. In times of peace they acted as a police force. They served on foot; generally formed the reserve of the Turkish Army, and were noted for the wild impetuosity of their attack. The Sultan's body-guard was formed of them. The Janizaries, however, soon began to be very unruly; and their history abounds in conspiracies, assassinations of Sultans, Viziers, Agas, etc., and atrocities of every kind; so that, by degrees, they became more dangerous to the Sultans than any foreign enemies. The attempts of the Sultans to reform or dissolve them were always unsuccessful, till Sultan Mahmoud II., in 1826, being opposed in some of his measures by the Janizaries in Constantinople, displayed the flag of the prophet, and succeeded in arousing on his own behalf the fanatical zeal of other portions of his troops. The Janizaries, deserted by their Aga and other principal officers, who remained faithful to the Sultan, were defeated and their barracks burned, when 8,000 of them perished in the flames. A proclamation of June 17, 1826, declared the Janizary force forever dissolved. All opposition was defeated with bloodshed. Not fewer than 15,000 were executed, and more than 20,000 were banished.

JANUARIUS.—The order of Saint Januarius was founded by King Charles of Sicily (afterward Charles III. of Spain), on July 6, 1738. It was abolished after the French Invasion of 1806, and reintroduced in 1814. The badge is a gold octagonal white and red enameled cross, with gold lilies in the upper and side angles. The obverse represents St. Januarius in episcopal robes, with an open book. The round middle of the reverse shows a golden open book, and two phials partly filled with blood. The Knights are either *Cavalieri di Giustizia*, who must count four noble generations, or *Cavalieri di Grazia.*

JAPANNING—A laboratory process, giving a coating of varnish and other materials to certain manufactures, by which a resemblance is produced to the beautiful lacquered wares of Japan and China. The term is more generally applied in this country to metal works upon which a dark-colored varnish is applied with heat; but the process is quite as extensively applied to papier-mâché works. The japanning material consists of anime or copal varnish, alone, or mixed with ivory-black, to produce a black japan; or with asphalt, to produce a dark or light brown, according to the quantity used. For tinned wares, a single coating is all that is usually given. After being varnished they are put into a heated oven for a time, after which they are ready for use; but in the case of more substantial articles several coats of varnish are applied, each being dried in the oven previous to the application of the next, so that a coating of sufficient substance to bear polishing is thus obtained. Rotten-stone and Tripoli powder are used by the polisher, and a beautiful surface is obtained, in no respect inferior to that of polished jet. The polishing powders are at first applied with leather, but the finishing is done by women, who use the palms of their hands only, with small quantities of Tripoli.

JATS—JAUTS.—The name of a people of Hindustan, first mentioned in history at the beginning of the 11th century. They opposed the invasion of Mahmoud the Gazne Vide, and are said to have gathered a fleet of as many as 8,000 boats in the Indus, where they were attacked by the invader and completely defeated. In the reign of Aurungzebe, the Jats appeared as banditti in the mountains in the interior of India. They increased in strength and daring, until they finally became formidable, and under their Chief, Sooraje Mull, even dictated the policy of the Mogul Court. The invasion of northern India by Ahmed Shah, Sovereign of Cabul, put an end to the prestige of Sooraje Mull, who, after allying himself to the Mahrattas, deserted them before the battle of Panniput, and joined Ahmed Shah. His services on the occasion of this battle were rewarded by the possession of Agra and its district. At the time of the establishment of British power in northern India, the since celebrated Runjeet Singh was Rajah of the Jats, and by a treaty with Lord Lake, was permitted to remain in control of his territories without paying tribute. Disagreement between the English authority and that of the Rajah brought about a conflict, and early in 1826 the almost impregnable fortress of Deeg, the stronghold of the Jats, was invested by a large force of British soldiers under Lord Combermere. On Jan. 18 the fortress was stormed and captured, and the power of the Jats was at an end.

JAVELIN.—A short and light spear used for darting against an enemy. In the Roman legion, the first and second lines (the hastati and the principes) were both armed with two javelins to each man. Each javelin was in all about $6\frac{3}{4}$ ft. in length: the shaft $4\frac{1}{2}$ ft. long, of tough wood, an inch in diameter; and the remainder given to the barbed pyramidal head. In action, the legionary hurled one javelin on the enemy at the first onset; the second he retained as a defense against cavalry. The Goths and other barbarians used a javelin. At present, javelins are used in Europe in hunting the boar, and by many savage nations in ordinary hunting. The assegai of the Caffre is a javelin of native iron.

JAZERAN.—A coat of scale armor, first worn in the Middle Ages. This garment was sleeveless and somewhat lighter than the hauberk. Commonly written *Jazerant*.

JEFFREY POJECTILE.—In this projectile, the lead is affixed to the rear of the projectile by dovetails, into which it is cast; a hollow, resembling that of the Minnié bullet, is left at the bottom, for the purpose of causing the lead to be driven into the rifling. A wad or covering, consisting of flannel coated with soft soap, is wrapped around the rear of the projectile, to facilitate loading, decrease windage, and lubricate the bore.

JELOUDAR.—An East Indian term, signifying to belong to the train or equipage.

JEMADAR.—A native officer in the Indian Army, whose position corresponds with that of a subaltern in a company of European infantry. The name is also given to the head man of a native establishment in a factory, and indeed to any man who exercises authority over a number or gang of men.

JE MAINTIEDRAI.—The motto of the House of Nassau. When William III. came to the throne of England, he continued this, but added the "liberties of England and the Protestant religion," at the same time ordering that the old motto of the royal arms, "Dieu et mon droit" should be retained on the great seal, 1689.

JENIZER-EFFENDI.—An appointment among the Turks, which in some degree resembles that of Provost-Marshal in European armies. The only functions which this officer is permitted to exercise are those of judge to the company. He sits on particular days for the purpose of hearing the complaints of the soldiers, and of settling their differences. If a case of peculiar difficulty should occur, he reports the case to the Aga, whose opinion and determination are final.

JENNIFER SADDLE.—A saddle very extensively used in the United States and other countries, prior to the invention of the *Whitman saddle*. While considered one of the best saddles in its time, it had the serious defects of being too short in the seat, too short in the bearing, and too much rounded on its under side, inclining it too "rock" and sore the back in the center; also sharp pommel and too straight in cantle.

JERKIN.—A buff military coat, on which was worn a light collar. The *jerkin* took the place of armor towards the end of the 16th century.

JERRID.—A slender javellin used as a dart by the soldiers of the East, in the Midde lAges.

JESSANT.—In Heraldry, springing forth, a term frequently used as synonymous with *Issuant*, rising, as a demi-lion is often represented doing, from the bottom line of a field, or upper line of an ordinary. Jessant is sometimes used improperly for *naissant*, or rising from the middle of an ordinary. The phrase *jessant-de-lis* is used with respect to a strange heraldic device depicting a leopard's head *affronte* with fleur-de-lis passing through it. The family of Moreley, Hants, bears sable, a leopard's head argent jessant-de-lis; and gules, three leopard's heads jessant-de-lis or, are the arms of the family of Cantelupe. See *Heraldry*.

Jessant-de-lis.

JET.—1. A term signifying the motion of any body that is urged forward by main force; it likewise means the space which is gone over by any propelled body; and sometimes the instrument from which anything is thrown or shot; as the cross-bow, etc. *Jet des bombes* is a phrase used instead of *tir*, which formerly expressed the course that a shell took when it was thrown out of a mortar by the power of gunpowder. 2. In pyrotechny, *jets* are rocket-cases filled with a burning composition; they are attached to the circumference of a wheel, or the end of a movable arm to set it in motion.

JEWELS.—By an egregiously absurd and unnecessary complication of nomenclature, introduced by way of adding dignity to the science of Heraldry, the tinctures of the arms of peers have sometimes been designated by the names of precious stones; argent is pearl or crystal; or, topaz; gules, ruby; azure, sapphire; sable, diamond; vert, emerald; and purpure, amethyst.

JEWEL TARGET.—A canvas target, having framework and machinery made of iron. The mechanism permits of the use of a target of any class by taking out the frame and legs of one target and substituting therefor those of another. A framework supporting the target works upon a center-pin or spindle (12 inches long) securely fastened to a heavy timber at the back of the pit, and revolves the target to the right or left such distance as may be required. When a shot strikes the target, the marker by suitable contrivances pulls the target over, and hangs a disk, denoting the value of the shot, in the shot-hole, patches the last hole (if any), and swings the target back into position ready for the next shot. The marker for this target is provided with small disks made of wood, tin, or iron, with hooks in the center and each side of them, and painted to represent certain values.

JIB-CRANE.—The mode of operating the hoisting and traversing mechanism of the larger sizes of the Weston jib-cranes is fully explained in the article TROLLEYS. The details of the gearing whereby these several motions are affected are as follows. Fig. 1 is a cross-section taken at the foot of the mast of a large jib-crane. A is the mast, to each side of which is bolted a housing containing the gearing for operating the two parts, X, and Y, of the main hoisting chain. Each of these housings is provided with a horizontal shaft, revolving upon which is the worm wheel P, the hub of which covers the entire length

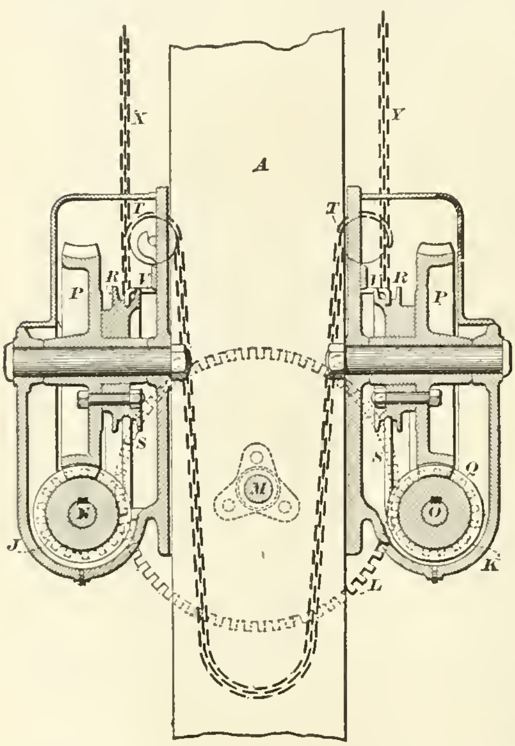


Fig. 1.

of the pin or shaft between its bearings. Over the hub of this wheel, is the pocketed chain-wheel R, with the chain stripper V, and a chain guide, S. The chain wheel is made separately from the worm wheel to admit of easy removal and renewal when worn out. Referring now to the right hand housing in the drawing, O is the crank shaft extending through the housing at right angles to the worm wheel shaft above. Q is the worm, fitted upon the shaft, O, at its center, and gearing into the worm wheel, P. K. is a spur pinion, fitted to one end of the shaft, O, and capable of sliding longitudinally thereon. T is a small guide sheave over which the slack of the chain falls after passing around the lower semi-circumference of the chainwheel, R. The arrangement of the opposite or left hand housing, and its contained gearing, is the same as that just described.

Fig. 2, is a detail view of one of the chain wheels, R, with the chain guide, S, and stripper, V, showing

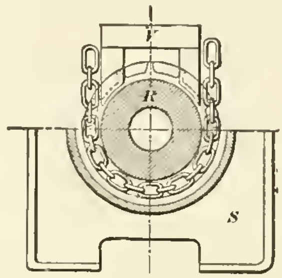


Fig. 2.

the manner in which the chain is guided during its contact with the wheel, and the provision, by means of the stripper, V, for compelling it to leave the wheel, R, at the proper point in whichever direction the wheel is being turned. The slack part of the chain, after passing over the guide sheave, T, falls into a receptacle between the housings at the foot of the mast. The chain being endless, the two parts, X and Y, come together in the receptacle just referred to, and are there united, the amount of slack chain contained in the box varying with the position of the running block.

Fig. 3 is a horizontal cross-section taken through both housings and the mast of the crane, the several

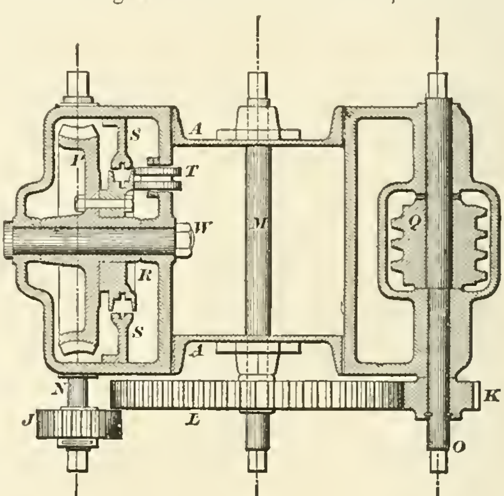


Fig. 3.

parts being designated by the same letters in Fig. 1. M is a shaft parallel to the crank shafts, O and N extending through the mast and carrying at one end the large spur wheel, L. The pinions, J, and K, as previously explained, are arranged to slip upon their shafts so as to bring them into or out of coincidence with the intermediate wheel, L, and the pinion, J, is disengaged. If now the crank be applied to the shaft, N, and turned in the proper direction, the chain, X, will be hauled in and the load raised. The same effect will result from rotation of the shaft, O. If both be turned simultaneously, hoisting will be effected at double speed. By applying the crank to the shaft, M, motion will be communicated through the wheel- L, and pinion, K, to the shaft, O, and hoisting will occur at a rapid speed proportionate to the relative diameters of the wheels, L and K. Three speeds are thus obtained for hoisting, all of which are equally applicable to lowering by reversing the motion of the cranks.

To effect the proper travel of the trolley, both pinions, J and K, are slipped into engagement with the wheel, L. By then turning either of the shafts, N or O, in the proper direction, one part of the hoisting chain, X, for example, will be hauled in, and the opposite part, Y, paid out at equal speeds, the effect of which is to cause the trolley to move horizontally upon the jib. By applying the crank to the shaft, M, these motions are accelerated, and a rapid movement of the trolley results.

Two cranks are furnished with each crane, and it is to be noted that the construction admits of the employment of both cranks upon any one of the shafts M, N, or O, so that the entire energy of all the men employed upon the crane is transmitted through that shaft, while, if more rapid action is desired, one of the cranks may be placed upon the right hand end of the shaft, N, and the other upon the opposite or left hand end of the shaft, O. In either case the two shafts, being on opposite sides of the crane, do not in any way interfere with one another, and are thus always available for the full number of men who can effectively be employed upon them.

The compactness and simplicity of this mechanism will be apparent from the foregoing description. The entire operating mechanism of the crane consists of two worm wheels and worms, and of the spur wheel L with its two pinions. The worm wheels and worms are entirely contained within the two housings, the upper parts of which latter are arranged to lift off to give access to the gearing. Each of the worms runs in an oil well, thus insuring perfect lubrication, and each of these wells is provided with a drainage-tap at the bottom to draw off the lubricant when desired.

Fig. 4 represents a jib-crane of medium size, each member of the frame consisting of two parts, separated so as to permit the chain and block to pass between them, so that the load can be moved close into the mast. The hoisting mechanism is attached to the mast near its foot, and the running block which carries the load, is suspended from a trolley travelling on the jib and capable of movement in and out by means of independent gearing attached to the jib at its intersection with the mast. Cranes of this design are built of any desired capacity from 1 ton to 5 tons. The frame consists of wrought iron channel beams, each of the three members of the frame being composed of two such channel irons. The dimensions are such as to give the accepted factor of safety, and the several parts are very securely connected together at their intersections by riveting.

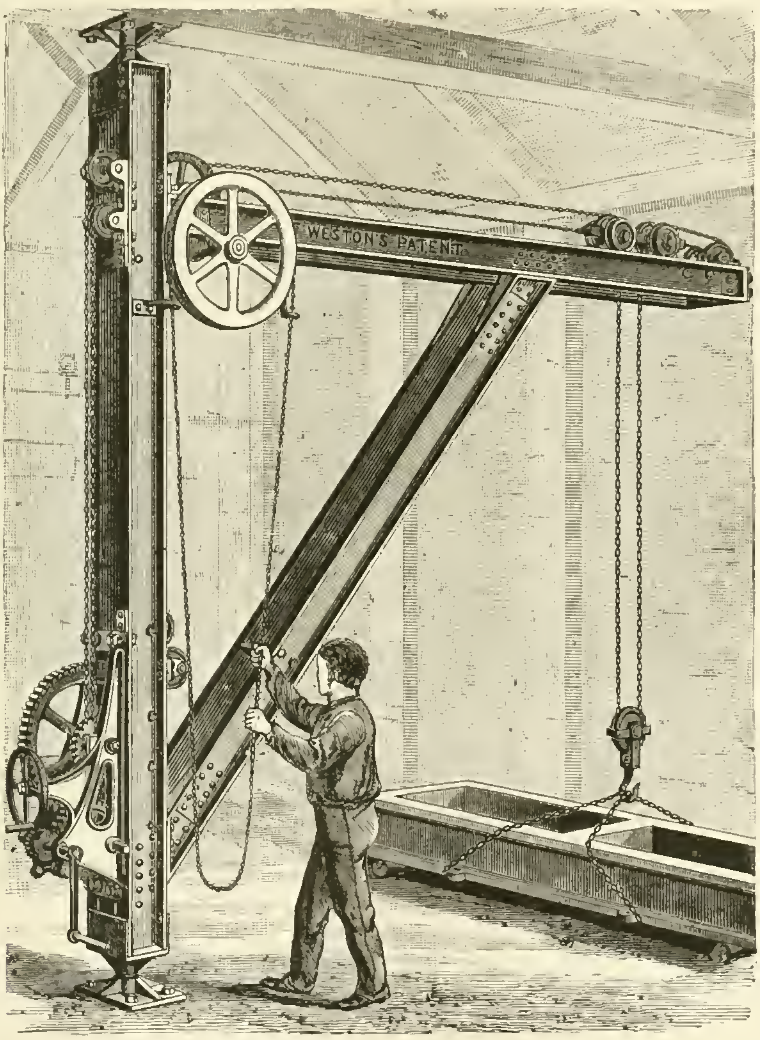


Fig. 4.

Hoisting is effected through a train of spur gearing operated by crank in the usual way, and provided with an automatic safety ratchet. Lowering is effected by a separate mechanism consisting of a turned worm wheel and worm, operated by a light hand wheel, as shown in the cut, this mechanism being also available for raising light loads. Thus arranged, the machine is self-sustaining and can be left at any time with the load in suspension without danger of the load running down or the handles flying back. The construction gives three changes of speed, and embodies the endless chain system, which insures an even distribution of wear over the entire length of chain.

Rotation is easily effected by pushing or pulling the suspended load, the pintles in top and bottom bearings being of steel and turning in bronze boxes. Motion of the trolley on the jib, in either direction, is effected by gearing operated from below by an endless hand chain, as shown in the cut. The self-sustaining construction of the hoisting gear holds the load suspended at any height while the trolley is moved in and out on the jib.

Cranes of this type are adapted for use in arsenals for handling and mounting heavy guns, in foundries, forges, rolling mills, etc. See *Cranes* and *Trolleys*.

JIGGER.—In mechanical maneuvers, an apparatus consisting of a strong rope with a block at one end, and a sheave at the other, used in maintaining the tension of—or, technically, in "holding on" to—the cable as it is thrown off from the capstan or windlass, around which it only takes two or three turns.

JIM CROW.—One of the tools used by railway platelayers for bending rails, and forms one of a set of platelayers' tools attached to the royal engineer siege equipment. It is suitable for bending the 24 lb. rails of the trench railway.

JINGAL.—A small, portable piece of ordnance to be fired from the ground or on a wall, resting on a long, slender butt-end, and two legs. This piece was commonly used in India. Sometimes written *Jingall*. See *Gingals*.

JOAR.—An East Indian term, signifying a general massacre of the women and children, which is sometimes performed by the Hindoos, when they find they cannot prevent the enemy from taking the town. When this dreadful and unnatural ceremony is to take place, a spot is selected which is filled with wood, straw, oil, etc. The victims are inclosed and the whole is set on fire.

JOHN BULL.—A familiar synonym for the English people. Its origin is attributed to Dean Swift, but Arbuthnot first gave it literary currency in his *History of John Bull* (1712), a political allegory intended to satirize the Duke of Marlborough, and to increase feeling against the war with France. In art John Bull is well known as a burly country squire, impetuous, honest, narrow-minded, dogmatic, and easily imposed upon.

JOHN OF JERUSALEM.—The Order of Knights of Saint John of Jerusalem, otherwise called Knights of Rhodes, and after of Malta is the most celebrated of all the military and religious orders of the Middle Ages.

It originated in 1048 in an Hospital dedicated to St. John the Baptist, which some merchants of Amalfi were permitted by the Calif of Egypt to build for the reception of the Pilgrims from Europe who visited the Holy Sepulcher. The nurses were at first known as the Hospitaler Brothers of St. John the Baptist of Jerusalem. The Seljuk Turks, who succeeded the Egyptian and Arabian Saracens in Palestine, plundered the Hospice, and on the Conquest of Jerusalem by the Crusaders under Geoffroy de Bouillon in 1099, the first Superior, Gérard, was found in prison. Released from durance, he resumed his duties in the Hospice, gave material aid to the sick and wounded, and was joined by several of the Crusaders, who devoted themselves to the service of the poor Pilgrims. By advice of Gérard, the brethren took vows of poverty, chastity, and obedience before the Patriarch of Jerusalem. Pope Pascal II. gave his sanction to the Institution 1113. Raymond du Puy, the successor of Gérard in the office of Superior, drew up a body of Statutes for the Order, which was confirmed by Pope Calixtus II. To the former obligations was afterward added those of fighting against the Infidels and defending the Holy Sepulcher. Various Hospices, called *Commanderies*, were established in different maritime towns of Europe as resting places for Pilgrims, who were there provided with the means of setting out for Palestine. The Order having become military as well as religious, was recruited by persons of high rank and influence, and wealth flowed in on it from all quarters. On the Conquest of Jerusalem by Saladin in 1187, the Hospitalers retired to Margat in Phenicia, whence the progress of infidel arms drove them first in 1285, to Acre, and afterwards, in 1291, to Limisso, where Henry II., King of Cyprus, assigned them a residence. By the Statutes of Raymond, the Brethren consisted of three classes, Knights, Chaplains, and Serving Brothers; these last being fighting Squires, who followed the Knights in their expeditions. The Order was subsequently divided into eight languages—Provence, Auvergne, France, Italy, Aragon, England, Germany, and Castile. Each nation possessed several Grand Priories, under which were a number of Commanderies. The chief establishment in England was the Priory at Clerkenwell, whose head had a seat in the Upper House of Parliament, and was styled First Baron of England.

In 1310, the Knights under their Grand-Master, Foulkes de Villaret, in conjunction with a party of Crusaders from Italy captured Rhodes and seven adjacent islands from the Greek and Saracen Pirates by whom it was then occupied, and carried on from thence a successful war against the Saracens. In 1523, they were compelled to surrender Rhodes to Sultan Solyman, and retired first to Candia and afterward to Vitebo. In 1530, Charles V. assigned them the Island of Malta, with Tripoli and Gozo. The Knights continued for some time to be a powerful bulwark against the Turks; but after the Reformation a moral degeneracy overspread the Order, and it rapidly declined in political importance; and in 1798, through the treachery of some French Knights, and the cowardice of the Grand Master, D'Hompsech, Malta was surrendered to the French. The lands still remaining to the Order were also about this time confiscated in almost all the European States; but though extinct as a Sovereign Body, the Order has continued during the present century to drag on a lingering existence in some parts of Italy, as well as in Russia and Spain. Since 1801 the office of Grand-Master has not been filled up: a Deputy Grand-Master has instead been appointed, who has his residence in Spain. The Order at first wore a long black habit with a pointed hood, adorned with a cross of white silk of the form called Maltese on the left breast, as also a golden cross in the middle of the breast. In their military capacity, they wore red surcoats with the silver cross before and behind. The badge worn by all the Knights is a Maltese cross, enameled white, and edged with gold; it is suspended by a black ribbon, and the embellishments attached to it differ in the different countries where the Order still exists.

JOHNSON LOADING-APPARATUS.—The aim of the inventor in planning this apparatus has been to produce a loading device which may be applied without altering the present style of gun-carriages, and which may be operated from a position considerably below the muzzle of the gun. A staff-carriage is supported by rods which may be raised or lowered by racks and pinions. The staff-carriage carries a short shaft, upon which there is a pinion for driving the sponge staff or rammer staff, also two drums for receiving the rope by which it is rotated. The first operation in cleaning the gun is to raise the staff-carriage; the sponge staff is then run through the carriage as far as convenient; the free end of the staff is then raised by means of a rod filled with a fork for the purpose. As soon as the teeth of a rack with which the sponge staff is provided, engage the teeth of the pinion in the carriage, the pinion is turned by means of the ropes, forcing the sponge into the bore of the gun. The sponge staff carries a drum by means of which it may be revolved when the sponge reaches the end of the bore. The sponge staff is withdrawn by reversing the motion of the pinion in the carriage. A cartridge rest receives the cartridge shell, or shot, and carries it to the muzzle of the gun. The rammer staff is then inserted and operated in much the same manner as the sponge staff. After loading, the staff-carriage and the cartridge-rest are lowered out of the way to permit of the ready adjustment of the gun. This very ingenious apparatus is the invention of Lieutenant David D. Johnson, United States Army.

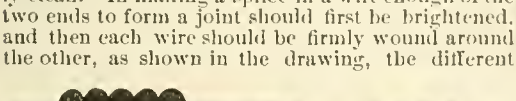
JOHUR DE RAJAH. An Indian sword used early in the seventeenth century.

JOIN.—A technical word used in the service, signifying to effect the junction of one military body with another. In a more limited sense, it means the accession of an individual, voluntary or otherwise, to a corps or army. If an officer, on being ordered to join, omits to do so wilfully, he is liable to trial by a General Court-Martial, or to be peremptorily suspended for being absent without leave.

JOINTEE-JYNTEE.—A wood whose charcoal has been much used in the Government powder works at Ishapore, near Calcutta, in the manufacture of gunpowder. The jointee grows from seed, and flowers after the first year; it then increases in size till it becomes a small tree; at three or four years old, it makes the best charcoal, the fibers being then large and defined, and well separated; the charcoal is of a lightish color, and is not dense to the eye or touch. The tree flourishes best on the banks of small nullahs or water-courses. Jointee charcoal is not so soft as that of the urhur or dhall stalk, but it is more dry, brittle, and hard. An averaged-sized tree of three years' growth will occupy about 5 square yards, and produce about three maunds of wood, which will yield about 30 lbs. of charcoal, the quantity required for two 100-lb. barrels of gunpowder. Therefore 10,000 barrels would require about sixty beegahs of land under constant cultivation, one-third to be cut each year. The average specific gravity of jointee wood is .767, and sp. gr. of the charcoal produced from it .275; and it yields 25 per cent. of charcoal. Experience has shown that this wood is not so good for gunpowder purposes as the dhall bush, and therefore should only be used in case of a failure of that crop.

JOINTS.—This is a very important point in connection with a system of mines. In many instances it will be found necessary to join either two lengths of cable, or an insulated wire and a cable, together, in both of which cases great care must be used in making the joints, so hat the insulation and the continuity of the circuit may be perfect.

As oxides of metals can scarcely be considered conductors, all joints in a wire, over which an electric current is to pass, should, when formed, be perfectly clean. In making a splice in a wire enough of the two ends to form a joint should first be brightened, and then each wire should be firmly wound around the other, as shown in the drawing, the different



evolutions touching one another, and passing, as near as may be, at right angles with the wire which they surround. A wire, in being spliced, must never be bent back and wound upon itself, forming a loose loop, which, for telegraphic purposes, is rather unreliable. In making a joint under water, a great object is to totally exclude the ingress of water, or even moisture, which would at once afford a path for the current and cause a loss or a leak in the cable.—See *Mines*.

JONES GABION.—A useful gabion made of ten bands of galvanised sheet-iron, worked over twelve wood pickets, the ends brought together and connected by two buttons at one end, fitting into two slots at the other. Each band is 77 inches long, 3¼ inches wide, of No. 20 gauge, or about 0·05 inch thick; weight of ten, 29 lbs. The buttons and button-holes are required to stand a weight of 672 lbs., the band itself will support about 1,500 lbs.; each band has four holes to admit of combination to form bridges, beds, stretchers, and for other incidental applications; little or no instruction is required for making these gabions.

Two expert men can make a gabion in five minutes.

JOODAY PERRAPUT.—An East Indian term, signifying a slave taken in war.

JOSLYN TOMES GUN.—A breech-loading rifle having a fixed chamber closed by a movable breech-block which slides in the line of the barrel by direct action. It is opened by cocking the hammer. In so doing a hook-shaped shoulder on its forward portion is disengaged from a corresponding recess in the receiver; and the whole bolt containing the hammer and lock, is free to move backward to its full extent. The firing-pin being linked to the hammer is also positively withdrawn from the face of the bolt. The piece is closed by reversing the motion of the bolt. It is held closed by a spring-catch (friction-pin) on its side. It is locked by the descent of the hooked portion of the hammer into the recess of the receiver, when the piece may be fired by a back-action lock concealed in the bolt, the trigger alone being detached. The firing-pin descends with the hammer along an inclined groove in the face of the bolt leading to the site of the fulmintae in the center of the cartridge-head. Extraction is accomplished by a spring-hook recessed in the side of the bolt, and riding over the rim of the cartridge when the piece is closed. Ejection is caused by the cartridge-shell being quickly withdrawn on two longitudinal guides, one on each side of the receiver, and ejected by the head striking first a stop on one guide; and then almost simultaneously a stop to the rear of the first, on the other guide.

JOURNAL.—A public record or general orderly book kept in the French service, and in which every transaction that occured during a siege is entered by the Governor of the town, for the inspection of a Superior Authority. The General Officer who carried on the siege of a place likewise kept a document of the same kind, and minuted down every thing that happened under his command. So that the Journal which was kept in this manner was a circumstantial detail of what occurred, day after day, during the attack and defense of a town.

JOURNAL OF ATTACK.—In actual siege operations a daily record is made by each Engineer Officer on duty in the trenches, of the amount of work done, the time required, the means of execution, etc., with any observations that may seem of value. These records are transmitted to the headquarters of the Commanding Engineer, where they are filed away for reference, and from them the progress of the trenches is carefully laid down upon the original directing plan of the attack. From the data furnished by such records, and from the results obtained in the Schools for training engineer troops, the average time required for executing the various portions of the siege works, under ordinary circumstances, during the different epochs into which they have been divided, has been laid down by writers on this subject. This mode of calculation has also been applied to test the relative value of different systems of permanent fortifications, by submitting them to a fictitious siege, and estimating from the time, as shown in this way, required for their reduction, how much longer the one system would hold out than the other. However ingenious this method may at first appear, it affords no real practical test of any importance; the duration of sieges depending upon moral and physical laws, as their whole history has shown, that no mode of calculation can reach. The immediate successors of Vauban, who made use of these calculations in theoretical sieges, have usually allowed nine days, from the opening of the trenches to the completion of the 3d parallel; estimating that all the batteries, along the front of the 1st and 2d parallels, would be completed on the sixth day, and the fire of the defenses be brought under in twenty-four hours after the batteries were in full play.

JOURNAL OF DEFENSE.—In the American service, during war, the Commander of a place and the Chiefs of Engineers and of Artillery are required to keep Journals of Defense, in which are entered in order of date, without blank or interlineation, the orders given or received, the manner in which they are executed, their results, and every event and circumstance of importance in the progress of the defense. These Journals are sent after the siege to the War Department.

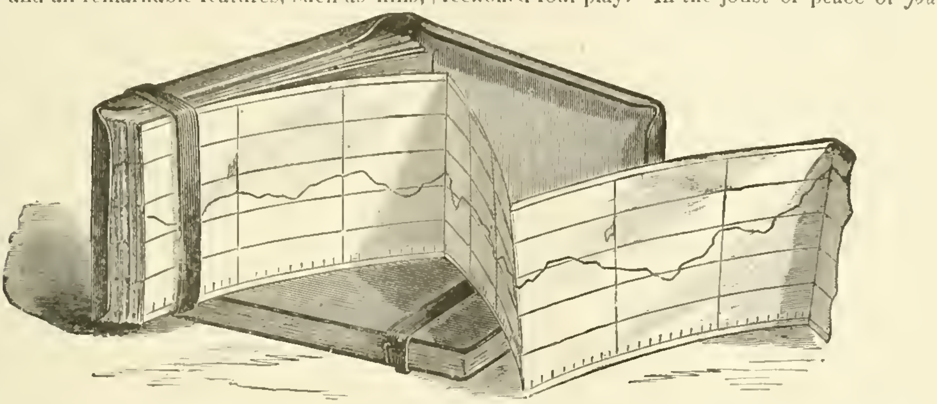
JOURNALS OF MARCH.—Commanding officers of troops marching through a country little known,

JOURNAL of the march of [*here insert the names of the regiments or companies composing the column*], commanded by ——— ———, from [*here insert the point of departure*] to [*the stopping place*], pursuant to [*here gvie the No. and date of order for the march*].

Date.	Hour.	Weather.	Distance.	REMARKS.
1860.			Total, 19	
July 8.	5. A. M.	Cloudy, with wind.—Cold early in morning.—Cloudy.	3	Road rocky; but little grass; good water. Plenty of timber on the summit of hills, extending 3 miles; road to right of hills.
	1. P. M.		8	Good shelter for camp at foot of peak; fuel plenty. Springs of sweet water, with good grass near. Road to this point rather more sandy.
	10.		3	Road runs through a canyon ½ mile long, to right of a small stream; marsh on left of stream; water sweet; grass excellent. Halted to graze two hours. No Indian signs.
	6.30.		1	Companies F, G, and I, 3d ——, detached at Mt. P——, under command of ——— ———, (see par. 3, General Orders, No. ——), to take road to ———. A small creek, easily forded.
	6.		4	Road turns short to right at top of hill after crossing river; crossing good, but a little boggy on right bank. This bottom shows signs of recent overflow, when it must have been impassable; banks low; water sweet; no wood near crossing; road hard and good up to river.
July 7.	4.30.			
			Total, 47	
July 9.	4.30 A. M.	Rain.	5	At the point where the roads fork, turn to the right. The left-hand road leads to a deep ravine, which cannot be crossed.
	4.30 P. M.	Very pleasant; cloudy in the P. M.	3	After the road strikes the ravine, it runs one mile along its bank before coming to the crossing-place. The camping ground is at springs, half a mile beyond the ravine. Old Indian signs at the springs.
	3 P. M.		15	Road less rocky; last three miles rather sandy; no water. Passed at one point an Indian grave.
	9. "		5	Road still rocky; good springs, where casks should be filled. No more water for twenty miles after leaving springs. Occasional hills to left of road; no wood or grass.
July 8.	6.30 A. M.			
			19	

keep journals of their marches according to a form laid down in Army Regulations. At the end of the march a copy of the journal is retained at the station where the troops arrive, and the original is forwarded to the Headquarters of the Department or Corps d'Armée. Thence after a copy has been taken, it is transmitted, through the Headquarters of the Army, to the Adjutant General, for the information of the War Department. The drawing represents Ketcham's continuous profile-book, which is mostly used for route-sketching and general field notes. When this cannot be obtained, a book made of sheets of paper folded to half the letter size will answer. The record should run from the bottom to the top of each page.

Referring to the form on page 144, it is understood that the distance, in miles, between each of the horizontal divisions, will be noted in the column headed "*Distance*," which will be summed up at the top of each column, and the sum carried to the bottom of the next column. The notes within each horizontal division are to show the general directions of the march, and every object of interest observed in passing over the distance represented thereby; and all remarkable features, such as hills,



streams with their names, fords, springs, houses, villages, forests, marches, etc., and the places of encampment, will be sketched in their relative positions. The "*Remarks*," corresponding to each division, will be upon the soil, productions, quantity and quality of timber, grass, water and fords, nature of the roads, etc., and important incidents. They should show where provisions, forage, fuel, and water can be obtained; whether the streams to be crossed are fordable, miry, have quicksands or steep banks, and whether they overflow their banks in wet seasons; also the quality of the water; and, in brief, everything of practical importance. When a detachment leaves the main column, the point on the "route" will be noted, and the reason given in the *Remarks*. The Commander of the detachment will be furnished with a copy of the journal up to the point, and will continue it over his new line of march.

JOURNEE.—A term used among the French to express any particular engagement or battle; as *La journée de Marengo*. We frequently adopt the word in the same sense; thus, a hard-fought *day* signifies a hard-fought *battle*.

JOURS.—The tours of duty which are done in the course of a day and a night. *Etre de jour* is to be Officer of the Day, or to command a body of troops at a siege or otherwise in the capacity of a General Officer, etc.

JOURT.—The Kirghis-jourt is a capacious, solid, warm, and fire-proof structure, that admits of being pitched or taken to pieces in an hour, and withstands the cold and violent winds of the steppes of Central Asia, in a way that no tent or combination of tents could pretend to effect. A jourt of from 20 to 25, or even 30 feet in diameter, forms two camel-loads, or about half a ton in weight. One camel carries the felt, the other the wood-work. There are four separate parts in its structure: 1. The *door-way*, a solid piece of ornamental carpentering, that takes to pieces instantly. 2. The *sides* which consist of lengths of wood-work, that shut up on the principle of the *lazy-tongs*. 3. The *roof-ribs*. The bottom of each of these is tied to the sides of the jourt, and its top fits into a socket in 4. the *roof-ring*, which is a hoop of wood strengthened by transverse bars. Over this framework broad sheets of felt are thrown; their own weight makes them lie steadily, for they are quite an inch in thickness; however, in very stormy weather, they are weighted with stones. There is no metal in the structure.

JOUSTS.—Exercises of arms and horsemanship, performed in the Middle Ages by Knights and Nobles. In the joust the combatants engaged one another singly, each against his antagonist, and not in a troop, as in the tournament. The number of courses to be run and strokes to be given was generally three, but sometimes a larger number. The weapon most in use in the joust was the lance, but sometimes the battle-axe and sword were employed. To direct the lance anywhere but at the body of the antagonist was reckoned foul play. In the joust of peace or *joute de plaisance*, a foot encounter preceded the mounted combat. In the 15th century the usages of jousting had come to differ in different countries to such an extent that an elaborate treatise was written in explanation of the various modes distinguishing the characteristic differences.

JOUTE.—A close fight between two individuals. It likewise means an engagement at sea.

JOVES.—In fortification, the two sides in the epaulment of a battery which form the embrasure.

JOWHER.—A kind of watering in Oriental sword-blades and Damascus gun-barrels.

JOYEUSE.—The name given to the sword of Charlemagne.

JOZERAUNT.—Ancient armor; a jacket strengthened with plate. Also written *Jozerine*.

JUDGE ADVOCATE.—The title of an official attached to Military Commissions or Courts-Martial, whose duties are analagous to those of Prosecuting Attorneys in Civil Courts; but whose functions in relation to military law, are also similar to those of a District Attorney, or Corporation Counsel, in being of an advisory character. The appointment of Judge-Advocates for special Courts rests in the authority which appoints the Court, whether that be the President, the Secretary of War, or the Commander of the Army. But there is also in the United States Army a Corps of seven Judge Advocates with the rank of Major, who are under the general direction of the Judge Advocate General, and who can be detailed on Courts-Martial or Military Commissions, but are usually stationed at the Headquarters of the Military Departments, where they act as legal advisers to the Department Commanders, and may be appointed by them to Court-Martial duty. The official duties of a Judge Advocate during a trial by Court-Martial or Military Commission, or examination by a Court of Inquiry, are as follows: Preparation of the case for the prosecution, procuring of witnesses, administering the oath, opening the case for the prosecution with the necessary argument, questioning the witnesses, and submitting the case to the Court. But besides these duties the Judge Advocate has still another—seemingly anomalous in this connection—that of protecting the witness from improper or leading questions, and to that extent also acting as counsel for the accused. In the English military service the duties of the Judge Advocate have been so far modified that he does not act as Prosecutor, but solely in his advisory capacity in connection with the Court, and as the Recorder of its proceedings.

The Articles of War are silent on the subject of the Judge Advocate's assisting the Court with his counsel and advice as to any matters of form or law; it nevertheless is his duty, by custom, to explain any doubts which may arise in the course of its deliberations, and to prevent any irregularities or deviations from the regular form of proceedings. The duty assigned the Judge Advocate is more especially incumbent on him in cases where the prisoner has not the aid of professional counsel to direct him, which generally happens in the trials of private soldiers, who having had few advantages of education, or opportunities for mental improvement, stand greatly in need of advice under circumstances often sufficient to overwhelm the acutest intellect, and embarrass or suspend the powers of the most cultivated understanding. It is certainly not to be understood that, in discharging this office, which is prescribed solely by humanity, the Judge Advocate should, in the strictest sense consider himself as bound to the duty of counsel, by exerting his ingenuity to defend the prisoner, at all hazards, against those charges which, in his capacity of Prosecutor, he is, on the other hand, bound to urge and sustain by proof; for, understood to this extent, the one duty is utterly inconsistent with the other. All that is required is, that in the same manner as in Civil Courts of Criminal Jurisdiction, the Judges are understood to be counsel for the person accused, the Judge Advocate, in Court-Martial, shall do justice to the cause of the prisoner, by giving full weight to every circumstance or argument in his favor; shall bring the same fairly and completely into the view of the Court; shall suggest the supplying of all omissions in exculpatory evidence; shall engross in the written proceedings all matters which, either directly or by presumption, tend to the prisoners's defense; and finally, shall not avail himself of any advantage which superior knowledge, ability, or his influence with the Court may give him in, enforcing the conviction, rather than the acquittal, of the person accused.

When a Court-Martial is summoned by the proper authority, for the trial of any military offender, the Judge Advocate being required to attend to his duty, and furnished with articles of charge or accusation, on which he is to prosecute, must, from the information of the accuser, or other sources, instruct himself in all the circumstances of the case, and by what evidence the whole particulars are to be proved against the prisoner. Of these, it is proper that he should prepare, in writing, a short analysis, or plan, for his own regulation in the conduct of the trial, and examination of the witnesses. He ought then, if it has not been done by some other functionary, to give information to the prisoner of the time and place appointed for his trial, and furnish him, at the same time, with a copy of the charges that are to be exhibited against him, and likewise a correct detail of the Members of the Court. The Judge Advocate ought then to hand in to the Adjutant General, or Staff Officer charged with the details, a list of witnesses for the prosecution, in order that they may be summoned to give their attendance at the time and place appointed. It is proper, likewise, that he should desire the prisoner to make a similar application, to insure the attendance of the witnesses necessary for his defense. These measures ought to be taken as early as possible, that there may be sufficient time for the arrival of witnesses who may be at a distance. When the Court is met for trial, and the members are regularly sworn, the Judge Advocate, after opening the prosecution by a recital of the charges, together with such detail of circumstances as he may deem necessary, proceeds to examine his witnesses in support of the charges, while at the same time he acts as the Recorder or Clerk of the Court, in taking down the evidence in writing at full length, and as nearly as possible in the words of the witnesses. At the close of the business of each day, and in the interval before the next meeting of the Court, it is the duty of the Judge Advocate to make a fair copy of the proceedings; which he continues thus regularly to engross till the conclusion of the trial, when the whole is read over by him to the Court, before the Members proceed to deliberate and form their opinions. The sentence of the Court must be fairly engrossed and subjoined to the record copy of the proceedings; and the whole must be authenticated by the signature of the President of the Court and that of the Judge Advocate.

It is required by the Articles of War, that "Every Judge Advocate, or person officiating as such, at any General Court-Martial, shall transmit, with as much expedition as the opportunity of time and distance of place can admit, the original proceedings and sentence of such Court-Martial, to the Secretary of War; which said original proceedings and sentence shall be carefully kept and preserved in the office of the said Secretary, to the end that the persons entitled thereto, may be enabled, upon application to the said office, to obtain copies thereof." The Judge Advocate sends the proceedings to the Secretary of War through the Adjutant General. See *Court-Martial*.

JUDGE ADVOCATE GENERAL.—In England, the Supreme Judge, under the Mutiny Act and Articles of War, of the proceedings of Courts-Martial. This officer is also the adviser, in legal matters, of the Commander-in-Chief and Secretary of State for War. Before confirmation the sentences of all Courts-Martial, with the evidence adduced, are submitted to him; and it is for him to represent to the Commander-in-Chief any illegality of procedure, or other circumstance rendering it undesirable that the Queen should be advised to confirm the Court's decision. The Judge-Advocate-General receives a salary of £2,000, and is a member of the House of Commons and of the Ministry—changing, of course, with the latter. As it is essential that the Judge Advocate General should have an intimate acquaintance with the military law, as well as with the general law of the land, he is provided with an assistant or *Deputy*, whose office is permanent, and who is selected from among barristers of eminence. The *Deputy Judge Advocate* is an officer holding a temporary commission as Public Prosecutor in every Court-Martial. He must be an officer of intelligence, as it is part of his duty to examine and cross-examine witnesses, to warn the members of the Court of any illegality in their proceedings, and generally to fulfill, in the limited area of the Court, the functions which belong to the Judge Advocate General.

In the United States, the Judge Advocate General is the Chief of the Bureau of Military Justice at Washington with the rank of Brigadier General. To him the proceedings of all Courts-Martial, Courts of Inquiry, and Military Commissions are forwarded for revision and record. In England the Judge Advocate General is the final legal authority for the Army, and the adviser of the Crown in cases where any action of the Sovereign is required. His power is supreme as to reviewing the proceedings of Courts-Martial, etc. See *Bureau of Military Justice*.

JUDGE-MARTIAL.—In former years the Supreme Judge in Martial Law, as to the jurisdiction and powers of Military Courts in the British system.

JUDSON POWDER.—A low grade high-explosive, invented by Egbert Judson, of San Francisco, California, and patented in 1876, since which time it has been manufactured in large quantities at Berkley, California, and has grown rapidly in favor with all who have used it, taking the place of black powder in heavy work. It is not a high explosive and cannot be used for such work as is intended for Giant, Atlas or Hercules powder, but wherever black powder is in use Judson powder can be substituted to great advantage. As this powder contains nitro-glycerine it becomes hard in cold weather (at about 45° F). When in this state it readily breaks up into grains by a little pressure and can then be poured like sand into the smallest crevice. When using frozen powder, it is necessary to use a priming cartridge of Giant, and to always have this cartridge soft. For blasting or quarry work, Judson powder is put up in water-proof paper-bags, containing 6¼, 12½ and 25 pounds each, and 8, 4 and 2 bags respectively are put in wooden boxes holding 50 pounds. It is also put up in water-proof cartridges of any size desired for special purposes. See *High Explosives*.

JUMP.—A gun-barrel made of a ribbon of iron, or laminated iron and steel, coiled around a mandrel at a red heat, then raised to a welding heat and placed on a cylindrical rod, which is struck heavily and vertically on the ground, is said to be *jumped*. The effect is to cause the edges of the ribbon to unite, a junction which is completed by the hammer on an anvil, the mandrel retaining its position. Such barrels are said to be *twisted*. The twist is *stub*, *wire*, or *Damascus*, according to the mode of manufacture of the ribbon. See *Gun-barrel*, and *Twist*.

JUMP OF A GUN.—The increased angle of departure at which a projectile leaves a gun, after the gun has been truly levelled at the target or object to be struck. The method usually pursued to ascertain the "jump" of a gun is to place a target at 120 feet from the gun which has been truly levelled, so as to be horizontal. On firing the gun, the position of the hits on the target determines the "jump" as, if above the level on the target, it shows that the projectile has left the piece with a certain amount of elevation; if it had not been so, gravity would have brought the shot below the level on the target. This "jump" is due to the tendency the gun and carriage have to rotate on the trail. Experiment has shown that the "jump" which the system makes before the projectile leaves the muzzle is much affected by the nature of the rifling. A breech-loading gun in which the shot is forced through the bore, "jumps" more than a muzzle-loading gun of the same weight and length.

JUNCTION-BOX.—In submarine mining, when it is necessary to employ a multiple cable, a junction-box is used to facilitate the connection of the several separate wires diverging from the extremities of such a cable. In one angle of such a box the multiple cable is introduced, while the cables make their exit on the opposite sides and pass to different mines. The ends of the cables are secured from pulling out by hooked nippers. Each multiple cable is composed of seven cores, and each of these is connected by means of joints with the mine cables within the junction-box. The boxes are usually made of cast metal and must, as an essential condition, be perfectly water-tight. They are of various forms, depending upon the object for which each is to be used. They should be supplied with the other apparatus for laying mines.

A junction-box should be placed in such position as to be easily attained, even in the presence of an enemy, and its buoy should, if possible, not be seen. It is also very essential that it should be in a safe and guarded position, for any injury to the junction-box or multiple cable would be fatal to the group of mines in connection.

JUNIOR.—Any one having a lower rank. When the grade is the same, the junior has the more recent commission or warrant.

JUNK.—1. Pieces of old cable or cordage, used for making points, gaskets, etc. When picked to pieces, it is much used in the arsenal instead of oakum. 2. A familiar term in the British Army and Navy for the salt meat supplied for long trips—the name being probably derived from the fact that it becomes as hard and tough as old rope, pieces of which are officially styled junk.

JUNK WADS.—Wads used for proving cannon. Wad-molds for each caliber, consisting of two cast-iron cylinders of different diameters set in oak, or of two strong pieces, strapped with iron, and joined by a hinge, are employed in their manufacture. The junk, after having been picked, is compressed by being beaten in the smaller mold with a *maul* and *cylindrical drift*—the latter nearly of the size of the mold—until it assumes the requisite dimensions; it is then taken out by raising the upper part of the mold, and closely wrapped with rope-yarn passed over it in the direction of the axis of the cylinder, and fastened by a few turns around the middle of the wad. It is then placed in the large mold, and again beaten with the maul and drift until its diameter is increased to that of the mold; when it is taken out and its diameter verified by a wooden gauge corresponding to the large shot-gauge of the caliber.

JUPON—JUST AU CORPS.—A surcoat. The name jupon is chiefly applied to the short, tight form of that military garment in use in the 14th century. It was a sleeveless jacket or overcoat, composed of several thicknesses of material sewed through, and faced with silk or velvet, upon which were embroidered the arms of the wearer. It fitted closely to the body, and, descending below the hips, terminated in an enriched border of various patterns.

JURISDICTION.—All officers, conductors, gunners, matrosses, drivers, or other persons whatsoever, receiving pay, or hire, in the service of the Artillery, or Corps of Engineers of the United States, are subject to be tried by Courts-Martial, in like manner with the officers and soldiers of the other troops in the service of the United States. The officers and soldiers of any troops, whether militia or others, being mustered and in pay of the United States, are at all times and in all places, when joined or acting in conjunction with the regular forces of the United States, governed by these Rules and Articles of War, and are subject to be tried by Courts-Martial, in like manner with the officers and soldiers in the regular forces, save only that such Courts-Martial are composed entirely of militia officers. No person is liable to be tried and punished by a General Court-Martial for any offense which shall appear to have been committed more than two years before the issuing of the order for such trial, unless the person, by reason of having absented himself, or some other manifest impediment, shall not have been amenable to justice within that period.

Can Courts-Martial and Civil Courts have concurrent jurisdiction over offenses committed by soldiers? Or, in other words, if a soldier is guilty of an offense which renders him amenable for trial before the Civil Courts of the land, can he also be tried for that offense (if its specification should establish a violation of the Rules and Articles of War) by a Court-Martial? By the Constitution of the United States Congress is authorized "To make rules for the government and regulation of the land and naval forces;" and Congress, pursuant to this authority, has established Rules and Articles for the government of the armies of the United States. These Rules are an additional code, to which every citizen who becomes a soldier subjects himself for the preservation of good order and military dicipline. The soldier, however, is still only a citizen of the United States. He has not, by assuming the military character become, as is the case in very many European countries, a member of any fully privileged body who may claim trial for all offenses by Courts-Martial. He is still amenable to the ordinary Common Law Courts for any offenses against the persons or property of any citizen of any of the United States, such as is punishable by the known laws of the land. An examination of the Rules and Articles of War will show that the offenses therein described, and against which punishment is denounced, are purely military. They are crimes which impair the efficiency of the military body, and even in cases in which they would be recognized as offenses by the ordinary Common Law Courts, they could not be considered the *same offenses*. Take, for instance, Article 21, which inflicts the punishment of death, or other punishment, according to the nature of his offense, upon any officer or soldier who shall strike his Superior Officer. Here is an offense punishable under the known laws of the land as an assault and battery, and, as such, it could be tried by the Common Law Courts. But such trial would not prevent a Court-Martial from afterwards taking cognizance of it under Article 21; for the offense before the Common Law Court would be striking an *equal*, while before the Military Court it would have essentially changed its character. Again, suppose an officer had been guilty of stealing, he might be prosecuted before the Common Law Court for the felony, and afterwards charged with conduct unbecoming an officer and a gentleman, and dismissed the service. It can hardly be contended that the offenses in either of the cases cited would be the *same* before the different Courts; and if not, the Article which forbids a trial a second time for the same offense, could not be pleaded in bar of trial. Recognizing, then, the principle that the soldier, as a citizen, is subject to the Common Law Courts for offenses committed against the well-being of the State, it must also be recollected that he is subject to trial by a Court-Martial for any violation of the Rules and Articles of War. In the case of "Eels, plaintiff in error, *v.* the People of the State of Illinois," it was urged that the Act of the State of Illinois under which Eels was tried was void, as it would subject the delinquent to a double punishment for the same offense, the crime with which he was charged being actionable under a law of the United States. The Supreme Court decided that, admitting the plaintiff in error to be liable to an action under the Act of Congress, it did not follow he would be twice punished for the same *offense*, and gave the following definition of that term:

An offense in its legal signification means the transgression of a law. A man may be compelled to make reparation in damages to the injured party and be liable also to punishment for a breach of the public peace in consequence of the same act, and may be said, in common parlance, to be twice punished for the same offense. Every citizen of the United States is also a citizen of a State or Territory. He may be said to owe allegiance to two Sovereigns and may be liable to punishment for an infraction of the laws of either. The same act may be an offense or transgression of the laws of both. Thus an assault upon the Marshal of the United States and hindering him in the execution of legal process is a high offense against the United States, for which the perpetrator is liable to punishment; and the same act may also be a gross breach of the peace of the State, a riot, assault, or a murder, and subject the same person to a punishment under the State laws for a misdemeanor or felony. That either or both may, if they see fit, punish such an offender cannot be doubted. Yet it cannot be truly averred that the offender has been twice punished for the same offense, but only that by one act he has committed two offenses, for each of which he is justly punishable. He could not plead the punishment by one in bar to a conviction by the other.

JUSTAUCORPS.—An ancient tight-fitting coat, having a military appearance and constructed of cords. A simple primitive prototype of mail-armor.

JUSTIFIABLE HOMICIDE.—The killing of a human creature without incurring legal guilt, as where a man is duly sentenced to be hanged; where one, in self-defense, necessarily kills another to preserve his own life, etc.

JUTE.—The jute of commerce is a fiber produced from two species of *tiliaceae*, the *corchorus olitorius* and *corchorus capsularis*, two plants, alike in qualities, though slightly different in appearance, and sown indiscriminately; the first having round seed-pods and reddish stalk, the latter long seed-pods and bright green stalk. From the fiber, which is the cheapest known are produced gunnies, gunny-cloth and cordage, and from the finer qualities, carpets, shirting, coat-linings, etc., are made. It is extensively used for mixing with silk, cotton, and woolen fabrics, and also in paper-making, while the leaves are eaten in many places as food. The first mention of the word jute is in 1796, in the manuscript commercial index of the Court of Directors of the East India Company. It is the Bengali name used by the natives of Cuttack and Balasore, where the first European manufactories were established in the middle of the last century. In 1829 the total export from Calcutta was 20 tons, value £60. In 1833 it had increased sixteen fold, and about 1864-65 the increased demand caused jute cultivation to extend to other districts, the exportation in 1872-73 reaching the enormous amount of 300,000 tons, value £3,500,000. England, Bombay, and America originally divided the exports of jute, and up to the time of the civil war North America took the largest share of the gunnies. Jute and gunnies are now exported from Bengal largely to France, Australia, and other parts of the world. Jute grown in England is not remunerative. It has been successfully grown in small quantities in America, however. Gunnies are classed as Nos. 1, 2, and 3. No. 1, thick and close woven, is used for sugar, fine grains such as linseed or rape-seed, and similar products; No. 2, also close woven, but thinner, for rice and all the larger grains; No. 3, very thick, coarse, and open, is principally suited for the outer covering of double bags. The manufacture of gunny with primitive looms is a common form of convict labor in Bengal. Near the Himalayas, in north-eastern Bengal, the natives wear a fine cloth of their own manufacture, made of jute, or of jute and cotton. Increased demand has lately induced jute production in Burmah, Italy, Queensland, and America, etc; and a European Company has been started to cultivate jute in British Burmah on a large scale. The manufacture, again, is largely carried on in Great Britain, and is the chief industry of Dundee and Belfast. In Bengal jute valued at about a million sterling is annually manufactured, mostly for local consumption, the bulk being turned out by the English mills, of which there are several near Calcutta, employing thousands of hands, the Gauripore and Barnagore mills being the principal.

JUZAIL. A very heavy rifle used by the Afghans.

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KABBADE.—A military garment of the Modern Greeks. It was generally made of wool, without sleeves, and fastened by a girdle around the waist. It was also frequently worn by both the Romans and Gauls. See *Sagum*.

KAISER.—The German title of Emperor. It was derived from that of Cæsar, permitted by Diocletian to be used by the governing Prince of Dalmatia, Croatia, and the line of the Danube, who was Heir Presumptive to the Imperial Throne. The term was employed by the German Emperors of the Middle Ages, and later by the Emperors of Austria. In 1871 it was assumed by William I., of Prussia, on his being crowned Emperor of Germany.

KAJAWAHS.—An Indian term. Large panniers, placed across a camel's back, in which camp kettles, pots, etc., are carried on the march. The panniers are large enough to carry disabled men with much ease and comfort.

KAKTOWDA.—A term applied in the East Indies to the fine mold used in making butts for archery practice.

KALAI.—A Turkish fortress. The term is rather particularly applied to stoccades or very similar structures.

KALMUCKS.—The Kalmucks, or, as they call themselves, the Derben-Ueirat (the four relatives), and also designated by the name of Eleutes and Khalimik (apostates), are the most numerous and celebrated of the Mongol Nations. They are divided into four tribes, the first of which, the *Khoskôts* (warriors) number nearly 60,000 families, and inhabit the country round the Koko-nur, which they consider the native country of the race. One portion of this tribe migrated to the banks of the Irtisch, and became subsequently incorporated with the second tribe, the Dzûngars; another portion migrated to the banks of the Volga, in the 17th century, and is found at the present day in the goverment of Astrakhan. The second tribe are the *Dzûngars*, who give the name to a large territory (Dzûngaria) in the west of Chinese Tartary; at the present day they number about 20,000 families. The third tribe are the *Derbets* or *Tchoros*, who deserted Dzûngaria, and finally, to the number of 15,000 families, removed a few years ago to the plains of the Ili and the Don, where they are being rapidly incorporated with the Don Cossacks. The fourth great tribe of the Kalmucks are the *Torgots*, who, about 1660, separated from the Dzûngars, and settled in the plains of the Volga whence they were called the *Kalmucks of the Volga;* but finding the Russian rule too severe, the majority returned to Dzûngaria.

No Mongol or Turkish race presents such characteristic traits as the Kalmucks; indeed they answer exactly to the description given of them by Jornandes 13 centuries ago, when, under the name of Huns, they devastated southern Europe. The Kalmuck is short in stature, with broad shoulders and a large head; has small, black eyes, always appearing to be half shut, and slanting downwards towards the nose, which is flat, with wide nostrils; the hair is black, coarse, and straight, and the complexion deeply swarthy. The Kalmuck is considered as the original type of the Mongol and Manchû races, and his ugliness is the index of the purity of his descent. They are a nomad, predatory, and warlike race, and pass the greater part of their lives in the saddle. Their usual food is barley-flour soaked with water, and their drink is the "koumiss" (made from fermented mare's milk). In 1829 Russia established a Kalmuck Institute for the training of interpreters and government officials for the Kalmucks of Russia, and she has since been making great efforts to introduce civilization among them. Most of the Kalmucks are Buddhists, but a few have adopted Mohammedanism or Christianity.

KALSA CUTCHERRY.—The room of business, where matters pertaining to the Indian Army are transacted, and all matters of litigation on that branch of service are determined.

KAMPAK.—A kind of hatchet saber of the Middle Ages, without a hilt or cross-guard. The handle is made quite straight, and it forms with the blade a Latin cross.

KAMPTULICON.—The name given to a kind of floor-cloth, which is said to be made of india rubber and cork; much of it however, consists of oxidized linseed-oil and cork. The cork is reduced to a state resembling very fine sawdust, and kneaded up with the real caoutchouc, or with the artificial kind made of oxidized linseed-oil, the whole being kept very soft by heat. The mass is then made into sheets by passing through cylinder rollers heated with steam. The sheets, when cold, are ready for use, when no ornamental surface is required; but very excellent designs may be painted upon it, the same as upon ordinary floor-cloth. Kamptulicon, notwithstanding the ease with which it is made, is more expensive than floor-cloth made by painting hempen or linen fabrics; it has, however qualities which render it very valuable for special purposes; its elasticity to the tread not only makes it agreeable to walk on, but it is noiseless, and is consequently well adapted for hospital passages and other positions in which quiet is desirable; it is also impervious to damp, and thereby well suited to damp stone floors. It is also very suitable for floor-cloths in powder-houses, but is not so durable as leather hides.

KANAUT.—A term used in India to designate the wall of a canvas tent. Sometimes written *Kanat.*

KANDGIAR.—A Turkish sword very much like the yataghans and flissas. It is generally single-edged, without guards. It is very often ornamented with diamonds and other precious stones. Also written *Kangiar.*

KAPIGI-BACHI.—The officer in charge of the gates of the Sultan's Palace. The name is also applied to a Turkish warrior. The name *Karauls* is given to the Sultan's body-guards.

KARTTIKEYA.—The Hindu Mars, or god of war, a being represented by the Purânic legends as sprung from Siva, after a most miraculous fashion. The germ of Karttikeya having fallen into the Ganges, it was on the banks of this river, in a meadow of Sara grass, that the offspring of Siva arose; and as it happened that he was seen by six Nymphs, the *Krittikâs* (or Pleiades), the child assumed six faces, to receive nurture from each. Grown up, he fulfilled his mission in killing Târaka, the demon king, whose power, acquired by penances and austerities, threatened the very existence of the gods. He accomplished, besides, other heroic deeds in his battles with the giants, and became the Commander-in-Chief of the divine armies. Having been brought up by the Krittikâs, he is called *Kârttikeya*, or *Shânmâtura*, the son of six mothers; and from the circumstances adverted to, he bears also the names of *Gângeya*, the son of Gangâ; *Sarabhû*, reared in Sara grass; *Shanmukha*, the god with the six faces, etc. One of his common appellations is *Kumarâ*, youthful, since he is generally represented as a fine youth; and as he is riding on a peacock, he receives sometimes an epithet like *Sikhivâhâna*, or "the god whose vehicle is the peacock."

KATAITYX.—A Greek casque, of the 8th century, B.C. It was made of leather and provided with a chin-strap, but had no crest.

KATAN.—A Japanese sword. Commonly called *Cattan.*

KATZENKOPF.—The German name for the *wheel-lock* and *mortar* pistol of the eleventh century.

KAVASS.—In Turkey, an armed Constable. The term is also applied to a government servant or courier.

KECHERKLECHI.—Guards attached to the person of the King of Persia: they are armed with a musket of an extraordinary size and caliber. The Kecherklechi were enlisted and formed into a regular Corps about the middle of the 18th century.

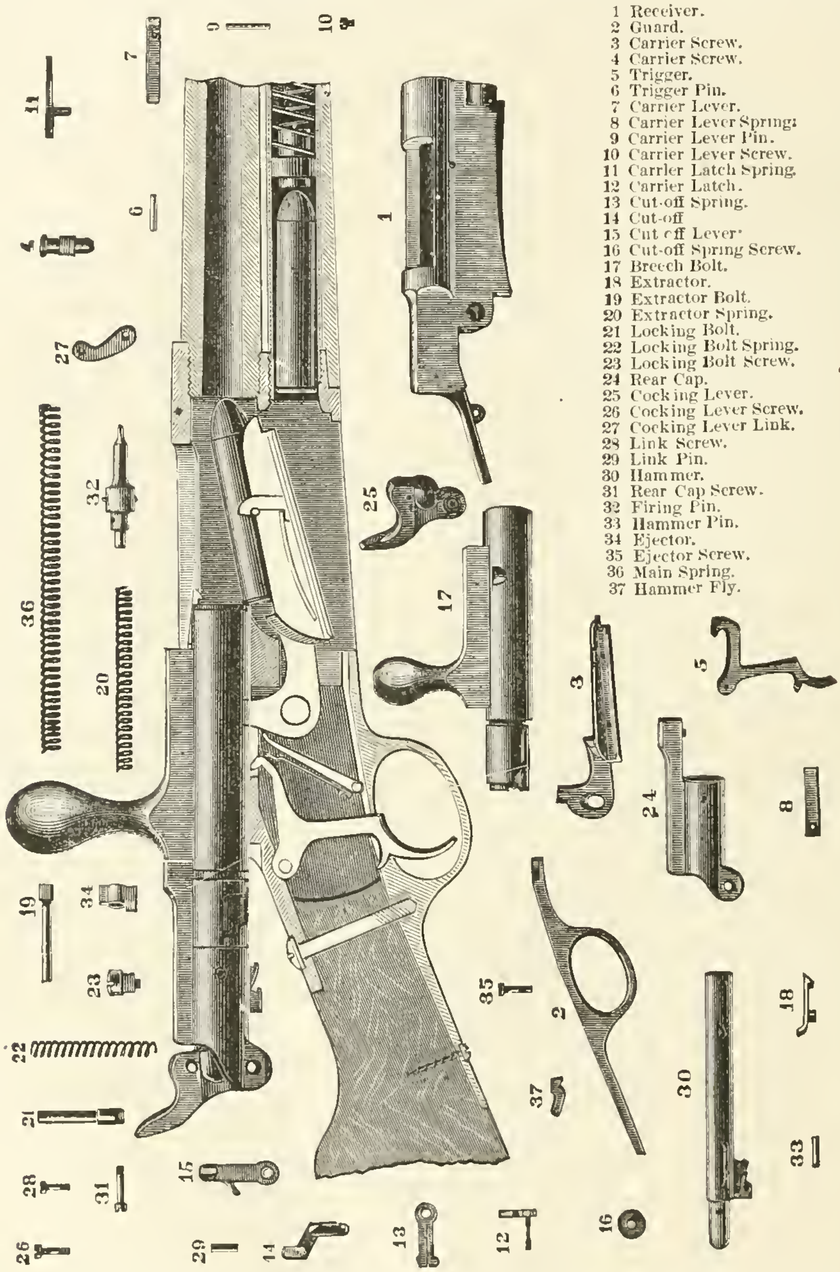
KEENE-REMINGTON MAGAZINE-GUN.—This gun is now made for the United States military cartridge, forty-five caliber, seventy grains of powder, but can be adapted to the use of other forms of military cartridge, such as the Spanish and Russian. The magazine is located under the barrel, thereby enabling it to carry the greatest possible number of cartridges within a given weight and length of barrel. It is believed that this is, for many reasons, the best position in which to carry the cartridges of a magazine-gun.

All of the motions are direct and positive. The cartridges are held securely in position while passing from the magazine over the carrier to the chamber in the barrel, in which respect it has a decided advantage over other magazine-arms. The cartridge does not pass on to the carrier until the gun is opened for the purpose of loading, so that there is no danger of a cartridge being exploded in the carrier in case a defective cartridge is fired in the gun.

ing the finger from the trigger; in this last respect differing from other magazine-guns, which can only be cocked by removing the hand from the trigger.

The parts are all large and strong, and can be readily removed and replaced for the purpose of cleaning or inspection. The magazine is so arranged that it can be charged while the breech is closed, thus avoiding the entrance of dirt into the working parts of the gun. The gun may be held either barrel up or reversed for this purpose. The drawing exhibits the parts with the nomenclature.

To charge the magazine.—Hold the arm in the left hand, the butt-stock under the right arm. Grasp the

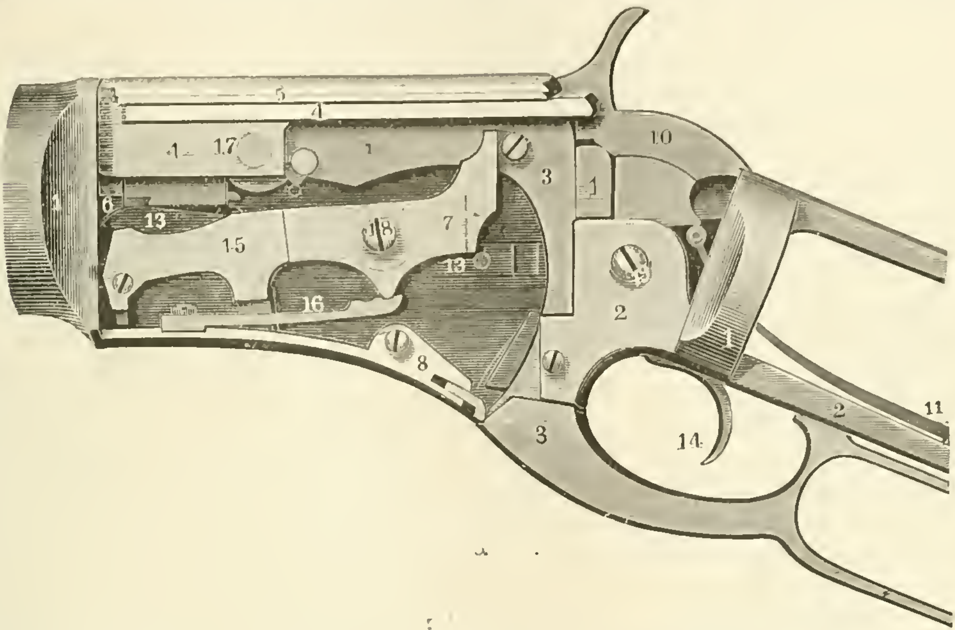


1 Receiver.
2 Guard.
3 Carrier Screw.
4 Carrier Screw.
5 Trigger.
6 Trigger Pin.
7 Carrier Lever.
8 Carrier Lever Spring.
9 Carrier Lever Pin.
10 Carrier Lever Screw.
11 Carrier Latch Spring.
12 Carrier Latch.
13 Cut-off Spring.
14 Cut-off
15 Cut off Lever.
16 Cut-off Spring Screw.
17 Breech Bolt.
18 Extractor.
19 Extractor Bolt.
20 Extractor Spring.
21 Locking Bolt.
22 Locking Bolt Spring.
23 Locking Bolt Screw.
24 Rear Cap.
25 Cocking Lever.
26 Cocking Lever Screw.
27 Cocking Lever Link.
28 Link Screw.
29 Link Pin.
30 Hammer.
31 Rear Cap Screw.
32 Firing Pin.
33 Hammer Pin.
34 Ejector.
35 Ejector Screw.
36 Main Spring.
37 Hammer Fly.

The arm is always left at half-cock, and the breech locked so that it cannot be jarred open and the cartridge lost out. From the half-cock it can be brought to the full-cock readily and quickly while the arm is being carried to the shoulder, and without *remov-*

cartridge between the thumb and the forefinger of right hand, and press it forward, bullet first, into the magazine with the end of the thumb, which may be held sideways for that purpose. The magazine may be charged with the breech either open or closed, and with the cut-off lever in its forward or backward position; but it is more convenient to do so with the breech *closed* and the cut-off lever *back*.

To load from the magazine.—First. If the arm has been fired or the hammer is down, unlock and draw back the breech-bolt *quickly* and with sufficient force to bring it *clear back*, thereby raising and locking the carrier and bringing up a cartridge. Shove the bolt forward and lock it; the hammer will remain at half-cock. If it is desired to fire, the hammer may be brought to full-cock while the arm is being lifted to the shoulder, the forefinger remaining on the trigger. Second. If the arm has been closed and left at half-cock, lower the hammer and then proceed as before. After the cartridge has been transferred from the magazine to the chamber, it should either be fired or removed from the gun before another cartridge is passed through the carrier.



1, receiver; 2, bottom tang; 3, lever; 4, breech-block; 5, top cover; 6, ejector; 7, carrier-block; 8, bottom plate; 10, hammer; 11, main spring; 13, side-loading spring cover, as seen from the back; 14, trigger; 15, carrier-block clamp; 16, carrier-block spring; 17, breech-block pin; 18, carrier-block screw.

To use the arm as a single loader, with the magazine in reserve, push the cut-off lever forward. This cuts off the passage of the cartridge from the magazine. The arm may then be used as a single loader. This gun is so made as to be left at half-cock after loading; but if it is preferred to have it left at full-cock, it is only necessary to remove the hammer fly, No. 37, which is let into the tumbler to carry the trigger over the full-cock notch. See *Magazine-gun*.

KEEP.—In mediæval fortification, a keep was the central and principal tower or building of a castle, and that to which the garrison retired, as a last resort, when the outer ramparts had fallen. A fine specimen of the ancient keep is still extant amid the ruins of the Rochester castle. The keep was similar to what the classical ancients called the citadel, inner fort. See *Castle*, *Fortification* and *Safety Redoubt*.

KEIR-METAL.—An alloy patented in England, which differs from *sterro-metal* mainly in having no tin. This alloy consists of copper 100, zinc 75, iron 10.

KELT.—A very early war-axe. It seems to have been spread in every direction, and to have belonged to no country in particular. It was also called *Celt*.

KENNEDY RIFLE.—A novel rifle developed and introduced by the Whitney Arms Company. It is a repeating or magazine-rifle, with the magazine placed under the barrel, and is operated by a lever, the backward and forward movement of which cocks the hammer, opens the breech, throws out the empty shell, and brings a new cartridge into place, ready for discharge. The drawing shows the action.

The following may be noted as the advantages of this arm:—It has all the requirements requisite to a first-class magazine-gun. It is of simple construction, and has fewer parts than any other magazine-rifle operated by a lever. It is strong. The parts are of such size and form as not to be liable to break or get out of order. It is made of the best material, wrought iron or steel, as is most suitable for each part. It is very easily manipulated, and can readily be understood by any person who is at all familiar with fire-arms. It is safe, accidents from premature discharge being impossible. The resistance to the discharge is in direct line with the bore of the barrel. The firing pin cannot reach the head of the cartridge until the breech is fully closed—consequently, the piece can only be fired when the breech is locked. *The cartridge used is the 45-caliber center-fire, United States Government standard, containing 70 grains of powder and 400 grains of lead.* When a lighter charge is desired, the United States carbine cartridge—the same length as the above—but loaded with only 55 grains of powder, may be used. The magazine is charged through the side of the receiver when the breech is closed, and the rifle can be used as a single loader, the charged magazine being held in reserve.

The arm is made in three styles:—The *musket* weighs 9 lbs. 4 oz. The barrel is 33 inch. It carries when loaded, 11 cartridges. The *carbine* weighs 7 lbs. 8 oz. The barrel is 22 inch. It carries when loaded, 7 cartridges. The *sporting rifle* weighs 9 to 10 lbs. The barrel is 28 inch. It carries when loaded, 9 cartridges. See *Phoenix* and *Whitney Rifle*.

KENT-BUGLE.—The key-bugle invented by Logier early in this century, and named after the Duke of Kent, the father of Queen Victoria. It has six keys, and is the predecessor of the great tribe of cornets. It will traverse chromatically a compass of more than two octaves, beginning from B flat beneath the stave up to the C above. The bugle with pistons or with cylinders has a lower compass than the preceding.

KENTLEDGE.—Old cast-iron articles which have become unserviceable, such as condemned guns, shot and shell, etc.

KERANA.—A long trumpet, similar in shape and size to the speaking-trumpet. The Persians use it whenever they wish to make any extraordinary noise, and they frequently blow it with hautboys, kettle-drums, and other instruments, at retreat or sunset, and two hours after mid-night.

KERN.—A name applied formerly to Irish and Gaelic infantry soldiers. The men in those days were armed with a sword and a dart or javelin, which was tied to a small cord, so that after they had thrown it at the enemy they could instantly recover it, and use it in any way they thought proper. The javelin was called *skene* which is also the Irish for a knife.

KET'S REBELLION.— An outbreak which took place in England, in 1549, under the leadership of William Ket, a tanner, living in Wymondham, Norfolk. He is said to have had 20,000 followers; but the rising was suppressed by the Earl of Warwick, after an engagement in which more than 2,000 of Insurgents were killed. The leader, Ket, with others, suffered death on the gallows.

KETTLE-DRUM.—1. A drum formed by stretching vellum over the circular edge of a hemispherical vessel of brass or copper. This instrument, which gives forth a sharp ringing sound, is used by regiments of cavalry and horse-artillery in lieu of the ordinary cylindrical drum, which would, from its shape, be inconvenient on horseback

The small military drum is frequently called by this name. They are still used in pairs, in the English and Prussian armies, and elsewhere, slung on each side of the withers of a cavalry-horse. One

drum is tuned to the keynote, and the other to the fifth of the key. The tuning is by a hoop and screws. Kettle-drums are not used in the United States military service, but are much used in orchestras supported upon a tripod, as shown in the drawing. 2. Kettle-drum, as applied to a social gathering, originated in the British army in India. It sometimes happened in the emergencies of camp life that in an entertainment given by officers and their wives there was a lack of requisite furniture, and the heads of kettle-drums were made to serve in place of tables to hold the cups of tea. So by metonymy the article used gave name to the occasion on which it was used. The name came to mean an informal party, and specifically an afternoon party, in which elaborate dress and costly viands gave place to every-day attire for ladies and business suits for gentlemen, with very simple side-table refreshments. This kind of visit was introduced into England at a time of general financial depression by some who wished to meet their friends socially, yet could not, as before, dress expensively and entertain sumptuously.

KETTLE-DRUM CART.—A four-wheeled carriage drawn by four horses, which was used exclusively by the British Artillery as a pageant. The Ordnance flag was painted on the fore part, and the drummer, with two kettle-drums, was seated, as in a chair of state, on the back part. This cart, which is finely engraved and richly gilt, has not been in the field since 1743, when the King was present. It is at present kept in the Tower of London.

KETTLE-HAT.—A cap of iron worn by knights in the Middle Ages.

KEY.—1. A bolt used on artillery carriages to secure cap-squares and for analogous purposes. A *key-chain*, is attached to the key to prevent it from being lost. 2. A common heraldic bearing in the insignia of sees and religious houses—particularly such as are under the patronage of St. Peter. Two keys in saltire are frequent, and keys are sometimes *interlaced* or linked together at the *bows*—i.e., rings. Keys *indorsed* are placed side by side, the wards away from each other. In secular Heraldry, keys sometimes denote Office in the State. See *Key-point.*

KEY-POINT.—A point the possession of which gives the control of that position or country. Great care must be taken to always direct an assault upon the key-point of the position in order that the main attack, when successful, may produce a lasting benefit. When about to commence the operations of a siege, the General is called upon to decide the following: 1. Which part of the position is easiest to carry; 2. Which part, carried, gives possession of the rest; or, which part is the *key-point;* 3. Which side of the part selected is the best on which to make his approaches; and, 4. Which part selected would be the best, taking into consideration the establishment of his depots and lines of supply, and the probabilities of an attempt to relieve the besieged. These questions are partially answered before the posting of the besieging army is completed, as it would be bad policy to have the troops encamped too far from the ground where the main operations of the siege are to be conducted. See *Point of Attack.*

KEYSERLICKS.—A name commonly applied to the Austrian troops. The term was indeed common among the British soldiers, when they did duty with the Austrians, and invaded France in 1794. See *Imperialists*

KHALASSIE.—An Indian sailor. This race of men come chiefly from the Chittagong district. Besides a sea life, khalassies take service on shore, and form a large portion of the native establishment attached to arsenals in India, bordering on the seaside. During the march of a regiment in that country, they are employed in looking after the camp equipage.

KHAN.—A title of Mongolian or Tartar Sovereigns and Lords. A *Khanate* is a principality. *Khagan* means "Khan of Khans," but has seldom been applied. The word Khan is probably of the same origin as King.

KHEDIVE.—One of the titles of the Ruler of Egypt, a tributary prince of the Sublime Porte, who, since 1867, has exercised absolute power within his own dominions. The first Khedive was Ismaïl, Sovereign of Nubia, Soudan, Kordofan, and Darfour, son of Ibrahim Pasha (eldest son of Mohammed Ali Pasha, founder of the dynasty), was born in 1830, and succeeded his uncle, Saïd Pasha, in 1863, as the fourth Viceroy of Egypt. He traveled through the Capitals of Europe, informing himself concerning their manners and customs, and these he introduced into his own dominions on his return. He fell under the displeasure of the Sultan, through the jealous fears of the latter regarding European ascendency in Egypt, but succeeded in obtaining from him important concessions. By a firman dated May 21, 1866, he gained the right of the succession in the direct masculine line in his branch; by that of June 8, 1867, the title *Khedive*, or Sovereign, was granted him; and by the firman of Sept. 29, 1872, he obtained the right to increase his army and navy at his pleasure, and to borrow money. Finally, he was conceded, in 1873, the right to conclude treaties of commerce, with the full autonomy of the administration of the Country. Yet despite all this, the Sultan retained in his hands the disposition of the Government in Egypt, since, in April, 1879, he proposed to the Western Powers to dispose Ismaïl in favor of his uncle, Halim Pasha, the rightful heir. This proposition was not received favorably, though repeated in June, and the Sultan was finally induced to issue a firman deposing Ismaïl in favor of his son, Prince Mohammed Tevfik. This was on June 26, and the firman abolished that of 1873, and deprived the Khedive of the power to conclude treaties with Foreign Powers, and to maintain a standing army. Ismaïl Pasha accordingly quitting the throne, his son was proclaimed Khedive, under the title of Tevfik I.

KHODADAUD SIRCAR.—The Government or Ruler blessed or beloved of God; it was a title assumed by Tippoo Sahib, the Sovereign of the Kingdom of Mysore, who fell in defense of his Capital, Seringapatam, when it was stormed, May 4, 1799, by the British forces under Lieutenant General Haiarri.

KHOP.—An early Egyptian iron weapon, about 6 inches long and roughly formed, from stone, in the shape of a sceax.

KHOUTTAR.—A Hindoo weapon, having a large blade like the Italian *anelace*, fixed on to a square handle, into which the hand is slipped, and thus protected as far as the wrist. There are *Khouttars* in which the blade is divided into two points, but they are not common. Such are called serpent-tongued.

KHYBER PASS.—The most practicable of all openings, four in number, through the Khyber Mountains, and the only one by which cannon are conveyed between the plain of Peshawur, on the right bank of the upper Indus, and the plain of Jelalabad, in northern Afghanistan. It is 30 miles in length, being here and there merely a narrow ravine between almost perpendicular rocks of at lest 600 feet in height. It may be said to have been the key of the adjacent regions in either direction from the days of Alexander the Great to the Afghan Wars of 1839-42, during which it was twice forced by a British army, in spite of an obstinate defense by the natives. The first fighting in the Afghan War of 1878-79 was in forcing an entrance into this pass, over which, as was stipulated in the conditions of peace, the Anglo-Indian authorities are henceforth to have full control.

KIBEE.—A flaw produced in the bore of a gun by a shot striking against it.

KICKING-STRAP.—A strap used in draught to control a violent horse. One or two should be attached to each horse battery. It is fastened to the shafts, and passes over the croup of the horse, thereby preventing him from kicking.

KIDNAPPERS.—A name formerly applied to parties who by improper means decoyed the unwary into the army.

KILLA.—The Indian term for castle, fort, or fortress. The Governor or Commandant of a Killa is known as *Killadar*.

KILLESE.—A name commonly given to the groove in a cross-bow.

KILMAINHAM HOSPITAL.—An institution near Dublin for the reception of wounded and pensioned soldiers. It was originally founded by King Charles II., and is conducted on similar principles to the sister Institution, Chelsea Hospital. Kilmainham Hospital is maintained by annual Parliamentary grant, and provides everything necessary for the comfort of upwards of 250 veterans and officers. The General Commanding the Forces in Ireland for the time being is *ex officio* the Master of Kilmainham Hospital, and has his residence on the estate.

KILN.—A name applied to various kinds of furnaces, ovens, or other devices made of stone, brick, or iron, or of the material itself to be operated upon. They may be divided into intermittent and continuous, or perpetual; or into furnace-kilns, oven-kilns, and what may be termed mound-kilns, such as are used in making charcoal; and also a kind which are intermediate between oven and mound-kilns, as certain kinds of brick-kilns, where the raw-brick is a part of the kiln, and forms a structure which cannot be strictly called an oven. The *furnace-kiln*, for burning lime-stone, may be of an intermittent or of a perpetual kind. An intermittent kiln is one in which the fire is let to go out after the charge is burned; a continuous kiln is one which is so arranged that the charge may be removed and a fresh one put in while the fire is kept burning, and the furnace kept at its reducing heat. An intermittent furnace-kiln may be made of stone or brick of an oval form, like an egg standing on either end. That form resembling an egg standing on its larger end is perhaps the most common, although some lime-kilns are shaped more like deep bowls, without much contraction at the top. Where wood is very plentiful and cheap, and the lime is burned for agricultural purposes, so that ashes is a desirable ingredient, a common bowl shape is perhaps preferable, because it is readily charged with both limestone and wood, and a mass of wood may be placed upon the top in addition to what is used in the charge, by which thorough burning will be secured. In a furnace-kiln, a grating of iron is placed at the bottom, or an arch of open brickwork, and then the charge is ingeniously placed, first with fuel, and then with the broken masses of limestone in such a manner as to allow the flame to pass through and thoroughly perform the work of heating. These kilns may be from 10 to 30 feet high, or even higher. Intermittent oval kilns are used in burning Portland and other kinds of hydraulic cement, and they are 40 to 50 feet high, and employ coke or coal for fuel. The charge is usually composed of one part of coke or coal and two parts of raw cement. There are, however, several kinds of cement which do not require so prolonged high heat as Portland cement, and these might be burned in a kind of kiln so constructed as not to require the fire to go out when the burned contents are removed so frequently. These kilns are cylindrical, except at the bottom, where they have the shape of an inverted cone, and a chamber below and a kind of spout leading into it from the bottom of the cone, so that the charge when burned may be raked down from time to time with a suitable apparatus, and removed, while it may be renewed at the top. Cement-kilns should be lined with fire-brick. A preferable form of continuous kiln is one in which the kiln-cylinder is charged only with the material to be burned, and a current of flame or heated gas is introduced at the side near the bottom. The heat thus passing up through the material reduces it to the proper condition, without adding any portion of the ashes of the fuel to it.

KILT.—A dress worn by men living in the Highlands of Scotland, and by a few regiments in the British Army. It consists of a loose petticoat extending from the waist to the knees. The kilt was worn by British chiefs as early as the beginning of the 7th century; it was made of skin, but striped kilts were common, and it is said that, in all probability, the Scottish kilt was known among the British earlier than is generally supposed, from the inhabitants of North Britain being on intimate terms with their neighbors, and likely to have assumed the dress.

KING.—The person vested with supreme power in a State. According to feudal usages the King was the source from which all command, honor, and authority flowed; and he delegated to his followers the power by which they exercised subordinate rule in certain districts. The Kingdom was divided into separate Baronies, in each of which a Baron ruled, Lord both of the lands, which he held under the obligation of rendering military service to the King, and in many cases also of the people, who were vassals of the soil, and his liege subjects. In modern times the kingly power often represents only a limited measure of sovereignty, various constitutional checks being in operation in different countries to control the royal prerogative. The King may succeed to the throne by descent or inheritance, or he may be elected by the suffrages of some body of persons selected out of the nation, as was the case in Poland. Even when the kingly power is hereditary, some form is gone through on the accession of a new King to signify a recognition by the people of his right, and a claim that he should pledge himself to perform certain duties, accompanied by a religious ceremony, in which anointing with oil and placing a crown on his head are included as acts. By the anointing a certain sacredness is supposed to be thrown round the royal person, while the coronation symbolizes his supremacy. There is now no very clearly marked distinction between a King and an Emperor. A Queen-regnant or Princess who has inherited the sovereign power in countries where female succession to the throne is recognized, possesses all the political rights of a King.

In England it is said that the King never dies, which means that he succeeds to the throne immediately on the death of his predecessor, without the necessity of previous recognition on the part of the people. He makes oath at his coronation to govern according to law, to cause justice to be administered, and to maintain the Protestant Church. He is the source from which all hereditary titles are derived, and he nominates Judges and other Officers of State, Officers of the Army and Navy, Governors of Colonies, Bishops, and Deans. He must concur in every legislative enactment, and sends Embassies, makes treaties, and even enters into wars, without consulting Parliament. The royal person is sacred, and the King cannot be called to account for any of his acts; but he can only act politically by his Ministers, who are not protected by the same irresponsibility. A further control on the royal prerogative is exercised by the continual necessity of applying to Parliament for supplies of money, which practically renders it necessary to obtain the sanction of that body to every important measure. The crown now in use as the emblem of sovereignty differs considerably in form in different countries of modern Europe; but in all cases it is distinguished from the coronets of the nobility in being closed above.

KING-AT-ARMS—KING-OF-ARMS.—The principal Heraldic Officer of any country. There are four Kings-at-Arms in England, named respectively Garter, Clarencieux, Norroy, and Bath, but the first three only are members of the College of Arms.

Garter Principal King-of-Arms was instituted by Henry V., 1417 A. D., for the service of the Order of the Garter. His duties include the regulation of the arms of peers and the Knights of the Bath. In the capacity of King-of-Arms of the Order of the Garter, he has apartments within the Castle of Windsor, and a mantle of blue satin, with the arms of St. George on the left shoulder, besides a badge and scepter. His official costume as Principal King-of-Arms of England is a surcoat of velvet, richly embroidered with the arms of the Sovereign, a crown, and a collar of SS. The insignia of this office are borne by Garter impaled with his paternal arms, the latter on the dexter side of the shield. These are argent, St. George's cross, on a chief gules a ducal coronet encircled with a garter, between a lion of England on the dexter side and a fleur-de-lis on the sinister, all or.

Clarencieux and Norroy are Provincial Kings-of-Arms, with jurisdiction to the South and North of the Trent respectively. They arrange a register, alone or conjointly with Garter, the arms of all below the rank of the peerage. The official arms of Clarencieux are argent St. George's cross, on a chief gules a lion of England ducally crowned or. Those of Norroy are argent St. George's cross on a chief per pale azure and gules a lion of England ducally crowned between a fleur-de-lis on the dexter side, and a key, wards in chief, on the sinister, all or. Both Provincial Kings have a crown collar and surcoat. The crown is of silver gilt.

The crown of a King-of-Arms is of silver gilt, and consists of a circle inscribed with the words, *Miserere mei Deus secundum magnam misericordiam tuam*, supporting 16 oak leaves, each alternate leaf higher than the rest. Within the crown is a cap of crimson satin turned up with ermine, and surmounted by a tassel wrought of gold silk. Kings-of-Arms were formerly entitled to wear their crowns on all occasions when the Sovereign wore his; now they assume them only when peers put on their coronets. The installation of Kings-at-Arms anciently took place with great state, and always on a Sunday or Festival-day, the ceremony being performed by the King, the Earl Marshal, or some other person duly appointed by royal warrant.

Bath King-of-Arms, though not a member of the College, takes precedence next after Garter. His office was created in 1725 for the service of the Order of the Bath. On Jan. 14, 1726, he was constituted Gloucester King-of-Arms (an office originally created by Richard III., in whose reign it also became extinct), and principal Herald of Wales. He was at the same time empowered, either alone or jointly with Garter, to grant arms to persons residing within the principality.

The chief Heraldic Officer for Scotland is called Lyon King-of-Arms, who since the union has ranked next to Garter. His title is derived from the lion rampant in the Scottish royal insignia, and he holds his office immediately from the Sovereign, and not as the English King-at-Arms, from the Earl Marshal. His official costume includes a crimson velvet robe embroidered with the royal arms, a triple row of gold chains round the neck with an oval gold medal, with the royal arms on one side and St. Andrew's cross on the other; and a baton of gold enameled green, powdered with the badges of the Kingdom. His crown is of the same form with the imperial crown of the Kingdom, but not set with stones. Before the Revolution he was crowned by the Sovereign, or his Commissioner, on entry on office.

There is one King-of-Arms in Ireland, the Ulster. In the 14th century there existed a King-of-Arms called Ireland, but the office seems to have become extinct, and Edward VI. created Ulster to supply the deficiency. His arms are argent, St. George's cross, upon a chief gules a lion between a harp and a portcullis, all or. The royal ordinance relative to the Order of St. Patrick, issued May 17, 1833, declares that in all ceremonials and assemblies Ulster King-of-Arms shall have place immediately *after* the Lyon. See *Herald*.

KINK.—A twist in a rope or cord, caused by the tightness of the coil, and a relaxation of pressure in the direction of its length. The best rope, however, rarely kinks. In uncoiling a new coil of rope, pass the end at the core to the opposite side and draw it out; the turns of the rope will then run out without kinking.

KIRK RIFLE.—A breech-loading small-arm having a fixed chamber closed by a movable breech-block, which rotates about a horizontal axis at 90° to the axis of the barrel, lying below the axis of the barrel and in front—being moved from below by a lever.

This piece is a modification of the well-known Spencer repeating rifle, containing in an unwieldy butt-stock, six magazine tubes instead of the single one usually carried. These are connected on a central spindle and revolved into place by hand.

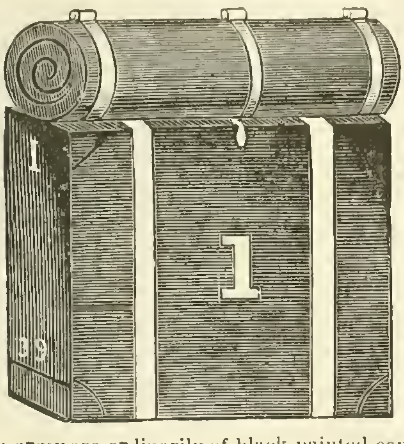
KISSELBACHES.—A name commonly applied to the soldiers of India.

KIT.—1. A cement for stuffing canvas to place over the vents of carcasses to keep out the damp. 2. In military language, the equipment in necessaries, such as shirts, boots, brushes, etc., of a soldier, but not applicable to his uniform, arms, or accouterments. Formerly, a high bounty was given, and then severely encroached upon, by making the recruit pay for his kit. The fairer principle is now adopted of issuing a free kit to each recruit, with a smaller bounty. The soldier has still to replace necessaries, worn out or lost, at his own expense, but he obtains the articles at wholesale, and very low prices. As these necessaries are so cheaply procured, it is held a very heavy military offense to make away with them.

KITCHEN CART.—A traveling-kitchen to accompany troops in the field. These carts are usually supplied at the rate of one to a battalion for 1000 soups. They should be provided with boilers *a la Papin* with an interior fire-place. These constitute the body of the cart, the superior part of which is furnished with plank to be used as a table. At the extremity of the cart there are two foot-boards upon which the cooks may rest while working during the march. Papin's digester is essential to cook well and rapidly. The interior arrangement of the fire-place which is suited to baking is very economical in fuel. See *Traveling-kitchen*.

KLICKET.—A small postern or gate in a palisade for the passage of a sallying party. Also written *Klinket*.

KNAPSACK.—A bag of canvas or skin, containing the soldier's necessaries, and worn suspended by straps between the shoulders. Those used in the



British army are ordinarily of black painted canvas; but some other nations, as the Swiss, make them of thick goat-skin, dressed with the hair on. The knapsack affords by far the easiest way of carrying light personal luggage during a march or walking tour.

KNEBELSPIESS.—A German lance used about the beginning of the 9th century.

KNIGHT BACHELOR. The lowest grade of knighthood, now only conferred in the United Kingdom. Originally, like all knighthood, a military distinction, knighthood of this description came to be often bestowed on civilians, and in recent times it has frequently been conferred for no weightier service than carrying a congratulatory address to Court. It is generally conferred by the Sovereign by a verbal declaration accompanied with the imposition of the sword, and without any patent or instrument. The person who is to receive the honor kneels down before the Sovereign, who touches him on the shoulder with a naked sword, saying, in French: "*Sois chevalier au nom de Dieu*" (Be a knight in God's name), and then adds: "Rise, Sir A. B." In exceptional cases, persons have been made Knights Bachelor by patent. The Lord Lieutenant of Ireland occasionally exercises a right of conferring knighthood.

KNIGHT-ERRANT.— A wandering knight; or any knight who traveled in search of adventures, for the purpose of exhibiting military skill, prowess and generosity. See *Knights*.

KNIGHTS.—Originally Men-at-Arms bound to the performance of certain duties, among others to attend their Sovereign or Feudal Superior on horseback in time of war. The institution of knighthood, as conferred by investiture, and with certain oath and ceremonies, arose gradually throughout Europe as an adjunct of the feudal system. The character of the knight was at once military and religious. The defense and recovery of the holy sepulcher, and the protection of pilgrims, were the objects to which, in the early times of the institution, he especially devoted himself. The system of knight-service, introduced into England by William the Conqueror, empowered the King, or even a Superior Lord who was a subject, to compel every holder of a certain extent of land, called a *Knight's Fee*, to become a member of the knightly order; his investiture being accounted proof that he possessed the requisite knightly arms, and was sufficiently trained in their use. The "Statute of Knights," of the first year of Edward II., regulating the causes that were to be held valid to excuse a man from knightly service, shows that in the 14th century the knightly office was not always eagerly coveted; yet its social dignity was very considerable, for even Dukes, if not admitted into the order, were obliged to yield precedence in any royal pageant or public ceremony. In time of war, each knight was bound to attend the king for 40 days, computed from the day when the enemy arrived in the country. After the long war between France and England, it became the practice for the Sovereign to receive money compensations from subjects who were unwilling to receive knighthood, a system out of which grew a series of grievances, leading eventually to the total abolition of knight-service in the reign of Charles II.

Knighthood, originally but a military distinction, came, in the 16th century, to be occasionally conferred on civilians as a reward for valuable services rendered to the Crown or community. The first civil knight in England was sir William Walworth, Lord Mayor of London, who won that distinction by slaying the rebel Wat Tyler in presence of the King. Since the abolition of the knight-service, knighthood has been conferred without any regard to property, as a mark of the Sovereign's esteem, or a reward for services of any kind, civil or military. In recent times it has been bestowed at least as often on scholars, lawyers, artists, or citizens, as on soldiers, and in many cases for no weightier service than carrying a congratulatory address to Court. The ceremonies practiced in conferring knighthood have varied at different periods. In general, fasting and bathing were in early times necessary preparatives. In the 11th century, the creation of a knight was preceded by solemn confession, and a midnight vigil in the church, and followed by the reception of the Eucharist. The new knight offered his sword on the altar, to signify his devotion to the Church, and determination to lead a holy life. The sword was redeemed in a sum of money, had a benediction pronounced over it, and was girded on by the highest ecclesiastic present. The title was conferred by binding the sword and spurs on the candidate, after which a blow was dealt him on the cheek or shoulder, as the last affront which he was to receive unrequited. He then took an oath to protect the distressed, maintain right against might, and never by word or deed to stain his character as a knight or a Christian. A knight might be degraded for the infringement of any part of his oath (an event of very rare occurence), in which case his spurs were chopped off with a hatchet, his sword broken, his escutcheon reversed, and some religious observances were added, during which each piece of armor was taken off in succession, and cast from the recreant knight.

It has been said that knighthood could originally be conferred by any person of knightly condition, but if so, the right to bestow it was early restricted to persons of rank, and afterwards to the Sovereign or his representative, as the Commander of an Army. In England the Sovereign now bestows knighthood by a verbal declaration, accompanied with a simple ceremony of imposition of the sword, and without any patent or written instrument. In some few instances, knighthood has been conferred by patent, when the persons knighted could not conveniently come into the presence of royalty, as in the case of Governors of Colonies, or other persons occupying prominent situations abroad. The Lord Lieutenant of Ireland also occasionally, but rarely, exercises a delegated power of conferring knighthood. The monosyllable "Sir" is prefixed to the Christian names of knights and baronets, and their wives had the legal designation of "Dame," which in common intercourse becomes "Lady." Persons who are simply knights without belonging to any order are called in England, knights *bachelors*, a name probably corrupted from *bas chevalier*. Knighthood of this kind is now only conferred in Great Britain. A degree of knighthood called *banneret* formerly existed in England and France, which was given on the field of battle in reward for the performance of some heroic act. For the mode in which that dignity was conferred, see BANNERET. No knight-banneret has been created in the field since the time of Charles I., when that honor was bestowed on one Sir John Smith, for rescuing the royal standard from the hands of the rebels. George III. twice conferred the title on occasion of a review, but the proceeding was considered irregular, and the rank of the knights not generally recognized. The form of helmet which the requirements of the later Heraldry have appropriated to knights, entitling them to place it over their arms, is full-faced, of steel, decorated with bars, and with the visor a little open. For the different orders of knighthood, see separate articles, under their appropriate headings, in this work.

KNIGHT-SERVICE.—A tenure of lands held by knights on condition of performing military service. It was abolished in the time of Charles II. of England. See *Knights*.

KNIGHTS TEMPLAR.—A celebrated Religious and Military Order, founded at Jerusalem in the begin-

ning of the 12th century, by Hugues de Paganes quired from the Abbot and Canons of the Church and Convent of the Temple, whence the Order obtained the name of the "Poor soldiers of the Temple of Solomon," afterward abbreviated into Templars. The knights were bound by their rule to hear the holy office every day, or if prevented by their military duties, to say a certain number of paternosters instead: they were to abstain from flesh four days in the week, and from eggs and milk on Fridays. They might have three horses and an esquire each, but were forbidden to hunt or fowl. In the earlier period of their history, the Templars made a great show of poverty, contrasting much with their later condition. After the conquest of Jerusalem by the Saracens, they spread over Europe; their valor became everywhere celebrated; immense donations in money and land were showered on them; and members of the most distinguished families thought themselves honored by enrolment in the Order. In every country where they existed, they had their Governor, called the Master of the Temple or of the Militia of the Temple. The Templars had settlements in England from an early period. The first was in London, on the site of Southampton Buildings, Holborn; but from 1185 their principal seat was in Fleet Street, still known as the Temple. The Round Church which bears their name was dedicated by Heraclius in 1185.

The Templars were at first all laymen and of noble birth. Pope Alexander III., however, in 1162, authorized the admission of spiritual persons not bound by previous vows, as Chaplains to the Order, who were not required to adopt the military vows. A third class was afterward introduced, consisting of laymen not of noble birth, who entered as serving brothers, some of them being attendants on the knights, and others exercising trades in the houses or lands of the Order. Eventually, many persons became affiliated members without taking the vows, for the sake of the protection afforded them. As the power and prosperity of the Templars increased, so did their luxury, arrogance, and other vices, which gave the French Kings pretext for endeavoring to suppress them, and lay hold of their possessions. Accusations, many

Regular Jewels—Knights Templar.

Geoffroy de St. Omer, and seven other French knights for the protection of the Holy Sepulcher, and of Pilgrims resorting thither. Baldwin II., King of Jerusalem, bestowed on this order their first place of residence; and an additional building was ac-

of which were absurd and incredible, were brought against them by two members of their own body. Their principal enemy was Philippe IV. of France, who induced Pope Clement V. to accede to a scheme by which the whole members of the Order were seized and imprisoned, their lands confiscated, and many of them tried, convicted, and executed for capital crimes. The English Templars were arrested by command of Edward II., and a Council held in London in 1309 having convicted them of various crimes, most of which were probably imaginary, the King seized their possessions. In 1312 the whole Order throughout Europe was suppressed by the Council of Vienne, and its property bestowed on the Knights of St. John, to which latter Order their English possessions were formally transferred by a Statute of Edward II. in 1323. The habit of the Templars was white, with a red cross of eight points of the Maltese form worn on the left shoulder. Their war-cry was "Beau Séant;" and their banner, which bore the same name, was parted per fess sable and argent. They also displayed above their lances a white banner charged with the Cross of the Order. Their badges were the *Agnus Dei*, and a representation of two Knights mounted on one horse—indicative of the original poverty of the Order.

KNOTS.—1. Knots of different kinds are borne by different families as heraldic badges, and are occasionally introduced as charges in shields. The forms of some of them appear to be suggested by the initial letter of the name or title of the bearer. In the Wake and Ormonde knot it is not difficult to trace a *W* and two *Os*. The Bourchier knot, as seen on the tomb of Archbishop Bourchier, at Canterbury, bears a resemblance to two *Bs*, and the Stafford knot to two *Ss*. The Lacy knot contains within it a rebus on the four letters of the name Lacy.

2. A twist or loop in a rope or cord, so made that the motion of one piece of the line over the other shall be stopped. The knot owes its power of passive resistance to the friction of the rope. The uses of knots are infinite; in the commonest occasions of life one or two simple knots are indispensable; in building, mining, and moving ordnance, knots of curious form are employed; while on shipboard, they may be numbered by the dozen, and each is appropriated to a specific duty. The following are the more important knots employed in mechanical maneuvers:

Two half hitches—Pass the end of a rope round the standing part and bring it up through the bight. This is a half hitch. Take it round again in the same manner for two half hitches.

A clove hitch—Pass the end of a rope round a spar, over, and bringing it under and round behind its standing part, over the spar again and up through its own part. It may then, if necessary, be stopped or hitched to its own part; the only difference between two half hitches and a clove hitch being that one is hitched round its own standing part and the other is hitched round a spar or another rope.

Round turn and two half hitches—Take a round turn around the stakes or posts, and secure the end by two half hitches around the standing part. This is useful in securing the guys of the gin to the stakes.

A bowline knot—Take the end of a rope in your right hand and the standing part in your left; lay the end over the standing part, and with the left hand make a bight of the standing part over it; take the end under the lower standing part up over the cross, and down through the bight. This is very useful in forming a temporary eye at the end of a rope.

Square knot—Take an overhand knot round a spar; take an end in each hand and cross them on the same side of the standing part upon which they came up; pass one end round the other, and bring it up through the bight. This is, sometimes called a *reef knot*. If the ends are crsssed the wrong way, sailors call it a *granny knot*.

A timber hitch—Take the end of a rope round the spar, lead it under and over the standing part, and pass two or more round turns around its own part; pass the first turn *over* the end part instead of through the bight, as in a half hitch. Used in securing the ends of the trace-ropes to the maneuvering bolts.

A rolling hitch—Pass the end of the rope round a spar; take it round the second time, nearer to the standing part; then carry it across the standing part, over and round the spar and up through the bight. A strap or a tail-block is fastened to a rope by this hitch. Used in shifting the fall from one end of the windlass to the other.

A blackwall hitch—Form the bight by putting the end of a rope across and under the standing part; put the hook of a tackle through it, the center of the bight resting against the back of the hook, and the end jammed in the bight of the hook by the standing part of the rope.

A cats-paw—Take a large bight in the rope, and spread it open, putting one hand at one part of the bight and the other at the other, and letting the standing part and end come together; turn the bight over from you three times, and a small bite will be formed in each hand; bring the two small bites together, and put the hook of a tackle through them both. This is very useful in applying a purchase or tackle to the fall of another.

A sheet bend, (weavers knot)—Pass the end of a rope up through the bight of another, round both parts of the other, and under its own part.

Carrick bend—Form a bight in the rope and lay the end across the standing part; stick the bight of another rope up through the loop thus formed, and carry the end over the end of the first rope under the standing part, and through the loop formed by its own bight; stop each end to its own standing-part.

Fisherman's bend (anchor knot)—Take two turns around the gun-sling or spar with the end of the rope; hitch the end around the standing part and through both turns, and then pass the end over the second and under the first turn.

A sheep shank—Make two long bights in a rope which shall overlay one another; take a half hitch over the end of each bight with the standing part which is next to it.

A marlinspike hitch.—Lay the marlinspike upon the seizing stuff, and bring the end over the standing part so as to form a bight; lay this bight back over the standing part, putting the marlinspike down through the bight, under the standing part, and up through the bight again. Very useful in putting on lashings etc. *Stopping* is fastening two parts of a rope together, as for a round seizing, without a crossing or riding. *Nippering* is fastening them by taking turns crosswise between the parts to jam them, and sometimes with a round turn before each cross. They are called *racking turns*. Pass *riders* over these and fasten the end. This is a convenient way to secure a fall while it is being shifted on the windlass. *A screw* is applied by weaving a light strap through the different parts of a fall, bringing the two ends together, and screwing the whole up tight by means of a stick or bar passed through the bights. *A strap*, or *sling*, is formed by knotting or splicing together the ends of a short strand or rope. It is used for hooking tackles into.

Pointing—Unlay the end of a rope and stop it; take out as many yarns as are necessary, and split each yarn in two, and take two parts of different yarns and twist them up taut into *nettles*; the rest of the yarns are combed down with a knife; lay half the nettles down on the scraped part, the rest back upon the ropes, and pass three turns of twine taut round the part where the nettles separate, and hitch the twine, which is called the *warp*; lay the nettles backward and forward as before, passing the warp each time. The ends may be whipped and snaked with twine, or the nettles hitched over the warp and hauled taut. The upper seizing must be snaked. If the upper part is too weak for pointing, put in a piece of stick. This is an elaborate way of whipping ropes, and requires considerable practice.

Seizing a rope is connecting the two parts with smaller rope, or spun-yarn. Take a piece of spun-yarn and double it; pass the bight under the two parts of the rope to be seized; put both ends through it and haul taut, using a level applied with the marlinspike hitch; separate the ends, pass them around the rope in opposite directions until enough turns are taken, hauling each turn taut, and seeing that they lay close and smooth. Cross the seizing by passing the ends in opposite directions between the ropes and around the seizing, and finish with a square knot.

A lashing is applied on the same principles. After sufficient turns have been taken, the lashing is *frapped* by taking the ends around the turns, hauling them close together, and making the lashing tighter, of course. *To pass a shear lashing.*—Middle the lashing and take a turn round both legs at the cross; pass one end up and the other down, around and over the cross, until half of the lashing is expended; then ride both ends back again on their own parts and knot them in the middle; frap the first and riding turns together on each side with sennit. This will be useful in rigging shears for hoisting guns, when a gin is not available. Any two spars that will support the weight can be used.

The knots most frequently used and the manner of forming them are described under the appropriate headings.

KNOUT—KNUT.—A scourge composed of many thongs of skin, plaited, and interwoven with wire, which was formerly the favorite instrument of punishment in Russia for all classes and degrees of criminals. The offender was tied to two stakes, stripped, and received on the back the specified number of lashes; 100 or 120 were equivalent to sentence of death, but in many cases the victim died under the operation long before this number was completed. If a culprit survived this punishment he was banished for life to Siberia. The whipping was inflicted by a criminal, who preferred this office to exile to Siberia, and who was constantly kept in prison, except when his services were required. The nobility were legally exempt from the knout, but this privilege was not always respected. In earlier times the nose was slit, the ears were cut off, and the letter V for *vor* (rogue) was branded on the forehead; but this aggravation was abolished by Alexander I. The knout was abolished by the Emperor Nicholas, who substituted the *pleti*, a kind of lash.

KODALLIE.—An Indian term. A tool used by the natives of India in digging all kinds of earthwork. The face of the tool is shaped like a hoe, and has a short handle nearly parallel to the face. It is used in a kneeling or sitting position.

KONKRI.—A sword of the Middle Ages, without a hilt or crossguard. The handle is straight and forms with the blade a Latin cross.

KORAZIN.—A short hauberk or jacket of scales. It is frequently called *Jazeran*. The term is also applied to a large imbricated hauberk, covered with overlapping plates, somewhat like the small hauberk of the 8th century.

KOT DUFFADAR.—A non-commissioned officer in the East Indian Native Cavalry, corresponding with a troop Sergeant Major. See *Duffadar Major*.

KOUL.—A soldier belonging to a noble corps in Persia. The *Kouls* constitute the third corps of the King's Household Troops. They are men of note and rank, and no person can arrive at any considerable post or situation in Persia who has not served among the Kouls. The Commander of the Kouls is known as the Kouler-Agasi, and is usually Governor of a considerable Province.

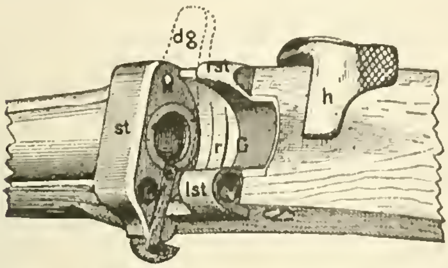
KRANKENTRAGER.—A special corps organized by the German Army; its duty is to carry the sick and wounded. The men are mostly taken from the *Landwehr*, but some are students from hospitals and universities. The former are in uniform, and the latter in plain clothes; but all wear the red cross on their arm, and are under the protection of the Geneva Convention. They are men of two years' service, intelligent, of good character, and have received some theoretical instruction in surgery and medicine. The instruction imparted to these men is directed by Superior Officers, assisted by Surgeons. They are taught to give the first care to the wounded; to carry them on stretchers and to form the stretchers, from any improvised material; to transport the wounded to the ambulance wagons; to prepare the wagons for that purpose; and to perform all such duties as shall be required of them during a battle.

KREBS.—A complete suit of armor, composed of imbricated plates.

KRIEGSSPIEL.—This German war game was contrived by a Prussian, Councillor Reiswitz, in order to follow with greater facility the campaigns of Napoleon I. His son, an artillery officer, found it, by reproducing the campaigns on a map, an easy method of studying the different movements of troops, and caused the game to be adopted in about 1824 by Feldmarschall von Müffling. The *Kriegsspiel* eventually became familiar with the Army, and was finally introduced in the military schools as the best means of studying strategy and tactics. This game was not only a study, but a favorite pastime, of VonMoltke's, Blumenthal's, Prince Frederick Charles, and of other German officers, who took a prominent part during the war of 1870–71. It is stated that they carefully studied for years, by means of this game, the ground on which they carried out their operations in France. The *Kriegsspiel* was first introduced in England after the Franco-German war (1870–71), and is now frequently played in all the large garrison towns of this country. A club has been formed at Aldershott for that purpose. The necessary apparatus for playing the *Kriegsspiel* is composed of maps carefully prepared on a scale of 6 or 8 inches to the mile; of metal blocks, made to scale, as nearly as possible, representing all the different branches of the service, from regiments to skirmishers; and strings of beads, for cavalry reconnoitering. The number of persons taking part in the game consists of the officers commanding the two armies, of a judge or chief umpire, supported generally by two or three umpires. The umpires alone see the ground occupied by the two forces. Instructions are given as to their positions; the time of the year, the length of the days, the state of the roads, etc., are settled beforehand. The losses made on both sides are calculated by means of tables carefully prepared; they form a large volume, and were published, in 1870, by Colonel von Trotha. Other circumstances, such as troops sheltered by earthworks, artillery firing out of range, are taken into consideration; those that have not been laid down in the rules are decided by a throw of the dice. Thus the action gradually develops itself as each Army advances on the contested ground, till victory is declared for one side or the other. The principal utility of the game appears to be in the arrangements previous to and during the early conduct of an action. When the troops get to close quarters, the element of chance enters so largely into the game that it destroys to a very great extent, the dependence that may be placed on the issue of the battle. The game, howevery, affords great practice in the drawing up of the order of march of columns previous to an action, and the development of the columns of march into formation for attack. In the hands of men having some military experience, this game becomes a certain means of acquiring and perfecting a Science which in time of peace cannot be easily acquired. It raises questions which are strategical problems of great interest. See *Strategos*.

KRIS.—A dagger or poniard, the universal weapon of the inhabitants of the Malayan Archipelago. It is made of many different forms, short or long, straight or crooked. The hilt and scabbard are often much ornamented. Men of all ranks wear this weapon; and those of high rank, when in full dress, sometimes carry three or four. In Java, women sometimes wear it. Also written *Creese* and *Krees*.

KRNKA GUN.—The system of altered breech-loading muskets of the Russian service is the invention of Sylvester Krnka, a regimental armorer of the Austrian army. Its chief features are simplicity and compactness. The drawing represents the breech system with the breech-block removed. The following are the principal parts, viz: *s t*, is that portion of



the breech-frame or receiver into which the barrel is screwed; *r*, is the slot or well in which the breech-block rests when the chamber is closed; *m* is the hole into which is screwed the point of the hinge-pin around which the breech-block revolves; *l s t*, is the lug in rear of the breech-block through which the hinge-pin passes; *c*, is the groove by which the cartridge is inserted into the chamber; *r s t*, is the lug which serves as a support for the breech-block and a stop for the hammer, *h*; *e*, represents the extractor in position; *k*, is a small catch-pin actuated by a spring which presses into a small indent in the front face of the breech-block and holds the block in place with slight friction; *d g*, are broken lines, showing the position of the thumb-piece of the breech-block when closed but not locked down by the hammer.

The lower portion of the block is semicircular in form, and has a groove, into which fits a raised band or rib, *r*. The object of this arrangement is to increase the strength of the parts to resist the force of the charge. The rear corner of this rib is rounded off to prevent it from interfering with the insertion of the cartridge; the firing-pin is pushed back, when the block is opened by the oblique surface of the notch, and also in closing the block, by the chamfered corner of the receiver, *s t*. The extractor is a lever of the first order, and is operated by opening the breech smartly, in which case the shell is thrown out clear from the receiver. The cartridge belongs to the center-fire system of Berdan. The shell is made of brass; the head is folded and strengthened with a re-enforcing-cap. The caliber of the Russian altered arms is 60, or 0″.6. See *Small-arms*.

KRUPP GUN.—The fabrication of cannon is the matter of chief personal interest to Herr Krupp, who watches with the closest interest what governments in every part of the world are doing, and proposing to do, in relation to their armaments. Nearly every government, except England and the United States, has been a purchaser of Krupp guns, and there seems to be no cessation in the demand for them. At present Italy and China are his best customers, and the 125-ton guns for the Italian government which he has now in hand are the most prodigious pieces of ordnance which have ever been made. Krupp's pre-eminence as a gun-maker is unquestionably due to his early perception of the fact that steel must supplant iron in the fabrication of ordnance, and to his possession of such unrivaled facilities for the manufacture of steel in his own works. New ideas in the construction of ordnance Herr Krupp does not claim to have developed, but he was one of the first to perceive that breech-loading cannon would completely take the place of muzzle-loaders. It was this change which definitely forced the abandonment of iron in the construction of cannon in Europe. Krupp satisfied himself that the wedge system of breech-closing was the best, and in spite of the conclusion of the French and English authorities that the French interlocking system is superior, Krupp goes ahead and shows no sign of giving up the system with which his name has come to be identified. The 125-ton guns are 35 calibers in length—that is, over 55 feet. The inner tube is covered with steel rings to the muzzle, and the outer jacket at the breech in which the breech-closer is placed is an enormous piece of steel. Not a single part of these extraordinary guns could be produced by any establishment in the United States, for we have no means in America of hammering or working such enormous masses of metal. The largest caliber is 40 centimeters, or something over 16 inches, and the boring of a tube of this size is an important operation. The core, when the boring is completed, is still a ponderous cylinder, which can itself be bored and used as a tube of a smaller gun. The cutting of the rifle grooves in a large gun is a very simple operation and not a protracted one, as these grooves are cut simultaneously, and the work is done by the machines with mathematical accuracy. Every gun is tested on the grounds near the shops by being fired four times, and the large guns are then sent to Meppen, in north Germany, to be tested by the agents of the governments which purchase them—if such tests be desired. Krupp often conducts experiments of his own at Meppen, and occasionally large numbers of foreign officers are invited to be present. The drawback to such elaborate experiments is the enormous expense which they entail. Considering that the butts are wholly artificial structures of sand and masonry, and that the largest cannon are here fired at close ranges, it will be seen that great strength and security are required. The workman in charge is pointed out as a person who has "fired more cannon" than any other man in the world. The trials at Meppen are all for the purpose of testing the range of the gun, those at the Works to test the strength of the gun. Near the firing-grounds at Essen is the Ordnance Museum, where are retained specimens of everything that Herr Krupp has accomplished in the development of artillery.

The principal feature in the Meppen programme of 1879 was the trial of Krupp's 40-centimeter (15.75 inch) breech-loading gun, weighing about 70 tons 17 cwt., known commonly as the 71-ton gun. The trial was specially important for three reasons: 1st. It is the first breech-loader whose power approaches that of the 100 and 80-ton guns made in England; 2d. It is a steel gun; 3d. Its proportions are based on results obtained during the last few years.

All these questions are interesting, and deserving of so much attention that it would be difficult here to deal fairly with all. For the purpose in hand, however, it is not necessary to discuss the question of the respective *metals* of the guns, because it can easily be shown that there was nothing in these experiments that bears upon this point beyond the negative fact that the steel guns in no respect exhibited any fault. We may safely say that the Woolwich guns would have done equally well, as far as the material is concerned, for the pressures in Krupp's guns were by no means excessive. The 71-ton gun, for example, was not subjected to as high a pressure as the English 80-ton gun has borne. A test which tries neither gun obviously furnishes us with no means of comparison, and hence the Meppen trials in no way furnish data for the discussion of the relative merits of wrought-iron and steel guns, but bear entirely on the two other questions, namely, that of breech-loading and proportions—the former, as concerns ease in working, and the latter power, and good shooting.

The 71-ton gun was mounted as for coast defense, on a traversing platform, and a carriage nearly of the English pattern in all respects. The brackets were made of wrought-iron, the gun being elevated by multiple gear, acting on elevating arcs, fixed on the gun. Beneath the carriage were two hydraulic buffers. A modified form of Cunningham's chain gear, was used for traversing the platform, which ran on trucks on three concentric racers, the pivot being about six feet in front of the carriage when run up. A lifting crane was attached to the platform, fixed on a sort of axle, with a counter-lever with powerful spring, which required considerable force to compress it by bending down the crane, and which decreased the work of lifting the projectiles by the same amount, thus dividing the labor of lifting the projectiles into two operations.

The gun was easily worked by a detachment of fifteen men. Ten rounds, with chilled projectiles were first fired; the time occupied by the last five rounds was twenty-four minutes. The breech piece moved easily. A good deal of oil was used on it. The breech-loading certainly saved the men much labor, not only in the actually ramming home but also in bringing up the projectiles, since it was not necessary for them to cross of the racers or the Cunningham chain. The charge was made up in four cartridges, each containing 110 pounds of prismatic powder. The least satisfactory part of the service of the gun considering everything, was the difficulty experienced in the ignition of the charge and in remedying miss-fires. The vent was in the axis of the piece, and a disk of calico was torn off the bottom of the cartridge last entered, to expose the powder to the flash of the tube. The latter was of a bad pattern, short and weak. No stress is to be laid on this, as the remedy is obvious. A primer or a stronger tube would rectify this fault. A more important question is the shooting of the gun as regards power and accuracy. The chilled projectiles had 0.078 in. windage, which is about the same as that in Woolwich projectiles, namely, 0.08 inch over a copper rim. The common shell subsequently fired, however, had the unpractical windage of about 0.01 inch over an iron body. The target diagrams show a remarkable degree of accuracy, chiefly in the vertical direction, which argues well for the regularity of the charge, which surely must be attributed to the prismatic powder employed. It stands to reason that a charge composed of a fixed number of prisms of uniform size and density gives promise of greater uniformity being attainable than when pebbles are employed; and there seems no reason to doubt that, whatever difficulties were at first experienced, this has been achieved. Surely if two attempts are made to obtain regularity in powder—one by employing prisms each uniform in size and shape, and if possible pressed uniformly, and another by means of pebbles of an accidental shape from uniformly pressed powder-cakes—the former, though it may be difficult, offers promise of ultimate success in the higher degree. As to the windage, stress can hardly be laid on the great reduction in the case of the common shell; the two kinds of projectiles made pretty nearly equally good practice.

Lastly, *as to the proportions of the bore and chamber.* The bore of the 71-ton gun is only 20 inches shorter than that of the 100-ton gun and 55 inches longer than that of the 80-ton gun. The chamber in length is 60.6 inches, that of the 100-ton gun being 59.7 and of the 80-ton gun 59.6. The caliber of the 71-ton gun is 15.75, against 16 in the 80 and 17.72 in the 100-ton gun. Consequently, the bore of the 71-ton gun is 21.8 calibers long, against 18 in the 80 and 20.5 in the 100-ton gun. The diameter of the chamber of the 71-ton gun is 17.32 inches, that of the 80 and 100-ton guns being 18.0 and 19.7 inches, respectively—that is to say it is 1.57 inches greater than that of bore, as compared with 2.0 inches increase in the 80 and 1.98 inches in the 100-ton gun. Speaking generally, then, the bore of Krupp's gun is relatively rather longer and the chamber less enlarged than in the 100-ton gun, while in the 80-ton gun the bore is actually the shortest and the enlargement of the chamber actually the greatest of the three. On these proportions mainly depends the power of the guns. To be able to make a comparison between them, discrimination is necessary. It would not be right to take equal or proportionate *charges* as the basis of the comparison, because the principle on which a long gun is advocated is that any greater result can thus be got from a gun with a given strain on it, but at the expense of some waste of powder. It is clear, then, that looking to the endurance of the gun rather than the expenditure of powder, the basis of comparison should be *proportionate pressures.* It would scarcely be right to say *equal* pressures, because the thicker gun can fairly be expected to bear a greater strain than the thinner one. Now, the best results obtained from these three guns are as follows: The 80-ton gun at Woolwich, with a proof-charge of 445 pounds, giving a pressure of 21.5 tons, discharged a projectile weighing 1,728 pounds with a velocity of 1,657 feet per second—having 32,938 foot-tons stored up work, or 658.37 foot-tons per inch circumference—equivalent to a penetration of a 32.34 inches plate of wrought-iron. The 71-ton gun at Meppen is reported on one occasion, with a charge of 485.1 pounds, giving a pressure on the gun of 20.92 tons, to have discharged a projectile weighing 1,715 pounds with a velocity of 1,703 feet per second—having therefore 34.489 foot-tons stored-up work, or 697.02 foot-tons per inch circumference—equivalent to the penetration of a plate 33.5 inches thick. During the public trials in August the 71-ton gun was not tested so severely, and it is therefore right to class the above in the same category as the Woolwich proof round above metioned. In August the average weight of the chilled projectiles was 1,712.6 pounds. The firing charge was 452 pounds, the initial velocity was 1,648 feet, the stored-up work was 32,241 foot-tons, the work per inch circumference 651.59 foot-tons, equivalant to a penetratian of 32.12 inches. The pressure on the bore was 19.85 tons. The highest result hitherto obtained with the 100-ton gun, of 17.72 inches caliber, has recently been furnished by Captain Noble; it is as follows: Charge, 573 pounds; projectile, 2,000 pounds, about; velocity, 1,725.5 feet; stored-up work, about, 41,300 foot-tons, or 742 foot-tons per inch circumference, which is equivalent to a penetration of nearly 35 inches of armor. The pressure on the bore was about 18.0 tons. It is quite clear, from the above, that the 71-ton gun is a much better weapon than the 80-ton gun, inasmuch as it beats it in every respect. It fires a heavier projectile with a higher velocity, which has therefore more energy or stored-up work and an inch and a half more penetration, and all this is done with less pressure on the bore of the gun. The reason is that it is a better proportioned gun, its main advantage being its greater length. The 100-ton gun compares much more favorably with Krupp's gun, but, nevertheless, would do so better if its length were greater. The main difference in the guns depends on the difference in length; and the question naturally arises with those investigating, how is it that the English Government is now completing and issuing 80-ton guns so inferior in power to Krupp's 71-ton gun, which has already achieved the results we speak of. The answer is, that the guns were designed for the "Inflexible," and that, being muzzle-loaders, the vessel had to be made with portions of the deck corresponding to the length of the gun, to make provision for its loading. All this was determined years ago. Since that time *investigations* have shown the desirability of greatly increasing the length; but the gun being a muzzle-loader, it is impossible to do so. For the ship in question, a muzzle-loader is limited as to its length by inflexible conditions; and all that can be done is, by enlarging the chamber, to utilize to the fullest extent the disproportionate thickness of metal. Apart from the trying instance, however, it is clear that every increase in length is in favor of the breech-loader, because the labor and inconvenience of muzzle-loading increase in an increasing ratio; and, in the case of turret guns, and probably in some guns in casemates and cupolas, muzzle-loading becomes eventually almost impossible.

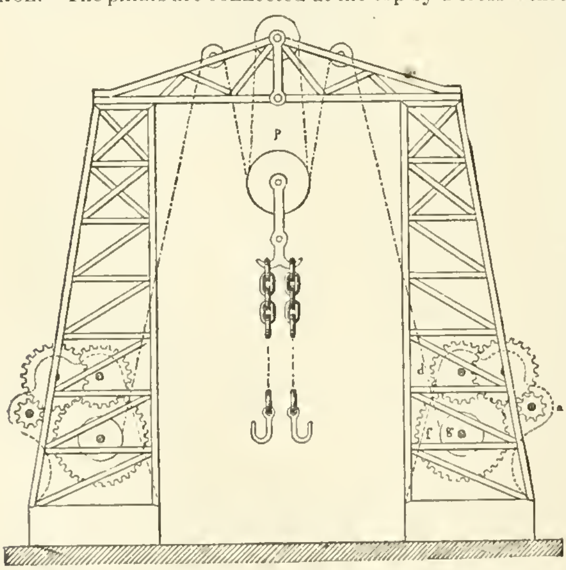
Very remarkable results were obtained with smaller guns. An excellent 51-ton 14-inch gun was tried, the behavior of which closely resembled that of the 71-ton gun, including the method of working, occasional miss-fires, and the like. An 11-inch (28-centimeter) howitzer, a 4.13-inch (10.5 centimeter) siege gun, and a 3.78-inch (9.6 centimeter) were fired, which did well but need not be here noticed in detail. A long 5.9-inch (15-centimeter) gun on a special sea service carriage with oil buffer gave good results; also an 8.27-inch (21-centimeter) howitzer, and a 5.9-inch (15 centimeter) mortar, were fired at dummy guns in a battery with good effect, notwithstanding that some of the fuses failed to act. Two remarkably characteristic guns, 3.4-inch (8.7 centimeter), were fired, fixed on pivots, one with little, and the other with absolutely no provision for recoil. With these is naturally connected another non-recoil arrangement of Krupp's, now well known, consisting of 6.1-inch (15 centimeter) gun, muzzle pivoting, the muzzle being ball-shaped and working in a socket in an armor-plate. These three guns possess peculiarities deserving of attention.'

One piece, 3.4 inches in caliber, was 14 feet 3¼ inches long. Its chamber was enlarged to an extraordinary extent, being 5.9 inches in diameter. The cartridge was a long bag, very loose on the powder, made so as to admit of being adjusted in the chamber by hand. The charge was 7.7 pounds. Two kinds of projectiles were fired—long ones, 12.5 inches in length, weighing 22 pounds, and shorter ones 9.5 inches in length, weighing 15 pounds. The initial velocities of these projectiles were 1,829 and 2,098 feet respectively. The maximum pressure was 11.6 tons. During this extraordinary performance the gun was held rigidly, being fixed on a strong vertical steel pivot, and so steady was it that small coins placed on its barrel were not shaken off on firing except near the muzzle. Eventually a Dutch officer displayed sufficient confidence to sit astride on the gun while it was fired, with the projectile shooting between his legs at the rate of about 2,000 feet per second. The second 3.4 gun somewhat resembled the above, but had provision for slight recoil, the pivot moving on its lower end as a center, the gun forcing the upper end back against a piston or buffer. The muzzle pivoting 6.1 gun was worked easily, the armor absorbing the shock of recoil, and suffering in no way apparently beyond the structure appearing to spring a little in the earth. A man laid it while riding on a saddle placed on the chase of the piece; he employed sights directed through a small hole at a convenient height above the gun, and he fired the gun himself by pulling the lanyard while still sitting on the piece. This system has been tried by one Goverment experiment, but has not hitherto found favor. It certainly appears as if a heavy gun so fixed to a shield, and impressing its work on it every round, must soon destroy the structure; but apparently it would take a very long time for a medium gun to do so, and it is possible that a gun so completely protected and able to fire with such great rapidity might perform admirable service before it failed in this way, so that, under some conditions, such a gun might be very valuable.

The ball portion of the muzzle can be readily unscrewed, and so can the disk containing the socket into which it fits in the plate. This operation can be safely performed, a shutter being run up which completely covers the opening from the enemy. It still appears possible, however, that a blow from a very heavy shot might distort and jam the screwed portion of the plate. Against ordinary siege guns such a gun working with all the speed due to non-recoil, and with such an extraordinary measure of security, might effect much. Two trials against armor took place, one to show the comparative effects of firing against chilled and soft hammered iron structures. As both were manufactured by Herr Krupp, the trial cannot be regarded as a representative one of the system he opposes, and it would be a mistake to discuss it here. The other was the firing of a 9.45-inch (24-centimeter) gun, with a charge of 165.3 pounds and a steel projectile weighing 348.3 pounds, at a target which consisted of a front 12-inch wrought-iron plate, a wood layer of 2 inches, and a back wrought-iron plate of 8 inches. The plates were rolled at Dillingen. The shot had a striking velocity of 1,876 feet, which would give 8,492 foot-tons energy or stored-up work, a penetrating figure of 288.5 foot-tons per inch circumference, and a penetration of 19.32 inches of iron. The projectile, however of each of two rounds fired passed completely through the entire 20 inches of iron and grazed about 2,000 meters farther up the range. The plates were indifferently rolled, and contained some phosphorus, it is said; but the penetration of the shot was, after making all allowances, extraordinary. They were scarcely deformed in appearance when recovered. The steel was excellent. They had ogival points, the heads being struck with a radius of two diameters.

To sum up, the features which chiefly concern us in these extraordinary trials are—1st. The success of the breech-loading system. 2d. The great results obtained as to power and accuracy of fire. 3d. The muzzle-pivoting and non-recoil systems. Although these have been noticed in the short relation already given, one or two words may be useful to lead a discussion. First, it must not be supposed that equally good results have not been obtained as to power when guns have been made in accordance with the conditions arrived at by recent experiments, as may be seen from the following examples: *Two years ago* the new type Elswick 6-inch gun was fired with a charge of 33 pounds and a projectile of 82 pounds, the initial velocity being 1,902 feet, and the total energy 2,057 foot-tons: the same gun, with a charge of 37.5 pounds, discharged a projectile of 82 pounds weight with a velocity of 2,031 feet, having 2,362 foot-tons total energy. With this may naturally be compared Krupp's 5.9-inch gun, fired at Meppen, with 33.1 pounds charge, and with projectiles weighing 88.2 and 112.5 pounds, giving velocities of 1,835.3 and 1,668.7 feet, and total energy of 2,060 and 2,171 foot-tons respectively. On one occasion it is recorded in Krupp's printed tables as having fired a shot of 69 pounds weight with a charge of 37.5 pounds with a velocity of 2,135.8 feet, having 2,183 foot-tons energy. In these comparisons the Elswick gun has slightly the advantage. It can scarcely fail to be observed, however, that to rival the results of Krupp, Elswick achievements, and not of Government guns, are instanced. In some measure this may be accounted for by the fact that private manufacturers are untrammeled by routine, and a master of the question seizes lessons taught by experiments and works them as he judges best. The Government does not encourage the manufacturing departments to aim at taking the lead in experimental investigation. There are however, one or two serious lessons that we might learn from foreign trials. Take, for example, the three cases of breech-loading guns, breech-loading small-arm rifles, and prismatic powder. All these have been taken up, tried, and discarded, while they were steadily worked out to a successful issue by Germany. About 1853 the needle-gun was tried and rejected in England. Prussia, acting on her own judgment, patiently worked at it, and in 1863 or 1864 the entire superiority of breech-loading arms became indisputably proved and they were universally adopted. About 1866 the English tried prismatic or pellet powder, and rejected it; and after adopting breech-loading guns about 1858, they gradually superseded them about 1866 by muzzle-loading ordnance: and now, after Germany has steadily worked out these questions to a successful issue they are trying both one and the other again, and those who have weighed the results obtained by them, as compared with those of their own guns and powder, can hardly doubt that both will be eventually adopted. Until recently, the Italians and English were the main supporters of muzzle-loading guns. These guns were characterized also by being made of wrought-iron, which complicates the comparison we now wish to make. Still, the fact remained that England and Italy had muzzle-loading guns of 100 and 80 tons weight, and of a power that no breech-loading ordnance could rival. The Meppen trials have exhibited a gun which entirely surpasses the last-mentioned piece, and, for its weight, compares well with the former. Instead of dealing with a theoretical gun existing only on paper, then, we have one in thoroughly good working order, loading and firing by hand with a rapidity, and shooting with a power and accuracy, far beyond the achievements of the 80-ton gun up to the present time. This result is not due to a want of knowledge but to the impossibility of applying knowledge to the case of the 80-ton gun. With muzzle-loading guns on the present English system they have greater labor in loading, and have to commit themselves to the length of their gun three or four years before they bring it into service. To argue that breech-loaders should be at once adopted would be to commit the fault we have complained of above, but surely we have sufficient reason to give them a trial on a large scale. If breech-loaders have the advantages of ease and rapidity in working, of the possibility of changing their length without revolutionizing the surrounding structure of the ship, and of affording greater cover, especially when nonrecoil carriages of any kind are employed, they surely deserve a full trial even at the cost of having both breech and muzzle-loading guns in the service. See *Krupp Sea-coast Carriages*, and *Krupp Steel Works.*

KRUPP GUN-LIFT.—It consists of two quadrangular pyramidal pillars 23 feet high, made of angle-iron riveted together and strongly braced, as shown in engraving, resting each on a solid base of cast-iron. The pillars are connected at the top by a cross-



beam 19½ feet long, made of two principal trussed beams strongly secured by cross-ties, and carrying at the middle a double pulley, and at about 4 feet distant, on either side, a single pulley. A long chain is secured at its ends to the windlasses, *g*, passing over the pulleys and around the triple block, which is provided with a double hook to receive the ends of the sling-chains. The alphabetical order of the letters indicates the manner in which the wheels and pinions actuate each other. The chain thus makes a half turn on each single pulley, one turn on the double pulley, and one and a half turns on the triple block, as shown in the drawing, the ends of the chain being double between the pulley and block. It is easy to see how a limited number of men, operating on the cranks of the windlasses on both sides, are able to raise as heavy a weight as a 12 or 14 inch gun. See *Gun-lift*, and *Prussian Gun-lift.*

KRUPP SEA-COAST CARRIAGES.—The top carriage is composed of two cheeks connected together by a front, rear and bottom transom. The latter, of boiler-plate, extends under the bottom of the cheeks their entire length, and is shod on the under side where it comes in contact with the rails with brass shoes screwed fast to it. The cheeks for the 6-inch gun are made of a single plate 1 inch thick. For the larger calibers they are made of two plates riveted together, with a wrought-iron frame between them; in the upper side of the frame the trunnion-beds are formed to receive the trunnions, which have bronze friction-rings fitted on them. Cap-squares are used for all carriages. Both cheeks are provided on their outer faces with an apparatus for giving the elevation. It is composed of a cog-wheel operating a circular rack fastened to the gun by a bronze stud. The rack is held in place engaged with the teeth of the cog-wheels by a small roller with its axis in the cheek.

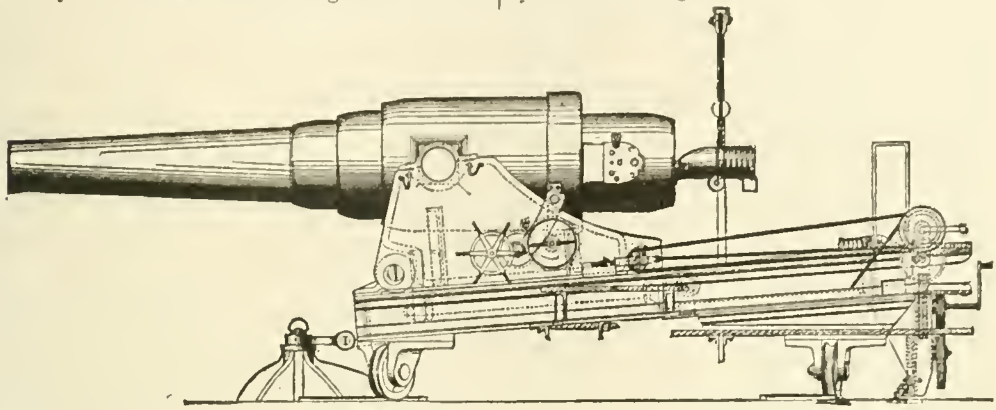
To elevate or depress the gun there is a wheel on the left side, with holes in its periphery to take a handspike; and on the right side there is a wheel with handles. In carriages for heavy guns this wheel is not on the same axis as the cog-wheel, but works in a pinion to gain power to raise the gun. The gun is held in any desired position by turning a check-screw which presses the wheel against the cheek. In firing, the top carriage rests on the chassis rail throughout the entire length of the shoe, in order to distribute the pressure arising from the discharge over a greater surface. To run the gun into battery the top carriage is provided with four truck-wheels. The rear pair are on eccentric axles, and can be thrown in gear by turning the axles part way round; this brings the front wheels in play, which turn on fixed axles. In the 6-inch gun-carriage each pair of wheels has a common axle, which has its bearings in the two cheeks, and the wheels are close up to them on the inside. The bottom transom has two openings left in it to allow the rear wheels to bear on the rails. The lever of the rear wheels on the left end of the axle is kept in position by a latch on the cheek. In carriages for heavier guns, beginning with the 6.7 inch gun, the truck-wheels are placed between the two plates of the cheek, in front or rear of the frame. Each wheel has its own axle.

An automatic arrangement is made to run the gun into battery after firing, without any action on the part of the gunner. This device consists of two wedge-shaped pieces of iron screwed fast to the top of the rails in rear of the top carriage. When the gun recoils, the rear wheels run up these inclined planes, the rear end of the carriage is raised till the front wheels are brought to bear also, and after the recoil the carriage runs down the inclined planes into battery, ready for the next fire. The eccentric axle is kept from turning by a key in the cheek. To run the carriage from the battery this key is taken out, and the wheels may also be thrown in gear by turning the axle with a handspike in the handspike-socket. To provide for the possible wear of the front wheels, and preserve an equal and quick motion when running into battery, the front wheels are also mounted on axles with eccentric boxes, which are kept in position by a small screw in each. To make this adjustment, remove the screw and turn the box, which, on account of its eccentricity, will lower the axle; it is held in the new position by the screw placed in a second hole. Two angle-irons are fastened to the bottom transom to guide the top carriage in its recoil; and two guide-hooks which pass under the flange of the rail prevent the top carriage from balloting on it. India-rubber hurters and counter-hurters are provided to limit the recoil both to the front and rear. In the 6-inch carriage the hurters are replaced by the curve of the end of the angle-irons which join the bottom transom to the cheeks. Two rings are fastened to the rear end of the cheeks, near the bottom, to hook the ropes to for pulling the top carriage from battery.

The hydraulic buffer is used to regulate and check the recoil of the gun. It consists of a forged cast-steel cylinder bored out and turned. Its rear end is closed by the bottom, screwed on and fastened to the rear transom of the chassis by screws. The front end of the cylinder is also screwed into a piece to which the cover is held by screws. There is a hole in the bottom piece for filling the cylinder; it is stopped with a screw and a cock in the cover for emptying it. The piston-head, with four holes bored in it, fits the cylinder closely, and to it, the piston-rod of cast steel is fastened, and passes through the cylinder head, the joint being packed with hemp-packing and bronze packing-box. The end of the piston-rod is fastened to the cross-head, which is bolted to the bottom transom of the top carriage.

The chassis is composed of two rails, connected together by transoms. The rails are wrought iron, I-shaped, rolled in a single piece for the smaller guns, and built up for the 11-inch gun, and all of larger caliber. The front transom is composed of two plates, the upper and lower joined together in the middle by cross-pieces of the same profile as the rails. The rear transom is also composed of an upper and lower plate, united by two cross-pieces riveted to the plates with angle-irons. The rear end of the hydraulic cylinder is bolted to the front one of these cross-pieces through an intermediate piece. The middle transom, composed of a plate, re-enforced with angle-irons, supports the front end of the cylinder, which is secured to it by its brace. The front and rear transoms of the 6-inch carriage are made of single plates, placed vertically, and re-enforced at top and bottom by angle-irons. The traverse-wheel forks are made fast to a front and rear bolster, which are bolted to the chassis. Each bolster is composed of two vertical side plates, one horizontal plate and one vertical plate, with the necessary angle-irons to unite the parts together. The rear bolster is made enough higher than the front one that the four wheels may be all of the same size, notwithstanding the inclination of the chassis, which is necessary to make the gun run into battery after firing. The traverse-wheel forks, composed each of a front and rear branch, are bolted to the under side of the horizontal plate of the bolsters.

The traverse-wheels are of cast steel, with a deep semicircular groove cut in their periphery to fit over the traverse-circle, which is nearly semicircular in cross-section, so that a large part of the recoil of the chassis is transmitted directly to it. The rear wheels have several holes bored radially into them to receive the end of a handspike to traverse the carriage in giving the proper direction to the gun. Hurters and counter-hurters are placed on the front and rear ends of the rails, or the front and rear transoms, to stop the carriage running into or from battery. These hurters are made each of a steel piston, fitting in a box, and holding between the head and box a number of India-rubber disks, separated from each other by sheet-iron rings.



A hinged tongue, bolted to the front transom of the chassis, connects it to the pintle in front. A windlass, attached to the rear end of the chassis, is used to run the gun from battery. It has a drum with raised sides for the rope, and is operated by a crank turning a wheel and pinion. For guns of very large caliber a double set of wheels and pinions is added between the crank and drum. All of these parts are fastened to a stirrup, which is secured by means of a tenon to the rear end of the rail. To run the gun from battery, hook the ropes on each side to the rings in the top carriage, take a turn around the drum, tighten the ropes and work the cranks. In the carriage for the 6-inch gun the arrangement is replaced by a simple block-and-tackle, which is hooked in the rings in the rear end of the chassis.

In the other carriages these rings are fastened to the windlass-frame, and are also used in traversing the carriage. For this purpose, commencing with the 8-inch sea-coast carriage, a windlass is used, fastened to the rear end of the chassis by a boiler-plate frame, strengthened by angle-irons, to which all of the moveable parts are attached. The principal part is the drum, around the circumference of which the chain works, fastened at its two ends to rings outside the platform. A pair of horizontal and vertical leading wheels on each side prevent the chain from leaving the drum. If the drum be turned by means of the crank which communicates with it through the wheel and pinion, the drum moves on the stationary chain, traversing the chassis with an easy but rapid enough motion. In case the chain breaks, the chassis may be traversed with handspikes. A crane is provided for the heavy carriages, commencing with the 8-inch, for elevating the projectile. It is placed on the right side of the chassis, on a direct line with the breech of the gun, when it is in battery. It consists of a curved iron upright, which is held in a vertical position by a pillow-block and collar, and is readily turned by the handle. The drum is near the foot of the upright. By turning the crank, motion is given to the rope, either directly or by a wheel and pinion. One end of the rope is fastened to the drum, and thence it passes over two fixed pulleys on the upright. The other end has a hook fastened to it. This hook is inserted in the upper ring of the shot-cart, which, holding the projectile, is hoisted up, the tongue being first taken out. The crane is turned until the carriage touches the gun, to which it is hooked. The shot being rammed home, the crane is turned, and the empty cart is lowered. Steps are attached to the chassis at several places for the convenience of the gunners (angle-irons are fastened to the rails, and oak planks, secured to them), as the step for the gunner in pointing in rear and across the chassis, on both sides of the chassis, and between the rails, for the men serving the gun, inserting the projectile, the charge, etc.

The foundation of the platform is of brick masonry, from 3 to 6 feet thick, according to the caliber of the gun. The stability of the foundation being the essential condition of the continued good working of the carriage, the masonry should first of all have a solid bed. If the soil be not firm, as often happens on the sea-coast, the foundation should be made by driving piles, on which a good bed of concrete should be laid, and may be made still more solid by pieces of railroad iron.

The following implements are supplied for the carriages: Two wooden handspikes (ash), having ends shod with iron and made to fit in the holes of the elevating-wheel, in the rear truck-wheels, and rear traverse-wheels; one wrench for the packing-box; a wrench for the cock and the filling-hole screw in the hydraulic cylinder; a screw-wrench, and a shot-cart. The body of the cart is a piece of curved sheet-iron, on which the projectile lies. It is held in place by an iron strap passing over it, through which two screws pass and press against the shot between two bands. An eye-bolt and ring is provided on the top of this strap, into which the hook of the crane-rope is passed to hoist the shot. The front end of the cart has a flange, with two hooks to hang it to the breech of the gun, where it rests and serves as a guide in loading. The axle and two bronze wheels are placed a little in front the center of gravity, and a sheet-iron prop at the rear end, and also the pole, which can be taken off, but is held in place when in use by two hooks below and two studs above.

To load the cart, the projectile is first placedon its base and the cart over it; the screws for holding the projectile are turned down; the cart is then righted and the pole put in place. For every battery, or in large batteries for every three guns, there is added a pair of windlasses like that already described and used in running the top carriage back, and a funnel with a graduated scale inside giving its contents in gallons. Its bottom orifice is closed by a cock, and is used in filling the cylinder with glycerine. An extra block and tackle is added to those carriages which have no windlasses.

The carriages having been all mounted and proved in the Shops by firing and working them, it is only required for mounting them in battery that the corresponding parts should be secured to the platform, which should be level and firm. The pintle-plate should be laid down so that the pintle shall be exactly vertical. The rear traverse-circles should be placed on the arc of a circle described with the pintle as a center, and a mean radius of 15 feet, for all sea-coast carriages from 6 to 11 inch caliber.

The 12-inch carriage is similar in its genera. construction to those above described. It admits of an elevation of the gun of 17°, and a depression of 7°. The axis of the trunnion-beds is 93.7 inches above the platform. The elevating apparatus is provided with a wheel on either side of the carriage, having radial handles with which to operate it. This wheel carries a pinion, which is connected by an intermediate wheel to that which works the circular rack, thus gaining power to raise the breech. The rails have a depth of 17.7 inches, a width on top of 6.29 inches,and an inclination of 4°. The piston-head of the hydraulic cylinder is pierced with 4 holes .76 inch in diameter; 19½ gallons is the maximum quantity of glycerine that should be put in the cylinder. The weight of the top carriage is 12,456 pounds; the chassis, 33,842 pounds.

The 14-inch carriage differs from the 12-inch only in some minor details. The axis of the trunnion-beds is 105 inches above the platform. The carriage admits of the gun being fired over a parapet of 78 inches in height, with an elevation of 19° and a depression of 6°. A dial-train is attached to the circular rack of the elevating apparatus, and shows to the gunner working the wheel the degree of elevation given to the gun. The hydraulic buffer has two cylinders 9 inches interior diameter, in place of a single one. They are placed close to the rail on each side of the chassis. Three traverse-circles and three sets of traverse-wheels are used instead of two.

A graduated arc of a circle is traced on the platform in rear of the chassis, with a pointer fastened to the end of the rail to give direction to the gun when the object fired at cannot be seen on account of darkness, smoke, or fog. Weight of the top carriage and chassis, 74,961 pounds. See *Hydraulic Buffer*, *Krupp Gun*, *Platforms*, *Sea-coast and Garrison Carriages*, and *Siege Carriages*.

KRUPP RIFLING.—In this system the grooves are quite shallow, their sides being radial and forming sharp angles with the bore. The rifling has a uniform twist of one turn in 45 calibers generally. The grooves are wider at the bottom of the bore than at the muzzle, so that the compression of the lead-coated projectile is gradual, and less force is expended in changing the shape of the projectile. This change of shape is effected by making the whole groove of the same size as at the muzzle, and then cutting away gradually on the loading-edge of the groove. Of course, as the twist is uniform, the driving-side of the groove cannot vary. The outer surface of the lead coating of the projectile is in raised rings with grooves between, to allow space for its being drawn down in passing through the bore. The advantages of this, or the *compressing* system, are that the projectile is centered during its passage through the bore, which prevents balloting; the angles of departure and the initial velocities are therefore more uniform, and the stability of the axis of rotation on leaving the bore is better assured; from which result great regularity and precision of fire. There is little or no difficulty as to erosion of the metal caused by the gas forcing its way between the projectile and the bore. The lead jacket of the forced projectile does not prevent the employment of heavy charges. Forced projectiles do not wedge in the bore. The regularity of the movement of these projectiles does not wear or injure the bore. The soft metal coating prevents damage to the lands. The bursting of a projectile covered with soft metal has comparatively no baneful effect on the gun.

The objections to the system are the severe strains on the gun by suddenly stopping windage, by fouling, and by forcing the projectile into a bore of smaller diameter. The compressed projectile must be fired from a *breech-loading* gun, and the increasing-twist is impracticable from the great length of the soft-metal bearing. The soft coating of the projectile is liable to injury in handling and in store; also to be stripped on firing.

KRUPP STEEL WORKS.—The widespread reputation of the steel produced in the great works of Herr Krupp, at Essen, in Prussia, has induced us to give it a brief notice. His manufactory, always a large one, has been gradually increasing in size during the last half century, untill it now covers nearly 1000 acres, and gives employment to some 14,000 persons. For large metallurgical works, Essen is favorably situated, being in the center of a coal-bearing area, where coal of the purest kind can be comparatively cheaply procured. There is also at hand the manganiferous iron ores of Prussia, which have been found so excellently adapted for the manufacture of steel; but it is believed that the admirable organization of every part of his manufactory has conduced, as much as anything, to the great success of Krupp. With laborers and mechanics who have passed the regulation-time in the Prussian army, overseers trained in the German technical schools, and a small staff of experienced analytical chemists, he has obviously a great advantage in conducting operations where order, system, and skill are of paramount importance. But even with these benefits, Krupp's productions would not have gained their celebrity, were it not for the scrupulous care with which he performs every manipulation. In the article IRON we have described the manufacture of steel by the *cementation* and *Bessemer* processes, but there are several other methods of making it, and one of these is by the decarburization of cast-iron in the puddling furnace. This is the process by which Krupp makes his steel, in the first instance; and the material he most largely employs is *spiegeleisen*, or specular cast-iron, a highly crystalline variety, usually containing about 4 per cent of manganese. This iron is admirably suited for conversion into steel. The puddling process for steel is similar to that employed for iron, except that the former is conducted at a lower temperature, and requires nicer management; but in the case of steel, the cast-iron to be operated upon is never previously refined. Cast-iron to the extent of about 4 cwts. is melted in the puddling furnace, mixed with a quantity of slag or cinder (chiefly silicate of iron), and stirred with a rabble. During this operation, the carbon in the cast-iron (usually about 5 per cent) is gradually oxidized by the oxygen present in the cinder; carbonic oxide is produced, and as it escapes, what is technically termed "boiling" takes place. When the ebullition becomes active, the temperature is raised until the appearance of incipient solidification occurs; the heat is then lowered, and the ordinary process of balling proceeded with. Steel thus produced usually contains from 0.5 to 1 per cent of carbon; but if the temperature is not skillfully regulated, the carbon becomes wholly burned away, and malleable iron instead of steel is produced.

Puddled steel, although useful for most purposes in the arts (except cutlery), nevertheless wants homogeneity, on account of a certain intermixture of cinder, which is difficult to get rid of without fusion—a defect which is apt to prevent it from welding perfectly. In Krupp's Works the puddled steel is remelted into crucibles, in order to convert it into cast-steel; and it is the wonderful uniformity of quality with which he manufactures this in very large masses, that constitutes the superiority of, and gives so great an interest to, his productions. The crucibles employed are made with extreme care, mainly from fire-clay, to which a little plumbago is added; their capacity varies from 50 to 100 lbs., and it is reported that as many as 100,000 are kept drying at the same time. After being once used, the crucibles are broken up, and mixed with other material, to make new ones. In the casting-house, where the large ingots are run, the furnaces, which contain about 1,200 crucibles, are arranged along the sides of the building; and in the central portion the steel molds, varying in capacity from 100 lbs. to 50 tons, are disposed in line between two pairs of rails, upon which runs a movable crane. It is in the casting of such an enormous ingot as 50 tons of steel (the largest yet produced) from crucibles of small capacity that the perfect organization of Krupp's Establishment becomes more strikingly apparent. At a given signal, one gang of workmen remove the crucibles from the furnaces, while another seize them with tongs for the purpose, and pour their contents into narrow canals of wrought-iron, lined with fire-clay, which converge into the opening by which the mold is filled. This is the critical stage of the operation, the difficulty being to deposit in the mold a continuous stream of melted steel of about the same degree of heat, so as to cool uniformly, and to solidify into a perfectly homogeneous mass. Of such uniform soundness are some of Krupp's large steel ingots, that one—shown in the London Exhibition of 1862, 9 feet high, 44 inches in diameter, and weighing 21 tons—when broken across did not show the slightest flaw, even when examined with a lens. In order to manipulate these extraordinary masses of steel, there is a steel hammer, weighing 50 tons—the mechanical marvel of the Works at Essen—which has a cylinder nearly six feet in diameter. It has a 50-ton crane at each of its four corners, and behind each of these again there are four heating furnaces. A movable bench on low massive wheels serves to remove a large ingot from any of the furnaces, which is then, by means of the powerful cranes, and a system of pulleys and crabs, placed on the anvil, and worked into any desired shape. The anvil-face weighs 185 tons.

The quantity of steel manufactured by Herr Krupp annually amounts to about 125,000 tons, representing a value of about £3,000,000. It consists chiefly of rails, tires, crank-axles, shafts, mining pump-rods, and guns—the proportion of ordnance being about two-fifths of the whole. Guns have been made at Essen for the Prussians, Austrians, Belgians, Dutch, Italians, Turks, Japanese, and also for the English, although not directly ordered by the Government. In 1874 the works included 1,100 smelting and other furnaces, 275 coke-ovens, 264 forges, 300 steam boilers, 71 steam-hammers, 286 steam-engines of 10,000-horse power, 1,056 machine tools, 30 miles of railway, 80 telegraph stations, a chemical laboratory, and photographic, lithographic, printing, and bookbinding establishments. There is a fire-brigade of 70 men, besides 166 watchmen. In 1876 the consumption of coal and coke together amounted to 612,000 tons; that of gas, 7,300,000 cubic meters in 20,342 burners. Krupp has built good houses, hospitals, etc., for his men. Besides the works at Essen, the firm possesses several mines and smelting works. In the Paris Exhibition of 1867, Krupp showed a huge gun intended for a coast battery to defend the attacks of plated ships. It was made entirely of cast-steel, weighed 50 tons, and could propel a shot weighing 1,080 lbs. It took 16 months, working day and night without interruption, to manufacture. The price of the gun alone was £15,750, and of its carriage and turn-table, which weighed respectively 15 and 25 tons, £6,000 more. In the Vienna Exhibition of 1873, Krupp showed, in a pavilion by themselves, a number of most interesting objects in steel. Among them were a huge gun like that shown at Paris, about 4 feet 6 inches in its greatest diameter; an octagonal ingot, weighing fully 50 tons; and a marine-engine shaft, 15 inches in diameter. He also exhibited at Philadelphia in 1876. See *Krupp gun*.

KSHATRIYA.—The second or military caste in the Brahmanical social system.

KU-KLUX—KU-KLUX KLAN.—The title of a Secret Association which existed in the Southern States from 1866 to 1872, and which terrorized that section of the country during the period in question. It was first made known as an active agency in Tennessee, in 1867, when the Governor of that State, William G. Brownlow, called upon the U. S. military authorities, to suppress violence and public disturbances in the State, which were traced to this organization. The history of the Ku-klux shows that at the close of the war various Societies of a political character were formed in the States of Alabama, Arkansas, Georgia, Kentucky, Mississippi, North and South Carolina, Tennessee, and Texas, under the names of the Knights of the White Camellia, White Brotherhood, Constitutional Union Guards, Pale Faces, Invisible Empires, Invisible Circle, etc., all of which were eventually lost in the broader scope and more powerful and permanent influence of the Ku-klux Klan. From the evidence afforded it would appear that the origin of these Secret Societies, and more particularly of the one we are specially considering, is to be found in the dislocation of poltical and social interests in the Southern States consequent to the aggressive influence of a long and devastating condition of warfare. In explanation of their foundations, ex-Confederates claim that they were preceded by organization of loyal leagues, which, as they allege, were formed among the Negroes in the South through the efforts of "Carpet-baggers," so-called radical leaders intriguing in the interest of the perpetuation of the power of the Republican Party in the Southern States. It is also claimed in behalf of the Southern people that, through the action of the 14th and 15th Amendments to the Constitution of the United States, the Southern white population was greatly endangered both in its homes and its social relations, the emancipated Blacks being generally considered in the light of a race angered by long and bitter servitude, now armed and equipped by law and public sentiment, and only waiting opportunity for an uprising and to grasp the balance of power among the high-spirited people to whom they had been slaves for more than two centuries. This is the Southern explanation of the rise of the Ku-klux. Whatever may be the measure of truth contained in it, this in no wise militates against the justness of public condemnation of its acts. By Joint Resolution, dated April 20, 1871, the two Houses of Congress ordered an investigation into the condition of affairs in the States recently in a condition of insurrection. For three years the press had been filled with detailed statements describing acts of atrocity attributed to the secret and terrible Ku-klux Klan, which rivaled the worst instances recorded against the Spanish domination in the Netherlands, and the bloody scenes of the French Revolution. In every Southern State except Virginia, West Virginia, Delaware, Maryland, and Florida, assassination of Negroes and white Republicans were of daily occurrence. The gift of suffrage to the colored man had been nullified in its outcome as a political influence through the system of terrorizing which utterly precluded the free suffrage of the emancipated Blacks. Besides instances of special massacres covering large numbers, and of which there occurred many in South Carolina, Louisiana, Mississippi, Texas and Tennessee, the daily and nightly assassinations, whippings, burnings, and other outrages were innumerable, and were never recorded. In reporting the state of society in Texas, the evidence given is to the effect that the Negroes were murdered with such frequency that there was no possibility of keeping an accurate record of the details. On the basis of reports of this nature, and stimulated, doubtless by the intense public feeling in the North, created by the gradually spreading conviction of the lamentable deficiency in the power of the law as applied in the South, Congress, through its Committee, proceeded to the investigation ordered by the Joint Resolution to which we have already referred. The result of this investigation appears in the 12 octavo volumes reporting the testimony taken and published among the official documents (Senate) of the year 1872. An immense mass of evidence displays the nature and acts of the Ku-klux, and fully justifies the title "Conspiracy," which Congress bestowed upon that organization. While the Ku-klux may have originated for a minor purpose, it is difficult to believe that this tremendous association of men sworn to fidelity; having its ramifications in every Southern State, and the power of life and death in most of them; with a ritual, oath, grips, pass-words, and all the other secret and systematic machinery necessary to the carrying out of the most hidden and dangerous purposes—it is difficult to believe that the real motive and intention of the Order were not the subversion of the Government of the United States, and the rehabilitation of the leaders of the Rebellion. To this end, the negation of the suffrage in the South, and the efforts to defeat reconstruction, may reasonably be supposed to have tended. And whatever diverse opinions may be held regarding the good sense, judgment, and patriotism displayed in the Reconstruction Acts and the methods adopted to carry them into effect, it is impossible to view without the severest censure the nature of the opposition to them, as conducted by a bloody and revengeful association of exceedingly cruel and implacable men, intensely crazed by the facility with which murder and incendiarism could be made to do duty for what its members chose to consider retributive justice. Following is the oath of the Ku-klux Klan, as it was offered in evidence before the Investigating Committee of Congress: "I (name), before the great immaculate Judge of heaven and earth, and upon the holy evangelists of Almighty God, do, of my own free will and accord, subscribe to the following sacred binding obligation. I. I am on the side of justice and humanity and constitutional liberty, as bequeathed to us by our forefathers. II. I reject and oppose the principles of the radical party. III. I pledge aid to a brother of the Ku-klux Klan in sickness, distress, or pecuniary embarrassment. Females, friends, widows, and their households shall be the special object of my care and protection. IV. Should I ever divulge, or cause to be divulged, any of the secrets of this Order, or any of the foregoing obligations, I must meet with the fearful punishment of death and traitor's doom, which is death, death, death, at the hands of the brethren." This sufficiently theatrical obligation becomes impressive when one reflects that its various sections were carried out with absolute rigor, and that disobedience of the orders of the Chief of a klan was actually visited with instant death. Thus were the customs of the *Carbonari* paralleled among so prosaic and conventional a people as the Americans so late as 1871. The members of the Order were obliged to deny their membership, even when answering as witnesses in a Court of law, and were obligated to clear each other by their testimony in such cases or when acting as jurors. The Ku-klux gradually died out as an active organization after the investigation of 1871; and although certain of their methods continued to obtain during the progress of elections in the South, the return to sounder sense and better feeling on the part of the people of that section, and the improving condition of the relations between the North and the South, gradually died away with the passions in which the organization originated. It is reported that there were at one time 550,000 members of the Ku-klux Klan in the South, of which number 40,000 are said to have been in Tennessee.

KUL.—The Turkish word for slave to the Prince. The Grand Vizier, the Bachas, the Beigler Beys, and all persons who receive pay or subsistence from situations dependent upon the Crown, are so called. This title is in high estimation among the Turkish military, as it authorizes all who are invested with it to insult, strike, and otherwise illuse the common people, without being responsible for the most flagrant breach of humanity.

KULLUM. (*Nauclea parviflora*).—A wood used in the Bombay Presidency for fuses. It is a very light, soft, close, and even-grained wood, of a light brown color, not very durable, and will rot when exposed to wet.

KUNDA DE RAJAH.—An Indian sword of the 16th century, $3\frac{1}{4}$ feet long, and entirely made of iron. The blade is damascened, and the handle, guard and hilt are beautifully engraved.

KURROL.—The Indian term for the advanced-guard of a main army.

KURTCHI.—The Persian name of a Militia. It consists of one body of Cavalry, which is composed of the first Nobility of the Kingdom, and of the lineal decendants of the Turkish Conquerors, who placed Ismael Sophi on the throne. They wear a red turban of twelve folds, which is made of particular stuff. This turban was originally given them by Ismael, in consideration of their attachment to the religion and family of Ali. In consequence of their wearing this turban, the Persians are always called by the Turks *Kitilbaschi* or Red-heads. The Kurtchi compose a body of nearly 18,000 men. The Commanding Officer of the Kurteki is known as *Kurtchi-baschi*, who formerly had the identical authority that was originally possessed by the Constable of France.

KYANIZING. A process for preserving ordnance timber, etc., from dry rot or decay. This most efficacious method, which consists of injecting into the pores of the wood a solution of corrosive sublimate, was invented by John H. Kyan, who was born in Dublin, Nov. 27, 1774, and died in 1850.

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LABARUM.—The famous standard of the Roman Emperor Constantine, designed to commemorate the miraculous vision of the cross in the sky, which is said to have appeared to him on his way to attack Maxentius, and to have been the moving cause of his conversion to Christianity. It was a long pipe or lance, with a short transverse bar of wood attached near its extremity, so as to form something like a cross. On the point of the lance was a golden crown sparkling with gems, and in its center the mysterious monogram of the cross and the initial letters of the name of Christ, with the occasional addition of the Greek letters *Alpha* and *Omega*. From the cross-beam depended a purple banner, decorated with precious stones, and fully surrounded by a rich border of gold embroidery. The cross was substituted for the eagle, formerly depicted on the Roman standards, and there were sometimes other emblems of the Saviour. Between the crown and the cross were heads of the Emperor and his family, and sometimes a figure of Christ woven in gold. See *Standard*.

LABEL—LAMBEL.—In Heraldry, the mark of cadency which distinguishes the eldest son in his father's lifetime, familiar to us from its entering into the composition of the arms of the Prince of Wales and other members of the royal family. It consists of a horizontal stripe or fillet, with three points depending from it. When the mark of cadency itself is designated a *file*, its points are called *labels*. It is said that the eldest son's eldest son should wear a label of five points in his grandfather's lifetime, and, similarly, the great-grandson a label of seven points, two points being added for each generation. The label extended originally quite across the shield, and sometimes occupied the upper, though now it is always placed in the lower part of the chief; the points, at first rectangular, assumed in later times the form called pattée, dove-tailed, or wedge-shaped, and more recently, the label ceased to be connected with the edges of the shield. Edward I., in his father's lifetime, bore the arms of England within a label not of three, but of five points azure, joined to the head of the shield, and interlaced with the tail of the uppermost lion. Edward II., when Prince of Wales, used indifferently the label of three or five points, as also did Edward III.; but from the time of the Black Prince downwards, the eldest son of the King of England has invariably differenced his arms with a label of three points argent, and the practice has been for the younger sons also to bear labels, which are sometimes of other colors and more points, and differenced by being charged with fleurs-de-lis, castles, torteaux, hearts, crosses, etc., as directed by the Sovereign by sign-manual registered in the College of Arms. The practice of differencing by the label which is thus *in viridi observantia* in our own and other royal families, is less used by subjects. Like other marks of cadency, labels are sometimes borne as permanent distinctions by a particular branch of a family. See *Heraldry*.

LABORATORY.—This term is generally applied to establishments for conducting chemical or physical investigations, or for chemical manufacture. Chemical laboratories may be for purposes of instruction, as are those which are attached to colleges or other high schools. These institutions also sometimes have special laboratories for research. All large private manufacturing establishments where chemical processes are employed, to a considerable extent have laboratories attached to them in which investigations are carried on; many of them in the nature of preparatory trials of processes, to facilitate the process of manufacture. A government manufactory is sometimes called a laboratory, and so are many smaller private establishments, as metallurgical laboratories, telegraph laboratories, etc. The following fixtures and furniture should be provided for a government laboratory.

1. *Cartridge-house.*—A table for making cartridges for small arms, 12 feet long and 2½ feet wide, for 12 men or boys to work at, and the length in that proportion for any greater number; tables for cutting paper and flannel, and for rolling cases on; choker for rocket-cases; press for rocket and port-fire cases; benches for cartridge-tables; stools. Closets should be partitioned off from these rooms and furnished with cases, drawers, racks, and shelves for materials and tools. 2. *Filling-house.*—A shelf, 2 feet wide, for weighing on; other shelves with closets under them; tables with raised borders for filling, folding, etc.; budge-barrels, or powder-barrels, with copper hoops and covers; stools for seats; footstools; a step-ladder; stands and gutters for emptying powder-barrels. 3. *Packing-house.*—Tables, benches and stools. 4. *Store-house.*—Shelf for weighing on the shelves, drawers, and closets; tables, scales, stools, seats, step-ladder. 5. *Driving-house.*—Blocks set in the ground or pavement; benches and stools. In favorable weather, a porch attached to the building, or a tent, may be used for a driving-room. 6. *Mixing-house.*—Tables with raised edges; sieves, etc. 7. *Furnace-house.*—Furnaces; work-benches; platform-balance or large scales; a tinner's bench and tools, with a vise, an anvil, and a chest for tools, a smith's forge, shovel and poker, stools, etc. 8. *Carpenter-shop.*—Turning-lathe and tools; carpenter's benches and tools. 9. *Magazine.*—Shelves and frames for boxes and barrels.

Two kinds of furnaces are used in the laboratory: In the first, the flame circulates around both the bottom and sides of the kettle; in the second, it comes in contact only with the bottom; the latter are used for compositions of which gunpowder forms a part. Furnaces are built of bricks. The kettle is of cast-iron, about 2 feet in diameter at the top, having a rounded bottom and a flange about 4 inches wide around the top, or else strong handles to set it by. The bottom is .75 inch thick, and the sides .5 inch. By setting it in an iron plate pierced with holes, encircling the bottom, a furnace of the first kind may be converted into one of the second kind by stopping the holes.

Furnace for reducing the oxide of lead or dross.—This furnace is built in the open air, on a stone or brick foundation. It is composed of a cylinder of sheet-iron, 16 inches by 30 inches, lined with refractory clay from 2 to 3 inches thick. The interior has a form of an inverted frustum of a cone, terminating below in a basin, the bottom of which is inclined toward a tap-hole. The fire is made in the furnace, and the draught supplied by a bellows, the nozzle of which enters at the top of the reservoir. The dross and the charcoal intended for its reduction, are thrown on the fire from the top of the furnace. The metal, as it is reduced, flows into the basin and escapes through the tap-hole into an iron vessel and is cast into bars or pigs as desired. In the field, furnaces may be built with sods, or sunk in the earth, if bricks cannot be readily procured.

Furnace built with sods.—Let the kettle rest on a trivet, the feet of which may stand on any piece of flat iron, such as the bottom of a shot-canister, or stand for grape, the bottom of the kettle about 1 foot from the ground; build round it with sods. The door of the furnace is 10 inches square; the flue of the chimney, opposite to the door, 6 inches square, and commencing about 6 inches from the ground; the first part of the flue inclined at an angle of about 15°, the rest vertical, and placed, if circumstances permit, against a wall; the top of the door and of the flue may be supported by small bars of iron.

Furnace sunk in the earth.—The edge of the kettle should be about 1 inch above ground, and the bottom 12 to 15 inches above the hearth of the furnace; the earth is dug down vertically 1 foot from the kettle for the front of the furnace, and the door is cut 10 inches square. The earth is removed and sloped out, so as to give access to the door; the flue is bored out on the opposite side with a crowbar; it commences 6 inches above the hearth, and comes out of the ground 18 inches from the furnace, whence it is carried horizontally about 13 feet.

In furnaces of the second kind mentioned above, the trivet may be omitted, and the kettle may rest on the sod or earth for about 1 inch all round, and the earth rammed in against the sides of the kettle.

It is important to observe the following precautions against accidents:

Avoid as much as possible, the use of iron in the construction of the buildings, fixtures, tables, benches, boxes, etc., of the laboratory; sink the heads of iron nails, if used, and fill over them with putty, or paste several thicknesses of paper over them. Before the men go to work cover the floor with carpets or paulins, which are taken up carefully, after the men leave, and carried at least 50 yards from the building, and there shaken thoroughly and swept. During the work have the carpets frequently swept. Place the stores in cloth bags in the windows exposed to the sun. Prevent persons from entering with sabers, swords, or canes, etc., or with matches about their persons. Direct all who work where there is powder to wear moccasins or socks, and to take them off when they leave. Direct the men not to drag their feet in walking. Make the doors and windows to open and close easily, without friction; keep them open whenever the weather permits. Never keep in the laboratory more powder than is necessary, and have the ammunition and other work taken to the magazine as fast as it is finished. Let powder-barrels be carried in hand-barrows made with leather or with slings of rope or canvas, and the ammunition in boxes. Let everything that is to be moved be lifted, and not dragged or rolled on the floor. Never drive rockets, port-fires, etc., or strap shot or shells in a room where there is any powder or composition except that used at the time. Loading and unloading shells, driving rockets, pulverizing the materials, the preparation of compositions requiring the use of fire, and in which the components of gunpowder enter, ought to be done, in all cases when possible, in the open air or under a tent far from the laboratory and magazine. Never enter the laboratory at night, unless it is indispensable, and then use a close lantern, with a wax or oil light carefully trimmed. Allow no smoking of tobacco near the laboratory. In meling lead, be sure that it contains no moisture; put the pigs in carefully, and do not use more than will fill the pot two-thirds full. Use the same precaution in melting all fatty substances. See *Fireworks*, *Laboratory Materials*, and *Royal Laboratory*.

LABORATORY MATERIALS. Laboratory materials may be classified as follows: 1st. Those for producing light, heat, and explosion. 2d. Those for coloring flames and producing brilliant sparks. 3d. Those used in preparing compositions. 4th. Those used in making tools, cases, cartridge-bags, and for miscellaneous purposes.

MATERIALS FOR LIGHT, HEAT, AND EXPLOSION.—*Potassium nitrate* (*niter*), KNO_3.—For use in the laboratory, niter should be freed from all foreign substances and be reduced to a fine powder or else to very minute crystals. It is best pulverized by hand in the rolling-barrels at the powder-mills; but it may be pulverized by hand in the laboratory as follows: Put into a *rolling-barrel* 50 pounds of dry, refined niter and 100 pounds of bronze balls; turn the barrel for two hours and a half at thirty revolutions a minute, striking it cautiously at the same time with a mallet to prevent the niter from adhering to the sides. Separate the balls by means of a brass-wire screen, and the foreign substances with a hair sieve. Niter may also be pulverized by pounding it in a brass mortar, or by solution as follows: Put 14 pounds of refined niter with 5 pints of clear water, in a broad and shallow copper pan, over a slow fire, and as the niter dissolves skim off the impurities; stir the solution with a wooden spatula until the water is all evaporated, when the niter will be very white and fine. Should it boil too much, the pan must be lifted from the fire and set upon wet sand or earth, and the niter should be stirred until it dries, to prevent it from adhering to the pan.

Potassium chlorate, $KClO_3$, is a white salt; crystallized in white scales; anhydrous; not altered by exposure to the air; soluble in water, more in warm than in cold; insoluble in alcohol; density, 1.989; decrepitates and fuses at about 500°; at about 720° it is decomposed into oxygen and potassium chloride. This salt is one of the most energetic of oxidizing bodies, because it parts with its oxygen so readily, of which it contains a very great quantity (.3915 of its weight). Thrown on burning coals, it melts quickly. It explodes by simple contact with sulphuric acid; mixed with a combustible body, the mixture may be exploded by friction or by a blow. It should be purchased crystallized, and should not contain more than one-thousandth of its weight of chloride of sodium or potassium. Its purity is tested by means of the nitrate of silver dissolved in distilled water, 73½ grains in one-quarter of a pint. Dissolve 77 grains of the chlorate in 300 grains of warm water, and let the solution get cold; the chlorate will be precipitated in crystals Add to the liquid about two drops of the solution of the nitrate of silver. After filtering, the liquid ought not to give a precipitate by the addition of more nitrate of silver.

Mercury fulminate, $CNC(NO_2)Hg$, is a gray salt, crystallized in fine silky needles; soluble in water, more so in warm than in cold water. It is an extremely dangerous substance to operate upon in a dry state, owing to the readiness and violence with which it explodes. It detonates strongly when struck by a hard body; but sometimes trifling friction may serve to produce this effect, even when employed in a moist state. Heated to 300° it explodes, evolving an exceedingly bright flame. It is decomposed, with explosion, by the electric spark, and contact with strong nitric and sulphuric acids. The products of detonation are carbonic acid, nitrogen, and vapor of mercury. It should always be manipulated moistened with at least 30 per cent. of water.

To prepare fulminate of mercury.—Dissolve in a glass retort capable of holding about a half-gallon, 10 ounces of pure mercury in five pounds nitric acid (aqua-fortis), of the specific gravity of 1.40. The solution is made by placing the retort in a water or sand bath of about 120°, or exposed to the sun's rays on a warm day. The vapors which come over are very deleterious, and should not be inhaled. It requires about eight hours to thoroughly dissolve the mercury. When the solution is complete, pour the liquor into a wide-mouthed glass vessel capable of holding 8 to 10 gallons, into which 5.675 pounds of alcohol (ethyl), about 6½ pints, of the specific gravity of .85 have been previously poured. Care must be taken to *pour the nitrate of mercury on the alcohol*, as the reverse mode of mixing the compound is very dangerous. Great heat is evolved during the effervescence which ensues from the mixture, and the glass vessels used should be well annealed, and of a form to bear a high heat without breaking. Carboys of thin flint-glass, without mouth-rings or any abrupt change in thickness, are best. The operation should be performed at a safe distance from the fire, as the vapors of ether disengaged are highly inflammable. When reddish fumes begin to appear, they must be reduced by adding alcohol in small quantities. The proportion of alcohol used in the whole operation varies according to the strength of the acid and alcohol, and also with the state of the weather. The proper quantity is that which is just sufficient to keep down the reddish fumes, and is determined by trial with the materials used. When the effervescence has ceased, the fulminate of mercury is found at the bottom of the vessel as a brownish precipitate. A small quantity of water is poured in, and the contents transferred to the washing-tub, where it is repeatedly washed in soft water, until the water no longer reddens litmus-paper. The fulminate is in the form of very small crystals, of a light gray color and brilliant surface. If the operation be well and carefully performed, no metallic mercury will be reproduced. The weight of the fulminate when well dried will be about 14 per cent. greater than that of the mercury used. If the proper proportions be not used (or if the materials be not of good quality), the product will be, instead of fulminate, an impalpable yellow powder which is incombustible. When this is observed, the result may generally be corrected by varying the proportion of alcohol in the mixture. The fulminate of mercury is kept under water, in stone jars, which should be preserved from frost. *Roll brimstone* is used for melting, and flowers of sulphur may be used instead of roll sulphur pulverized. The purity of the flowers is more to be depended upon than that of the roll sulphur. When mixed with potassium chlorate, however, it should be washed to remove sulphuric acid. Sulphur facilitates the ignition and combustion of compositions to which it is added.

Gunpowder—For compositions, gunpowder is *mealed*, either by rolling it for two hours with once and a half of its weight of balls, or by beating it an equal length of time in a leather bag, or by grinding it with a muller on a mealing-table. Mealed powder, and pulverized saltpeter, charcoal, and sulphur are generally obtained from the powder-mills.

Antimony (regulus of antimony) is a grayish-white metal, very brilliant, with a highly lamellated structure. Specific gravity, 6.7; melting point, 809°. It is easily reduced to powder, and by its combustion with sulphur produces a strong light and heat, with a blue or white flame. Antimony is never found pure in the shops; that which is sold under the name of regulus of antimony always contains a little sulphuret of antimony, arsenic, and sometimes the sulphuret of iron.

Lampblack is the result of the incomplete combustion of resinous substances. It is composed of 80 parts of carbon and 20 of impurities. It is employed to quicken the combustion of certain substances; but before it is used it should be washed with a hot alkaline solution, to remove all traces of empyreumatic oil.

Coloring Materials. A flame is colored by introducing into the composition which produces it a substance, the particles of which, being interspersed through the flame and rendered incandescent, give it the required color. Coloring substances do not generally take part in the combustion, and their presence more or less retards it. It is for this reason that potassium chlorate, a more powerful oxidizing agent than niter, is used in lieu of it in compositions for colored fires. There are a great variety of substances which give color to flames, the principal of which are strontium nitrate and sulphate for red, barium nitrate for green, the bicarbonate of soda for yellow, copper sulphate for purple, copper carbonate and acetate for blue. Lampblack is employed to give a train of rose-colored fire in the air, and powdered flint glass for white flames. Sparks are produced by introducing into the composition filings or thin chips of wrought or cast iron, zinc, steel, copper, or fragments of charcoal.

Iron. Filings and very thin chips give most brilliant sparks and stars, the effects of which depend almost entirely on the size of the particles used. The filings must be made when wanted, or be very carefully preserved from rust.

Cast-iron—Pulverized, it gives very large and white sparks, in fireworks (*Chinese fire*). Select the white cast-iron, or take the pieces of utensils with thin sides. To pulverize it more easily, heat it to a red heat and throw it into cold water.

Steel.—In fireworks, filings and small pieces give the most brilliant sparks.

Zinc is a bluish-white metal, usually brittle, and its fracture shows a crystalline structure. Specific gravity, 6.9; melts at 680°; is volatilized at a red heat, and takes fire in the air, burning with a light flame. At 400° it is easily reduced to a powder in a mortar. Granulated zinc is used to produce a bluish flame. An alloy of zinc and antimony pulverized gives beautiful blue drops. The oxide of zinc (*flowers of zinc*) produces the appearance called gold rain. It ought to be purchased in scales, not in a powder, as in this latter case it may be mixed with foreign substances.

Copper filings are used to give reddish sparks and a greenish blue flame.

Preparing Compositions. Turpentine, spirits of turpentine, Venice turpentine, tar, pitch, and rosin, are chiefly employed in the preparation of compositions for producing light. Alcohol, whisky, brandy, or vinegar is used in mixing compositions into which niter enters, as it does not dissolve niter. It should be strong. To prevent it being drunk, mix a little asafetida with it. Beeswax and mutton tallow are employed in mixing compositions intended to produce heat and light.

Gum arabic should be transparent, yellowish-white, brittle, insipid, inodorous, soluble in water and vinegar, insoluble in alcohol. It is used in solution to give body and tenacity to compositions, or to make them burn more slowly. It should be prepared as required, for when in solution it undergoes a decomposition.

Miscellaneous Materials—*Copper* is a red, brilliant metal, possessing great tenacity, ductility, and malleability. Specific gravity, 8.9; fusible at about 1980°. Copper, being but slightly acted on by saltpeter, is employed for powder measures, utensils for refining saltpeter, etc. Copper vessels should not be exposed to a great heat, or used for heating compositions containing sulphur, as the copper would be rapidly oxidized.

Bronze is used in the laboratory for utensils and implements which receive blows or act by percussion, and replaces steel and iron wherever there is danger of an explosion from a blow or from friction.

Brass is an alloy of about two parts of copper and one of zinc. Brass wire is used for ligatures, for screens and sieves.

Sheet-iron—Select the softest and most pliable. When it is substituted for tin, in strapping projectiles, it should be first annealed by heating it to a dull red heat, and letting it cool very gradually under warm ashes, not exposed to the air.

Lead is a bluish-white metal, bright, but tarnishes quickly in the air. Specific gravity, when pure, 11.48; melts at 600°, and volatilizes at a red heat. The purity of lead is judged of by its specific gravity. To determine this, after having weighed the pig, suspend it with a wire in a vessel of water, so that it shall be completely immersed, without touching the sides, and weigh it again. The weight in the air, divided by the difference between the weight in air and water, will give the specific gravity, which ought to be 11.35 for lead of commerce. Lead melted in contact with air is soon covered by a coat of gray oxide, which rapidly increases in thickness. The formation of this oxide, or dross, is prevented by covering the lead with powdered charcoal or rosin.

To reduce the oxide of lead—Put in a kettle about 50 pounds of lead, with $\frac{1}{10}$ of its weight of powdered charcoal or grease; cover the kettle, and raise to a red heat; stir the mass, and add gradually more coal, as it assumes a yellow color, using in all $\frac{1}{8}$ of the weight of oxide; dip out the lead with an iron ladle, and pour it into iron molds or pans. After having obtained in this way two-thirds of the weight of oxide, in lead, throw the dross into a tub of water, and wash it, to separate the ashes and coal; dry the remaining oxide and grains of lead, and put them in a ladle with $\frac{1}{20}$ of their weight of rosin; raise to a red heat, set fire to the rosin, shake the ladle and pour off the lead. A further addition of rosin will produce more lead; $\frac{1}{14}$ of the weight of dross is generally used. Tallow may be used in place of rosin. When the quantity of dross is considerable, it may be reduced, in a similar manner, in a small cupola-furnace.

Plumbers' solder is an alloy of lead and tin, in the proportion of two parts of the former to one of the latter.

Paper.—Paper for cartridge-box wrappers should be homogeneous, and without any trace of stalks; well sized, even, pliable, with a good body without being too thick, free from folds or rents. The sheet when moistened ought to present a uniform hue, without spots or marblings. Taken out of the water and suspended for a moment by the extremities of the short sides, it ought not to tear from its own weight. The sheet crumpled in the hand or pinched with the nails, ought not to tear in the folds, and when torn the rent should be fibrous. A strip of paper 4 inches wide ought not to break under a weight of 40 pounds, in the direction of its least strength. In testing the strength of paper, the two ends are held by two vises of hard wood. Each vise is composed of two rectangular jaws, which can be brought against each other and held firmly by means of screws, or by tenons on one jaw passing through the other and keyed firmly to it. A strip of paper 4 inches wide is cut and inserted in the vises, so that the length between them shall be exactly 12 inches. The jaws are closed tightly, and one vise is suspended from a fixed point by means of a cord or hook, and to the other is made fast the pan of a balance. It is loaded gradually, with care, until the paper gives way. The strips should not be taken from the edges of the sheets only, but from all parts, and from the length and breath successively, for in these two directions the strength is very different. Five sheets are generally taken from each ream, in which only one sheet can have less strength than that allowed. If this condition be not fulfilled, the ream is rejected.

Size and weight of paper.

	Inches.	Weight, pounds.	Proof weight, pounds.
No. 1. For musket-cartridges…	13 ×16½	……	40
No. 2. For musket-cartridge wrapper…	18 ×20	36	101
No. 3. Wrapper for Cartridge-box…	16 ×14	21	30
	18 ×16	27	
	20 ×20	37½	
	24 ×20	45	
No. 4. Rockets and Portfires…	19 ×28	65	180
No. 5. Fixed ammuntion	23½×24	60	225
No. 6. Cannon-cartridges	19 ×23	70	315
No. 7. Fireworks…	13 ×16½	20	85

The other papers are tested in the same way, and should possess the same general characteristics.

Tow should be entirely of hemp or flax, clean, dry, sound, free from stalks and foreign substances.

Merino or *serge*, for cartridge-bags, should be made entirely of wool; it should be strong, closely woven, twilled, and not frayed; the width should be even in the same piece; that $\frac{3}{4}$ yard wide is convenient and the most common. The colors are to be preferred in the following order; green, gray, yellow, blue, red, white; reject black, which is almost always burnt and weak.

Canvas should be the strongest and closest woven; it is used for the sacks for fire-balls.

Twine should be strong, smooth, and well twisted .03 inch thick for sewing fire-balls, etc.; from .06 inch to .08 inch for fixing ammunition, etc.

Rope should be even and well twisted, pliant without being soft, made of hemp of good quality, water-rotted, and entirely freed from stalk. Its size should be uniform throughout its whole length. The rope most commonly used in the laboratory is white-hemp rope, from 1 inch to 1.5 inch in girth.

Thread—Saddler's thread, of flax, three strands; used with paper boxes for revolver cartridges.

Glue should be hard, dry, transparent, of a brownish red color, and free from smell.

To Prepare Pastes and Glue.—*Flour paste*—Sift the flour and mix it with 8½ times its weight of water; heat it gently, stir it, and let it boil for three-quarters of an hour; when it becomes ropy pour it into bowls and pass it through a sieve before it is quite cold. The flour yields 7 times its weight of paste. Time required to make it, one hour and a half. It is best made of rye flour.

Starch paste.—Mix wheat starch with twice its weight of water, pour it gradually into 6½ times its weight of boiling water, and let it boil for ten minutes, stirring it all the time; then proceed as before. Starch yields 8 times its weight of paste. Time required, one hour.

Paste for pasteboard.—Mix the flour or starch with 12 times its weight of water; this yields 9 times the weight of flour and 11 times the weight of starch.

Paste mixed with glue.—The addition of $\frac{1}{16}$ of glue makes the paste fit for pasting sheets of parchment together or for pasting paper on wood. Dissolve the glue separately and pour it into the cold water with which the flour or starch is mixed.

Cheese paste is made of fresh white cheese and also quicklime. Pound the cheese in a mortar with boiling water; let it stand and decant it; repeat this operation three or four times. Pound together 3 parts of this cheese thus prepared and one part of quicklime, moistening it with pure water till the paste ropes like honey. Prepare only a little at a time. It is used in pasting parchment and parchment paper. These different kinds of paste should be used cold. A supply for not more than two or three days should be made at one time; but it may be preserved longer by adding alum in the proportion of $\frac{1}{10}$ of the weight of flour. The depredations of rats may be prevented by dissolving a like proportion of colocynth in the water with which the paste is made.

Hair sieves for mixing compositions.	No. 1.	50 meshes in 1 inch, or 2,500 in a square inch, a single hair in one direction, 2 in the other.
	No. 2.	25 meshes in 1 inch or 625 in a square inch, 2 hairs side by side in each direction.
	No 3.	12.5 meshes in 1 inch or 156 in one square inch, 3 hairs side by side in each direction.
	No. 4.	180 meshes in a square inch, brass wire.

The *sieves* for the laboratory are made of brass wire, hair, or silk, and may be square or round.

Brass sieves ought to be used only for dry materials. A silk sieve of 120 meshes to the linear inch is used in preparing glass dust for priming compositions.

Glue is dissolved in its own weight of boiling water. A glue-pot with a water-bath should be used to avoid burning the glue. Remove the pot from the fire as soon as the glue is found to be entirely dissolved. See *Fireworks*.

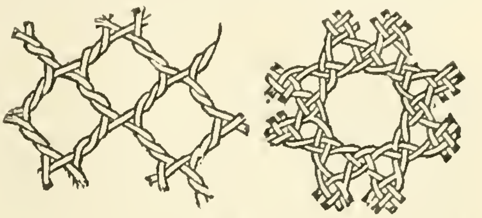
LABORER.—In a military sense, any direct and concentrated effort which is made to destroy a fortification. The term likewise applies to the working of a bomb or shell, which excavates, plows up, and scatters the earth about wherever it bursts. *Laborer un rampart*, signifies to bring several pieces of ordnance discharged from two oblique directions to bear upon one center. Shells are generally used on these occasions, and the chief design is to second the operations of the miner in some particular part from which the explosion is to take place.

LAC.—A substance obtained from incrustations made by an insect (*Coccus lacca*) on the branches and twigs of many trees in India. The lac is formed by the insect into cells, somewhat resembling a honeycomb, in which the insect is generally found entire, and owing to whose presence stick-lac yields by proper treatment a red dye, nearly, if not quite, as bright as that obtained from cochineal, and more permanent. Lac is found encircling the branches of these trees in the form of a tube; the broken branches with incrustations at various distances are called in commerce *stick-lac*, which ought to be semi-transparent. The coloring matter exhibited by grinding stick-lac, and then treating it with water, constitutes *seed-lac*, which, when melted up into masses, is called *lump-lac*. Shell-lac is obtained by further purifying the seed-lac. Lac dye consists of the coloring matter extracted from the stick-lac. It is met with in small squares similar to indigo, and is used as red dye instead of cochineal. Lac dye is largely manufactured in India and exported to England. In Bengal, lac is chiefly produced in the forests of Sylhet and at Burdwan; it is also procurable in the Deccan; but Siam and Pegu afford the largest supplies. Shell-lac is used for the manufacture of sealing-wax, also as varnish; in the latter form it is applied for setting the fulminating charge in gun-caps, and in coating Boxer's fuses and friction tubes.

LACAY.—A name formerly given to an old French militia. The word is found among the public documents which were kept by the Treasurers belonging to the Dukes of Britany in the 15th century.

LACE.—An ornamental fabric of linen, cotton, or silk thread, made either by the hands, somewhat after the manner of embroidery, or with machinery. The manufacture of lace by hand is an operation of exceeding nicety, and requires both skill and patience of no ordinary kind, and the best productions of this fabric surpass all other applications of textile materials in costliness and beauty.

Whether the ancients really had any knowledge of lace-making, excepting gold-lace, which will be mentioned at the end of this article, is not known, nor is it known with any certainty when this art came into practice in Europe; but there is good reason to suppose that *point-lace*, the oldest variety known, was the work of Nuns during the latter half of the 14th and the beginning of the 15th centuries. This point-lace is very characteristic, and is truly an art production. The artistic character of the patterns, and the wonderful patience and labor shown in carrying them out, places them, as female productions, on a parallel with the decorative works in stone, wood, and metal of the Monks. They indicate no tiresome efforts to copy natural objects, but masterly conceptions of graceful forms and tasteful combinations. It will readily be supposed that an art depending so much on individual skill and taste, would be likely to vary exceedingly; nevertheless, all the varieties esolve themselves into few well-marked groups, under three distinct classes. The first class is the *Guipure*, which comprises all the true needle-worked lace, whether ancient or modern; its varieties are: *Rose-point*, in which the figures are in high relief, having a rich embossed appearance; *Venetian-point*, *Portuguese-point*, *Maltese-point*; in all of these the pattern is flatter than in the *Rose-point*, *Point d'Alencon*, and *Brussels-point*. The last two are still made, the modern Point d'Alencon quite equaling in beauty and value that made in the middle of the 17th century, when its manufacture was introduced by the celebrated Colbert, Chief Minister of Louis XIV. The Point d'Alencon has very distinctive characteristics. When the pattern is once designed, each portion may be worked by a separate person, and the various figures are then connected by a groundwork of threads, which are so passed from one figure to another as to represent a web of wonderful delicacy and regulari-



ty; small spots or other figures are here and there skillfully worked in where the threads cross each other; these are called *modes*, and not only add much to the strength of the fabric, but greatly increase its richness of effect. In all these varieties, but two kinds of stitches are employed, and these differ chiefly in the greater or less closeness of the threads employed. First, a series of threads are laid down all in one direction, so as to cover the pattern, and then a certain number of these are taken up and covered by loops of the cross-stitches, or are more lightly held together. The second class is *pillow-lace*, sometimes called cushion or bobbin lace, from the pillow or cushion being used to work the pattern upon, and the various threads of which the figures are made up, each being wound upon a bobbin, usually of an ornamental character, to distinguish one from the other. The pattern, on parchment or paper, being attached to the *pillow* or cushion, pins are stuck in at regular intervals in the lines of the pattern, and the threads of the bobbins are twisted or plaited round them so as to form the net-work arrangement which is characteristic of this class of lace, the patterns, or figured portions, being worked out by a crossing of threads, which, although actually plaiting, gives the effect of weaving. The varieties of this lace are: *Spanish*, *grounded Spanish*, *Saxony Brussels*, *Flemish Brussels*, *Mechlin*, *Valenciennes*, *Dutch*, *Lisle*, *Chantilly*, *silk and cotton blonde*, *Limerick*, *Buckinghamshire* and *Honiton*. The last has of late years become the most beautiful of all the varieties made in Great Britain. The Irish or Limerick lace has also taken a high position. The third class is machine-made lace, which, by its wonderful improvement and rapid development, has worked a complete revolution in the lace trade, so that the prices formerly obtained for hand-made lace can no longer be commanded, whilst machine lace, of great beauty, has become so cheap and plentiful as to be worn by all classes. The lace-machine, or *frame*, as it is technically called, is so complicated that it would be hopeless to convey any really intelligible appreciation of it without a voluminous description of all its parts. One or two points of chief importance may, however, remove any difficulty in understanding its general principles. First, then, as in the loom, there is a series of warp-threads, placed, however, perpendicularly instead of horizontally, and not so close as in ordinary weaving, the space between each being sufficiently wide to admit of a shilling passing edgeways between them. Behind these threads, and corresponding to the inter-spaces, is a row of ingeniously constructed flat bobbins or reels resting in an arrangement called a *comb-bar* or *bolt-bar*. These are so placed that, with the first movement of the machine, each bobbin, which carries its thread with it, passes through two of the parallel and perpindicular threads of the warp, and is lodged in another and similar bolt-bar in front of the warp. But this front bolt-bar, besides an advancing and receding motion, has another movement called *shogging*—from right to left. When it receives a bobbin by its forward motion, it draws back, bringing the bobbin and thread through two of the upright threads; it then *shogs* or moves to one side, and goes forward again, taking the thread through the next two warp-threads, and lodging the bobbin on the back bolt-bar again, one distance beyond its last space; this it recovers by the next movement, and it again passes through the first space, to be again received by the front bolt-bar. By these movements the bobbin-thread is twisted quite round one upright thread of the warp; another movement then shifts the bobbin, so that it will pass through the next pair of upright threads, and so carry on its work, the warp-threads moving at the same time, unwinding from the lower beam, and being rolled on the upper one. There being twice as many bobbins as there are threads in the warp, each bolt-bar having a set which it exchanges with the other, and all being regulated with great nicety, a width of lace is made in far less time than has been required to write this short description. The various additions to, and variations upon, these operations, which only apply to bobbinnet, for the production of patterns, are so numerous and complicated—each pattern requiring new complications—that it will be useless attempting to describe them; suffice it to say, they all depend upon the variations which can be given to the movements of the flat, disk-like bobbins. The history of the lace-machine is not very clear; it is said to have been originally invented by a *frame-work* knitter of Nottingham, from studying the lace on his wife's cap; but it has continually received improvements, among which those of Heathcote, in 1809—the first to work successfully—Morley, in 1811 and 1824; those of Leaver and Turton, and of Clark and Marl, all in 1811. The manufacture of lace by machinery is chiefly located in Nottingham, whence it is sent to all parts of the world; but we have no means of knowing to what extent, for, with that strange perversity which distinguishes the statistical administration, only *thread-lace* is mentioned in the lists of exports, whilst the vast production of cotton-lace is mixed up with the returns of calico and other fabrics of that material. —*Gold-lace* and *Silver-lace*, properly speaking, are laces woven, either by the hand or by machinery; from exceedingly fine threads of the metals, or from linen, silk, or cotton threads which are coated with still finer threads of gold and silver; but in this country it is too common to designate as gold or silver lace, not only that which is rightly so-called, but also fringe made of the materials, and also gold and silver embroidery, such as is seen on trappings, and upon some ecclesiastical dresses, etc. Gold-lace is made in London, but considerable quantities of that used for decorating uniforms and other dresses, etc., in this country, is obtained from Belgium, where it is an important branch of manufacture. France supplies much of the gold and silver thread used, and excels all other countries in its production, in some of the more artistic varieties of gold and silver lace and embroidery. Italy has lately shown great taste and skill. The works of Luigi Martini of Milan attained great celebrity, and were recently said to produce about £16,000 worth per annum.

LACERNE.—The short woolen military cloak of the Romans.

LACHETE.—An opprobrious term which is frequently used among the French, and applied in all instances of cowardice, want of spirit, etc.

LACHICHE SYSTEM OF FORTIFICATION.—This system has a front similar to that of Cormontaigne, except that the perpendicular equals $\frac{1}{4}$ of the front, and that the salient places of arms have fleches for reduits. In order to avoid the effects of ricochet and vertical fires, the artillery is placed under casemates. The curtain, the reduits of re-entering place of arms, and the faces of ravelin have casemates open at the rear. The lower gallery serves for musketry, and facilitates the ventilation of the upper casemates. The glacis has a sufficient command to mask all the masonry. The fleches protect the covered-way against enfilade.

LACKERS—LACQUERS.—Varnishes prepared for coating metal-work. The formula usually employed is for gold color: alcohol, 2 gallons; powdered turmeric 1 pound; macerate for a week, and then filter with a covered filter, to prevent waste from evaporation; to this add, of the lightest-colored shell-lac, 12 ounces; gamboge, 4 ounces; gum-sandarach, $3\frac{1}{2}$ pounds. This is put in a warm place until the whole is dissolved, when 1 quart of common turpentine varnish is added. A red lacquer, prepared by substituting 3 pounds of annotta for the turmeric, and 1 pound of dragon's blood for gamboge, is extensively used.

The following lackers are used for iron ordnance: 1. Black lead, pulverized, 12 parts; red lead, 12 parts; litharge, 5 parts; lampblack, 5 parts; and linseed-oil, 66 parts. The mixture is boiled gently about twenty minutes, during which time it is constantly stirred. 2. Umber, ground, $3\frac{3}{4}$ parts; gum shellac, pulverized, $3\frac{3}{4}$ parts; ivory-black, $3\frac{3}{4}$ parts; litharge, $3\frac{3}{4}$ parts; linseed-oil, 78 parts; and spirits of turpentine, $7\frac{1}{4}$ parts. The oil must be boiled half an hour. The mixture is then boiled 24 hours, poured off from sediment, and put in jugs, corked. 3. Coal-tar (of good quality) 2 gallons; and spirits of turpentine, 1 pint. The turpentine to be added in small quantities during the application of the lacker. In applying lacker, the surface of the iron must be first cleaned with a scraper and a wire brush, if necessary, and the lacker applied hot, in two thin coats, with a paint-brush. It is best done in summer, when the metal is heated by the sun's rays, with gloves made of sheep-skin, the wool turned outwards, cut 0.4 inch long, the thumb alone being free. Old lacker should be removed with a scraper, or by scouring, and not by heating the guns or balls, by which the metal is injured. About 5 gallons of lacker are required for 100 field-guns and 1,000 shot; about 1 quart for a sea-coast gun.

The lacker for small-arms is composed of beeswax, 13 pounds; spirits of turpentine, 13 gallons; and boiled linseed-oil, 1 gallon.

All the ingredients should be pure and of the best quality. Heat them together in a copper or earthen vessel, over a gentle fire, in a water-bath, until they are well mixed. For holsters, scabbards, etc., the following is used: Prussian blue (in lumps), 4 parts; sugar of lead, $\frac{7}{10}$ parts; aqua-fortis, $\frac{7}{10}$ parts; linseed oil, boiled, 70 parts; and spirits of turpentine, 24.6 parts. This mixture is used for the first and second coats. The ingredients, except the turpentine, are boiled together in an iron kettle eight hours, when the mixture will assume a brilliant black color. When the varnish is nearly cool, stir in the turpentine. The kettle in which the varnish is made should be of a capacity to hold double the quantity of varnish to be boiled. For the third or finishing coat, the following is used: Gum copal (in clean lump), $26\frac{1}{2}$ parts; boiled linseed-oil, $42\frac{1}{2}$ parts; and spirits of turpentine, 31 parts. To make this varnish, put the copal in the vessel, set it on a charcoal fire for one hour, in which time it will melt, and all the watery particles will evaporate. Add the oil while the copal is warm, but not boiling hot. When nearly cool add the turpentine. For 5 pounds copal and the proper proportions of oil and turpentine the vessel should hold 6 gallons. See *Paints*.

LACS D'AMOUR.—In Heraldry, a cord of running knots used as an external decoration to surround the arms of widows and unmarried women; the *Cordelier*, which differs but slightly from it, being used similarly with the shields of married women.

LACUNETTE.—An early term in fortification, signifying a small fosse or ditch. The word *Cunette* has since been adopted.

LADDER BRIDGE.—A temporary bridge, formed by running a cart or gun limber into the stream and securing it there, with the shafts in a vertical position, by ropes from both sides of the river, one end of a ladder from each bank resting upon it, and covering the steps or rungs with planks.

LADLE.—1. For carrying the shot to the pieces, there are two kinds of ladles. The first consists of a ring and stem of iron, fastened to a wooden handle two feet long. The inner top edge of the ring is grooved out to receive the shot. The other ladle, for carrying the largest shot, consists of a similar ring, to which stems are fixed for connecting one single and one double handle, so that two men can be employed to carry the shot, the double handle being to prevent the ladle from turning over.

2. An implement for removing the powder or projectiles from guns, when it is not desired to discharge them. It consists of a ladle-head, made of the same kind of wood and in the same way as a rammer-head, and the ladle proper, which is of sheet-brass or copper, fastened to the head with copper nails.

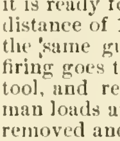
LADY OF MERCY, OUR.—The Spanish Order of Knighthood, founded in 1218, by James I. of Aragon, in fulfillment of a vow made to the Virgin during his captivity in France. The object for which the Order was instituted was the redemption of Christian captives from among the Moors, each knight at his inauguration vowing that, if necessary for their ransom, he would remain himself a captive in their stead. Within the first six years of the existence of the Order, no fewer than 400 captives are said to have been ransomed by its means. On the expulsion of the Moors from Spain, the labors of the knights were transferred to Africa. Their badge is a shield party per fess gules and or, in chief a cross pattée argent, in base four pallets gules for Aragon, the shield crowned with a ducal coronet. The Order was extended to ladies in 1261.

LADY OF MONTESA, OUR.—Order of Knighthood, founded in 1317, by King James II. of Aragon, who, on the abrogation of the Order of the Templars, urged Pope Clement V. to allow him to employ all their estates within his territory in founding a new Knightly Order for the protection of the Christians against the Moors. His request was acceded to by the following Pope, John XXII., who granted him for this purpose all the estates of the Templars and of the Knights of St. John situated in Valencia. Out of these was founded the new Order, which King James named after the town and castle of Montesa, which he assigned as its headquarters. The Order is now conferred merely as a mark of royal favor, though the provisions of its statutes are still nominally observed on new creations. The badge is a red cross edged with gold, the costume a long white woolen mantle, decorated with a cross on the left breast, and tied with very long white cords.

LAIDLEY PRACTICE-MUSKET.—In the construction of this gun the same form and motions of loading and firing as in the service-rifle have been retained as nearly as possible, consistent with a moderate expenditure in its production. An old smooth-bore musket is taken, reamed out for a length of eleven inches, for the reception of a coil ribbon-spring, on one end of which a closely-fitting piston is placed, having a stem of about five inches attached to its center; a hole is bored through the breech-screw and a cut made on its under side to receive a spring; a circular disk with a flaring hole through its center is secured in the barrel just in front of the end of the breech-screw; a short lever crosses the end of the barrel just in front of this disk, and is held in position by the spring already referred to; the hole in the cone is enlarged and receives a small spindle with a collar at its middle, which prevents it from coming out. About twelve inches from the breech a horizontal cut is made through the top of the barrel, leaving an opening of two inches in length; a cylindrical plug, having a hole through its axle, is inserted in the barrel at this place, and a handle screwed in. An inner barrel, having a bore of .22 inch and a length of 17 inches, its upper end counter-bored, is inserted in the barrel and secured by a screw; the length of the block is such as to close the space between the chambered recess and the end of the inner barrel. A hole is bored through the side of the stock to communicate with the hole through the breech-screw. To load the piece, bring the hammer to the half-cock and compress the spring. This is most conveniently done by fixing the ramrod in a cast-iron block at an angle of about 45° with the horizon. Seize the musket as at charge bayonet, insert the end of the rammer in the muzzle, and press the musket down until the spring is caught; withdraw the musket, hold it in the left hand near the lower band, the muzzle inclined downwards; seize the handle with the right hand, turn it, and draw it back; take a dart between the thumb and fore-finger, insert it in the bore, and push it well home with the thumb. Be sure that no part of it projects; close the breech-block and secure it by turning the handle. Cock the piece, and it is ready for firing. The men in firing stand at a distance of 15 paces from the target. Two men use the same gun, firing alternately. Each man after firing goes to the target, extracts the dart with a claw tool, and records the value of his shot. The other man loads and fires as soon as the preceding dart is removed and the target is clear. In order to give the soldier the benefit of practice-firing at objects at long ranges, the difficulty increasing greatly with the distance of the target, owing to the blur on the sight when the eye is adjusted to the proper focus to see distant objects, place a target at 500 or 600 yards distant, or as far off as convenient, so that it can be seen through the open window; place a target 15 paces from the firing-stand, at such a height that the distant target may be seen 4 or 5 inches below the middle of its lower edge; mark on the floor the position for the feet of the man when firing, raise the longer leaf of the sight, aim at the distant bull's-eye, and fire; the shots will strike the near target if correctly placed, and the accuracy of aim will be shown by the score thus made. The height of the target may have to be adjusted after the first few shots.

LAISCHES.—Thin metal plates which the ancient Gauls placed upon the buff-coats of infantry, between the buff and the lining.

LAMBEAUX.—In Heraldry, a cross formed in the upper like a cross pattée, but with the lower limb not widened, but terminating in a label of three points, "having," according to Sylvanus Morgan, "a great deal of mystery in relation to the top, whereon the first-born Son of God did suffer, sending out three streams from his hands, feet, and sides."



Lambeaux.

LAMBOYS.—In ancient armor, laminated skirts of small overlapping steel plates. These took the places of both the *taces* and *tuilles* of the somewhat earlier times.

LAMBREQUIN.—1. A word used in Heraldry in three senses: 1. The mantling attached to the helmet, and represented as depending over the shield. 2. A wreath; 3. The point of a label. See *Label*.

2. A leathern strap or flap hanging from a cuirass, which is often highly ornamented and made to reach as far as the thighs. Lambrequins frequently cover the helmet to protect it from wet and heat.

LAMPION DE PARAPET. A lamp generally used on a parapet or elsewhere in a besieged place. It is a small iron vessel filled with pitch and tar, which is lighted by the troops as occasion may require.

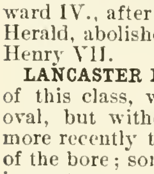
LANCASTER GUN.—A species of rifled cannon, which has been partially adopted in the British service. When the great difficulty of rifling heavy ordnance to an extent to give a sufficient rotary motion to the projectile became apparent, Mr. Lancaster devised a plan by which grooves might be dispensed with altogether. Instead of a strictly circular bore, he gave his gun an elliptical bore, the elipse being of very small eccentricity. The major axis was not in one plane from end to end of the gun, but was made to revolve in the length, until it had moved round one-fourth the periphery of the elipse. The projectiles are, of course, elliptical also; elongated, and somewhat pointed in front. When the shell is projected, it must follow the twist in the bore, and the rotary motion thus imparted is retained to the end of the range. Several Lancaster guns were employed at the siege of Sebastopol, and some of them burst. But these were scarcely fair specimens, being service 8-inch guns (with circular bore) bored to Mr. Lancaster's elliptical standard, and therefore weakened. The wrought-iron guns on his special model have given, however, more certain results. The special advantage claimed for the Lancaster gun is that it fouls less than any of the other guns in use. See *Ordnance.*

LANCASTER HERALD.—One of the six Heralds of England, ranking second in point of seniority. His office is said to have been instituted by Edward III., in the 34th year of his reign, when he created his son, John of Gaunt, Duke of Lancaster. Henry IV. raised Lancaster to the dignity of a King-at-Arms. Edward IV., after reducing him back to the status of a Herald, abolished his office, which was revived by Henry VII.

LANCASTER PROJECTILE.—The earlier projectiles of this class, were made of wrought-iron, simply oval, but without any rifle-twist upon them; but more recently the shot have been bent to the shape of the bore; some of these had a wrought-iron casing put over a cast-iron projectile, and this, projecting four inches to the rear, carried a lubricant which the wooden wedges at the bottom sent out while expanding the casing so as to fill the bore. The weight of this projectile was 44 pounds, and its capacity for bursting charge, $4\frac{1}{2}$ pounds. It was thick in the rear, and thin in the front, tapering to a point.

LANCASTER RIFLE.—A small-arm having a slightly oblate bore. The twist, as found by experience to be most advantageous, is one turn in 52 inches. The approved diameter of the bore is .498 inch, the length of the barrel being 32 inches. An eccentricity of .01 inch in half an inch is found sufficient to make the bullet spin on its axis to the extreme verge of its flight. The length of the bullet found to answer best with these rifles is $2\frac{1}{4}$ diameters in length with a windage of .004 or .005 of an inch.

LANCASTER RIFLING.—This plan of centering the shot was used with partial success by the English in the Crimea. The gun is rifled with two rounded grooves, each about one-third the circumference in width, so that the cross section of the bore is oval. Only a trace of the original bore is left at its minor axis. The major axis in the 32-pounder is 6.97 in., and the minor axis 6.37 in., so that, considered as a two-grooved rifle, the grooves are 3-inch deep at the centers. The absence of shoulders to the two grooves converts the two places of contact of the projectile with the rifling, into circular wedges tending to burst the gun or to compress the projectile.



LANCASTER.

LANCE.—1. A weapon of war composed of a sharp steel blade, from 8 to 10 inches long, grooved like a common bayonet with a socket at its base and two iron straps for attaching it to the handle. The handle is of strong, light wood, with a tip of iron at its lower end and a leathern loop at its center of gravity to support and guide the lance. It is usually from $8\frac{1}{2}$ to 11 feet long, and weighs about $4\frac{1}{2}$ lbs. This weapon is not used in the United States service. The Russians have their regular and irregular Cossacks armed with the lance. The Austrians, also, have Lancers; but the Polish cavalry use the lance better than any other people. The lance, when not in use, rests in a leather boot attached to the stirrup, the right arm being passed through the leather loop of the lance; or by putting the lower end in the boot and strapping the handle to the pommel of the saddle. Lancers are more formidable than other cavalry because they are able to reach further. Skill in combating a lancer consists in keeping to his left, in order to shun his lance. Pressed too nearly, the Lancer must have resource to his saber and let his lance rest upon his arm. The moment in which he attempts to seize his saber is dangerous to him. The Mexican cavalry are generally Lancers. 2. An iron rod which is fixed across the earthen mold of a shell, and which keeps it suspended in the air when it is cast. As soon as the shell is formed, this rod must be broken, and carefully taken out with instruments made for that purpose. Shells ought to be scrupulously examined with respect to this article, as they could not be charged were the lance, or any part of it, to remain within. 3. An instrument which conveys the charge of a piece of ordnance and forces it home to the bore.

LANCE A FEU.—A species of artificial firework which is made in the shape of a fuse, and is used for various purposes. Its composition consists of 3 parts of best refined saltpeter, 2 parts of flour of sulphur, and 2 parts of antimony; the whole being pounded and mixed together. The chief use of the *Lance à feu* is to throw occasional light across the platform, whilst artificial fireworks are preparing. They likewise serve to set fire to fuses, as they can be taken hold of without danger. *Lance de feu* is a species of squib, which is used by the garrison of a besieged town against a scaling party. See *Lances.*

LANCE A FEU PUANT.—A stink-fire lance prepared in the same manner as a stink-pot, and used by miners. When a sapper or miner has so far penetrated towards the enemy as to hear the voices of persons in any places contiguous to his own excavation, he first of all bores a hole with his probe, then discharges several pistols through the aperture, and lastly forces in a *Lance a feu puant,* taking care to close up the hole on his side to prevent the smoke from returning towards himself. The exhalation and stinking hot vapor which issue from the lance, and remain confined on the side of the enemy, infect the air so much, that it is impossible to approach the quarter for several days. Sometimes, indeed, they have had so instantaneous an effect, that in order to save their lives, miners, who would persevere, have been dragged out by the legs in an apparent state of suffocation. See *Lances.*

LANCE-CORPORAL.—The assistant to a Corporal; a private performing the duties of a Corporal. The Lance-corporal ranks above a private in the line, and usually performs the duties and possesses the authority of a Corporal, but does not receive a Corporal's pay.

LANCE KNIGHT.—A German foot-soldier; originally one of the serfs who followed the camp in the service of the common soldiers. See *Lansquenets.*

LANCE-REST.—A projection like a bracket, on the right side of a breast-plate in armor, to aid in bearing a lance.

LANCERS.—A description of cavalry soldiers who are armed with lances. The type and perfection of Lancers are the Russian Cossacks, whose long lances enable them to combat with enemies at a distance from which they themselves take little harm. The Lancers were brought into European notice by Napoleon, who greatly relied upon some Polish regiments. After the peace of 1815, the arm was adopted in the English service, but it is thought by many that the British Lancer has a weapon too short to enable him to charge on an infantry square with any chance of success.

The Lancer, like the Poet, "is born not fashioned." In the hands of the Pole, the lance, whether used to charge in line or in the dispersion of pursuit, is a truly fearful weapon; but to those to whom long practice in its use has not made it a second nature, it is only embarrassing, and more to be avoided by a comrade than by a foeman. Still the apprehension of being run through has a powerful moral effect upon a man; and there is no sound more appalling to a flying enemy than "Here come the Lancers."

LANCES.—Small paper cases, .2 to .4 inch diameter, filled with one or more compositions, each burning with a flame of a particular color. They are used to mark the outlines of figures, and are attached to light frames of wood or sticks of bamboo. To make the cases, cut the paper into rectangles of a length equal to the required length of the case and of such widths as to make the case three thicknesses of No. 7 paper. The length of the case is generally about ten times its exterior diameter, depending on the composition with which it is to be filled and the time it is required to burn. Paste the rectangle and roll it on an iron former with the hand. When the cases are dry, cut them to their proper length.

Place the cases in holes bored in a block of hard wood, the holes .02 inch larger than the case, and their depth .25 inch less than the length of the case. Drive in the bottom of each case a ladleful of clay. Insert in the top of the case a small funnel; pass the drift through the funnel into the case; fill the funnel with composition; raise the drift one inch above the top of the case; press it to the bottom and give it three light blows with a rocket-drift; continue in the same way, raising the drift above the top of the case between each volley until the case is filled to .25 inch of the top. Prime the lance with mealed powder, moistened with gummed water, and dip the end while moist in rifle-powder. When the case is to be filled with two different compositions, drive the case with the first composition till it is about .2 inch above the required height; remove the surplus to the exact height with a gauge, and proceed with the second composition as with the first.

Bore holes .02 inch larger than the lances, and .5 inch deep, from 2 to 4 inches apart, according to the size of lance. The holes should be bored so that the lance shall be horizontal when the frame is in position. Dip the end of the lance in glue, and press it firmly in the hole, arranging the lances parallel to each other. Or they may be fastened to the frame by means of sharp nails or tacks, driven into the frame and projecting about .4 inch. The end of the lance is pierced with an awl, dipped in glue, and thrust on the point of the nails, arranging them perpendicularly to the frame. See *Fireworks*.

LANCE-SERGEANT.—An acting Sergeant. This position is given to Corporals when additional Non-commissioned officers are required to assist the officers of troops and companies in the discharge of their duty. If the Lance-sergeants prove themselves efficient, they are usually promoted as vacancies occur.

LANCES LEVEES.—Uplifted lances, indicating that the enemy was beaten, and that the Chevaliers or Gendarmes should close the day by giving a final blow to the disordered ranks.

LANCE-SOCKET.—A leather socket which supports the butt of the lance when carried on horseback; called also *lance-bucket*. See *Lance*.

LANCE WOOD.—A wood valuable for its great strength and elasticity. It is produced by the small tree *guatteria virgata* (natural order *anonaceæ*). Another species, *G. laurifolia*, yields the wood called white lance-wood. The latter is not much used. Lance-wood is of great value in carriage constructions, when it is used for shafts and carriage-poles, for which it is especially fitted. The part used is the main trunk of the tree, which is very straight, and rarely more than 9 inches in diameter, with the bark on. It comes in small quantities from the West Indies, chiefly, however, from Jamaica.

LANDGRAVE. A German nobleman of a rank corresponding to an English Earl. The wife of a Landgrave is known as Landgravine.

LANDING.—In fortification, the portion of the floor of the gallery, between the frames that bound the entrance to a return, is termed a *landing*. The landing is in all cases horizontal, as well as that portion of an oblique return between the oblique frame and the one next succeeding, which last should not be placed further than an ordinary interval from the furthest point of the oblique frame. See *Gallery*.

LANDS.—In ordnance, the spaces between the furrows or grooves in the barrel of a rifled gun. See *Barrel*.

LANDSBERG SYSTEM OF FORTIFICATION.—This system consists of three unrevetted enceintes: the first of tenailles of 60° with small redans in the re-entering angles; the second, of a fausse-braye, with bonnets at salient; the third of an envelope of 125 to 225 yards faces replacing the covered-way. In the main ditch there are casemated redoubts for musketry and artillery. The ramparts are much exposed to enfilade; and all the more so since there is no traverse; the absence of a covered-way exposes the place to an attack of vive force; the relief being small, escalade may be resorted to; there is no provision made for sorties; and the space left for houses is very limited. Landsberg calculates that the outlay will be much less than for Vauban's hexagon, and that a vigorous defense may be expected from a garrison of 20,000 men and 60 guns.

LANDSTURM.—The Third Reserve of the German Army. The German soldier, after remaining 3 years in the Active Army, 4 in the Reserve, and 5 years in the *Landwehr*, is draughted into the *Landsturm*, which owes its origin to the wars of the First Empire, and was formerly a force raised for home defense only. But, in 1874, a bill was passed by which the Emperor can summon that force of his own authority in case of urgency, and the men of the Third Reserve can be draughted into the *Landwehr* if their services are needed. It is computed that this new organization will increase the strength of the German Army up to nearly two millions of men.

LAND SURVEYING.—The measurement of the area of a portion, whether small or large, of the earth's surface, is an important application of mathematics, and involves a thorough acquaintance with geometry, trigonometry, and the theory and use of the instruments employed for the determination of angles. Fields or portions of ground of small extent are measured easily and with sufficient accuracy by a chain (for distances), and a box-compass or cross-staff (for angles). For larger areas, the use of the surveyor's table is requisite; and for those of still greater extent, in which the greatest accuracy is requisite in the determination of the angles, the astrolabe, theodolite, sextant, circle, reflector, micrometer, etc., are used. The surface to be measured is divided into triangles, which are separately measured and calculated; but when a large extent is included in the measurement, it is not enough to proceed from one triangle to another, in which way an error at the outset may be propagated with continual increase; but a base line, as long as circumstances admit of, must, in the first instance, be accurately measured, upon which, by means of the measurement of angles, all the subsequent calculations are made to depend, and lines subsequently measured are only intended to be corrective of the results obtained by calculation. When the extent of surface is still greater, as when a whole country is to be measured, points here and there are astronomically determined, their meridians are accurately laid down, and a complicated system of triangles is employed to insure accuracy. This is called *triangulation.*

LAND TRANSPORT.—A branch of the Control Department. It comprises men of the Transport Companies, and cattle for the draught or otherwise of the stores and baggage of an army. Carts or wagons of the lightest nature should be used, and the horses employed to draw them should be driven and not ridden. Pack animals should only be used on emergency, when a sufficient number of carts cannot be obtained. In mountainous countries, resort must be had to this kind of transport, as was the case in Abyssinia. But, as a rule, pack animals are to be avoided as being the worst and most difficult transport to manage. In India, the transport consists of bullock carts of the country, elephants, and camels. See *Military Train.*

LANDWEHR.—A military force in several of the German States; somewhat corresponding to the militia of Great Britain. It is not always retained under arms. During peace, its members spend most of their time in civil pursuits, and are called out for military service only in times of war or of commotion—care being taken, however, that they are sufficiently exercised to make them ready for such service when necessary. The name Landwehr was first applied to the Tyrolese, who rose against the French; and in 1805 a similar force was raised in the other German Provinces of Austria, which, however, the Emperor has recently abolished. By far the most elaborate and complete system of land-defense was the Prussian, which was called into existence in 1813, when all Germany rose against Napoleon. As early, indeed, as 1806, or earlier, Marshal Knesebeck, then a Major in the Prussian Army, had proposed such a thing; but it was not till the opening of the campaign of 1813 that the Prussian Landwehr was organized according to Scharnhorst's plan by a Royal Edict, dated Mar. 17. At first, it was designed solely as a land-defense, properly so called, and not, what is now the case, as an integral part of the regular army. It was called out in two separate levies, the first comprising all men from 26 to 32, and the second those from 32 to 39. The old men up to 60 belonged to the *Landsturm*, which was called out only for the defense of house and hearth. After the second peace of Paris appeared the *Landwehrordnung* (Landwehr-regulation)of April 21, 1815, according to which the country was divided into 104 districts, each of which had to furnish a battalion of Landwehr. To every battalion of Landwehr was attached one squadron of Uhlans; three battalions formed a regiment; two regiments, a Landwehr brigade, which, along with the brigades of cavalry and infantry, was placed under a General of Division. By the Constitution of April, 1871, the Prussian obligation to serve in the army was extended to the whole German Empire. Every German capable of bearing arms, after serving in the standing army for seven years, has to enter the Landwehr, and remain in it for another five years.

LANE.—The term applied to a body of soldiers in two ranks standing face to face, forming, in fact, a street, passage, or lane. The French call this formation *haie*, or hedge. It is used when troops form a guard of honor for persons of rank to pass through.

LANGREL.—A villainous case-shot made up of various fragments of iron of irregular shape and size, so as to fit the bore of the cannon from which it is to be discharged. It was formerly much used for disabling sails and rigging of ships. Also written *Langrage.*

LANGUED.—In Heraldry, an animal whose tongue is of a different color from its body, is said to be *langued* of that color. It is understood in England that unless the blazon direct otherwise, all animals are langued gules whose tincture is not gules, and an animal gules is langued azure. This rule does not hold good in Scottish Heraldry, where "when the tongue, teeth, and claws are of different tinctures from their bodies, they are to be mentioned as armed and langued of such a tincture."—*Nisbet.* When a beast or bird is represented without teeth or claws, this is expressed in blazon "sans langue and arms." The term Lampassé is used in the same sense.

LANGUE DE BOEUF.—A sword of the 15th century, with a tapering blade, about 25 inches long and 5 inches wide at the handle end. It was double edged, and very much resembled the *parazonium*, or small sword, of the ancient Greeks and Romans, which they carried on the left side.

LANGUET.—A small slip of metal on the hilt of a sword, which overhangs the scabbard: the ear of a sword.

LANSQUENETS.—German foot soldiers raised towards the end of the 15th century. They enlisted voluntarily, and hired themselves out as mercenaries to any power that was willing to pay them. Charles VII. of France first added them to his infantry. After the 16th century the name fell into disuse.

LANSQUENETTE.—A short, wide, two-edged, and pointed sword of the 16th century. The handle was like a truncated cone, and flattened at the end to form the pommel.

LANTERN.—A contrivance for the purpose of giving light; it is made of glass or any transparent matter. There are two kinds of lanterns, *dark* and *Muscovy*, which are used at night in batteries or on the line of march.

LANTERNE.—1. An implement made of copper, resembling a round spoon or ladle. It is fixed to a long pole and serves to convey gunpowder into a piece of ordnance. 2 A Swiss cannon rammer, on a long shaft, the end of which contains a wadding screw. It was first used in the 15th century.

LANTERN SLIDES.—Contrivances used in transcribing microscopic despatches sent by carrier pigeons in time of war. The *negative* should be very delicate and full of details; rather thin without being flat, and clear in the shadows. Intensification should be avoided, except in the case of line work. Especial care should be taken in adjusting and focussing the camera, as the subsequent enlargement greatly magnifies all defects. The *slide* is simply a positive taken from the negative, and may be of the same size, though it is generally reduced. This operation is best performed in a darkened room with a wooden shutter in the window. An opening in the shutter, of the proper size, is arranged to hold the negative, and the camera is so adjusted that the positive will be of the proper size for a slide. In this case, transmitted instead of reflected light is the active agent, and the length of exposure is very much reduced. The same care as before is necessary in the adjustment and focussing of the camera. The light passing directly through the negative should come from a clear sky. In case the horizon line is near the prolongation of the axis of lens, the negative will be unequally illuminated, and the positive will not be of uniform density. *Wet plates* are preferable for both negatives and positives, as the most skillful and careful manipulation will not insure clear glass for the highest lights of the latter when sensitive dry plates are used. The *Collodion* should be of a shiny color and the negative bath only faintly acid. Give free exposure, and rather under-develop with an acid developer in order to obtain the requisite density. Use 45 minims of glacialacetic acid per ounce of Instantaneous Developer. After the plate is fixed, should the lights be found veiled, the plate may be *cleaned* by flooding it with the following solution:

Potassium Cyanide......................!.....20 grains.
Water...1 ounce.

Saturated with iodine until clear. *Toning* is best done with a 10-grain solution of platinic chloride. It will frequently be necessary to use dry plates for lantern slides instead of wet plates because of the inconvenience attending the use of the latter. See *Photography.*

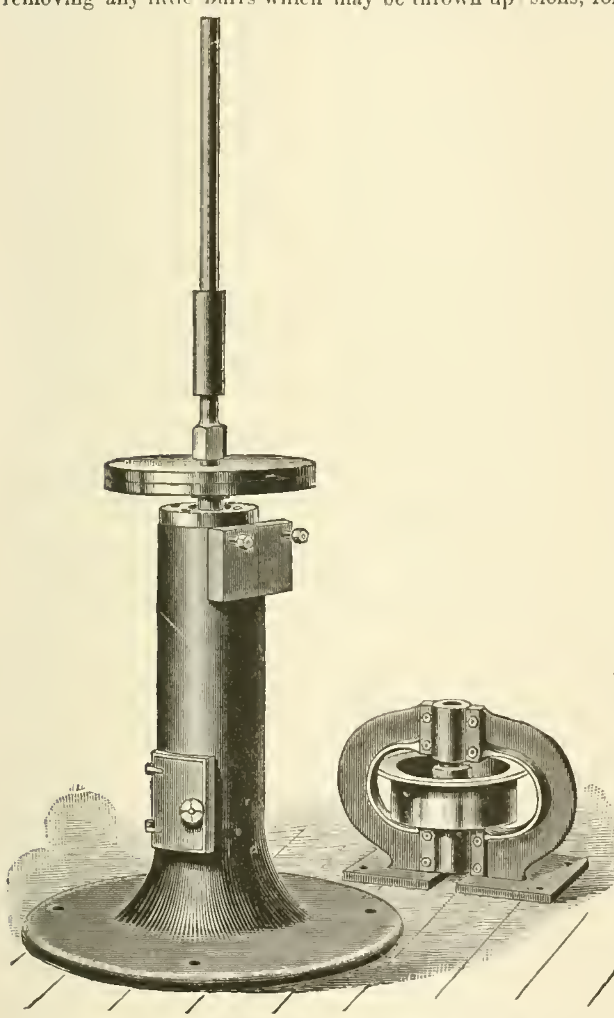
LANYARD.—A strong cord, one end of which has a small iron hook, and the other a wooden handle. It is used for exploding the friction-primer when a piece is to be fired.

A new form of lanyard has a sliding handle, which strikes a fixed button on the cord, and thus explodes the primer. The farther end of the lanyard is held by the left hand at the height of the breast, while the right hand slides the handle until it strikes the button, usually opposite the right side.

LAPEL.—The facings of a coat. Until the introduction of epaulettes in 1812, the white lapel was synonymous with a Lieutenant's commission in the British service. Commonly written *Lapelle.*

LAPITHAE.—A wild race inhabiting, in ancient times, the mountains of Thessaly. They derived their name from a mythical ancestor, *Lapithes*, a son of Apollo, and the brother of Centauros, the equally mythical ancestor of the Centaurs. A bloody war is said to have been waged between the kindred races in prehistoric times, which ended in the defeat of the Centaurs, but the Lapithæ were in their turn subdued by Hercules.

LAPPING.—1. The process a gun undergoes after being rifled, also after "proof," for the purpose of removing any little burrs which may be thrown up



on the edge of the grooves by the proof rounds. The lapping-machine, represented in the drawing, is extensively used in government arsenals and armories for grinding thin, flat pieces that cannot well be clamped for milling without retaining their winding irregularities. With this machine an unskilled workman can grind a true surface at much less expense than milling would cost. Diameter of lap, 18 inches; weight of machine, 600 pounds; speed of lap, 1,500 revolutions per minute; speed of counter-shaft, 6 by 5 inch tight and loose pulleys, 625 revolutions per minute. 2. The wearing away the land-surface in a rifled gun to ease the entrance of the projectile.

LAPSE.—An expression formerly used in the British Army to signify the reversion of any military property. Thus, upon the sale or purchase of one commission at the regulated difference, another (where there are two) is said to lapse to government. Commissions lapse or fall into the patronage of government, when vacancies happen by death, by officers being superseded, or where officers apply to sell who have only purchased a part of their commissions, and have not served long enough to be entitled to sell the whole; in which case they are only permitted to sell what they actually purchased, and the remainder is the gift of the government.

LAP-WELD.—A weld in which the welding edges are made thin, lapped one over the other, and welded.

LARGESSE.—Money which, in early time, it was the practice to grant to Heralds on certain state occasions, for proclaiming the style and title of the Sovereign and his Nobles. The regular fees, as recorded in one of the Ashmolean MSS., were: "At the coronacion of the king of England £100 apparalled in scarlet. At the displaying of the kinge's banner in any campe, 100 markes. At the displaying of a duke's banner, £20; at a marquis', 20 markes; at an earle's, 10 markes. The king marrying a wife, £50, with the gifts of the kinge's and queene's uppermost garments; at the birth of the kinge's eldest son, 100 markes; at the birth of younger children, £20. The king being at any syge with the crown on his head, £5."

LARIAT.—A long cord or thong of leather with a noose. The term is now commonly applied to a rope $1\frac{1}{4}$ inches in circumference and 30 feet long, made of Italian hemp, which is much used in the United States Cavalry service to picket the horses while grazing. See *Lasso.*

LARMES.—A term employed in Heraldry. When the field is bestrewed with an indefinite number of drops of a blue color, it is said to be *gutte de larmes*, a nomenclature peculiar to British Heraldry.

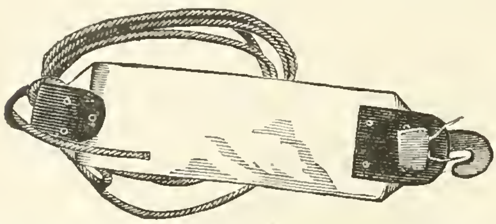
LASCAR.—In the East Indies, a term signifying properly a camp-follower, but generally applied to native sailors on board of British ships. The Lascars make good seamen, but being of an excessively irritable and revengeful nature, are generally kept in the minority in a ship's crew. Such men, under the name of *Khalassies*, are employed in some of the Indian arsenals. At Hong Kong and in Ceylon there are companies of Lascars in the pay of the British Government.

LASHES.—Formerly General Court-Martials could sentence a soldier to receive a certain number of lashes. At present this mode of punishment is prohibited, and no person in the military service is punished by flogging, or by branding, marking, or tattooing on the body.

LASHING.—The securing together any bodies by means of ropes; there are two modes generally used, viz., *square* and *diagonal*. The nature of rope depends on the work to be done. In securing sheers, guns, and any articles that require to be fixed, lashing is resorted to. There are three kinds of rope used for lashing—*log* line, *seizing* line, and *Hambro'* line. Lashing used in mounting and dismounting guns are of different dimensions.

LASHING RINGS.—Rings fixed on the sides of artillery traveling-carriages, to lash the tarpaulin, as also to tie the sponge, rammer, and ladle.

LASH-ROPE.—A rope used in packing. The packs or loads are made fast and retained on the animal's back by means of a cinch and lash-rope. The cinch is made of strong canvas, about eleven inches wide and one yard long, doubled so that the edges are in the middle. Strong pieces of leather are firmly



stitched on both ends and on both sides, with the canvas cinch between, as shown in the drawing. A three-inch iron ring is made fast at one end, and a hook of hard wood at the other. Natural shapes are usually selected for the hooks. The lash rope is of $1\frac{1}{4}$ inch hemp rope or rawhide, about 35 feet long, with one end spliced to the cinch-ring, the other end served. See *Packing*.

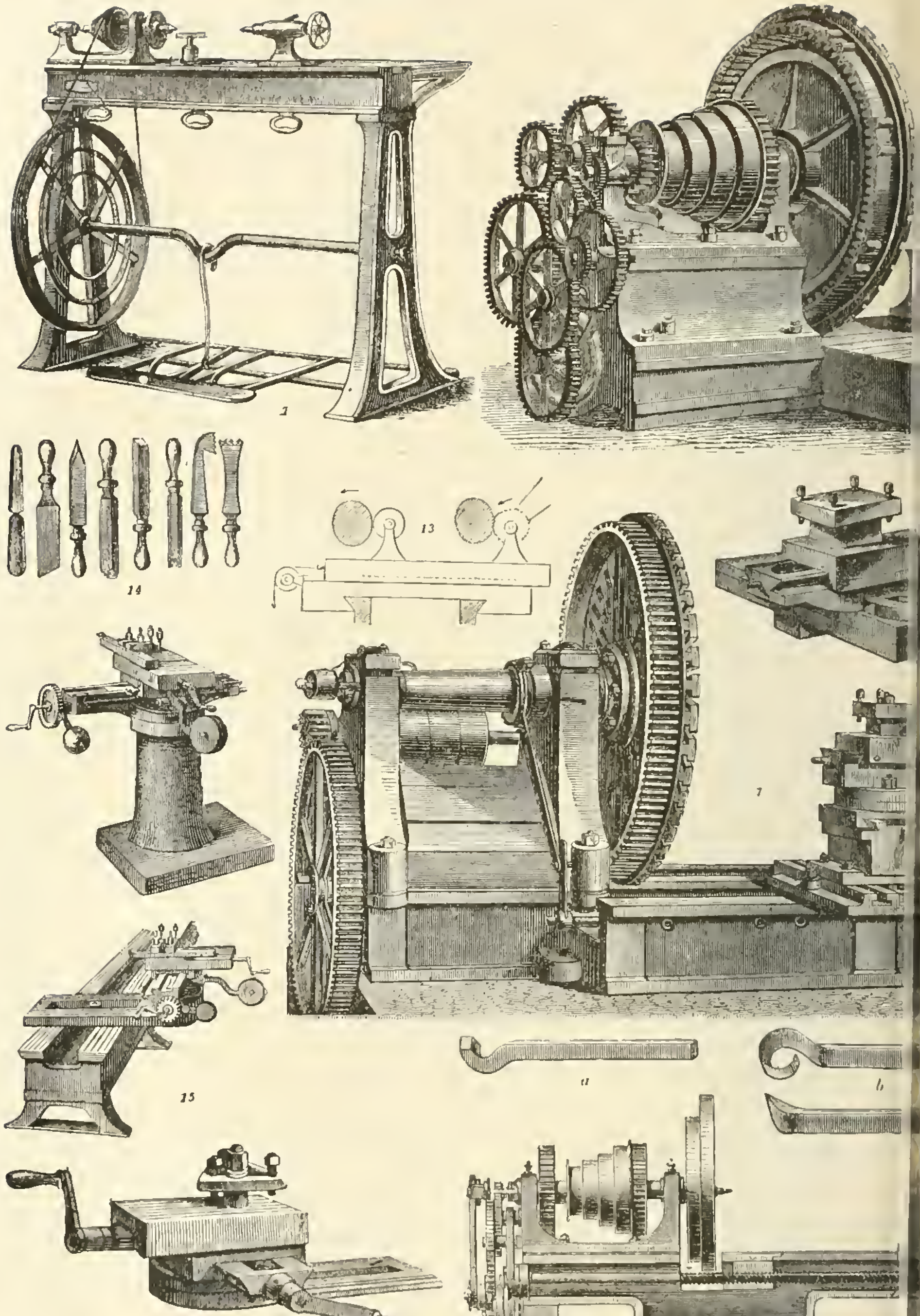
LASSO.—A long stout cord or thong of skin, with a leaden ball at each end, employed by the South Americans in capturing wild horses, oxen, etc. It is thrown in such a manner, that when it strikes the neck or leg of the animal to be captured, the impetus of the ball causes the cord to coil round the limb. The hunter's horse is furnished with a saddle having a high pommel, so that the hunter may coil his end of the lasso round it, or even fix it, if he chooses, though this latter practice often leads to dangerous consequences. The lasso was frequently used against European soldiers during the contest of the South American Republics for Independence; and, though with very little success, by the barbarians of the Russian Army against the French sentinels during the Crimean War. Similar in its name and application is another implement consisting of a stout thong of hide with a slip-noose, used in many countries; but chiefly among the South American and Mexican hunters. It requires much greater address to use it successfully. In Mexico the lasso is called a lariat.

LASSO HARNESS.—A harness consisting of a brown leather surcingle and one trace. The surcingle is rather wider than a common girth, and is composed of two pieces (joined together by rings), one of which is placed over the saddle, and the other round the belly of the horse. There are also rings at the end of the surcingle, which is drawn very firmly round the horse, and fastened tight by lapping a white leather thong (fixed at one end of the surcingle) through these rings. There are two descriptions of traces, one being 8 and the other 12 feet long. They have hooks at each end, and when the lasso harness is made use of by cavalry, etc., to assist draught-horses in moving very heavy carriages, or in dragging guns, etc., up steep hills, one of these hooks is fastened to a ring in the surcingle, and the other to the carriage. When two horses are in draught, the traces must be inside, and each rider should keep his horse's croup a little outwards.

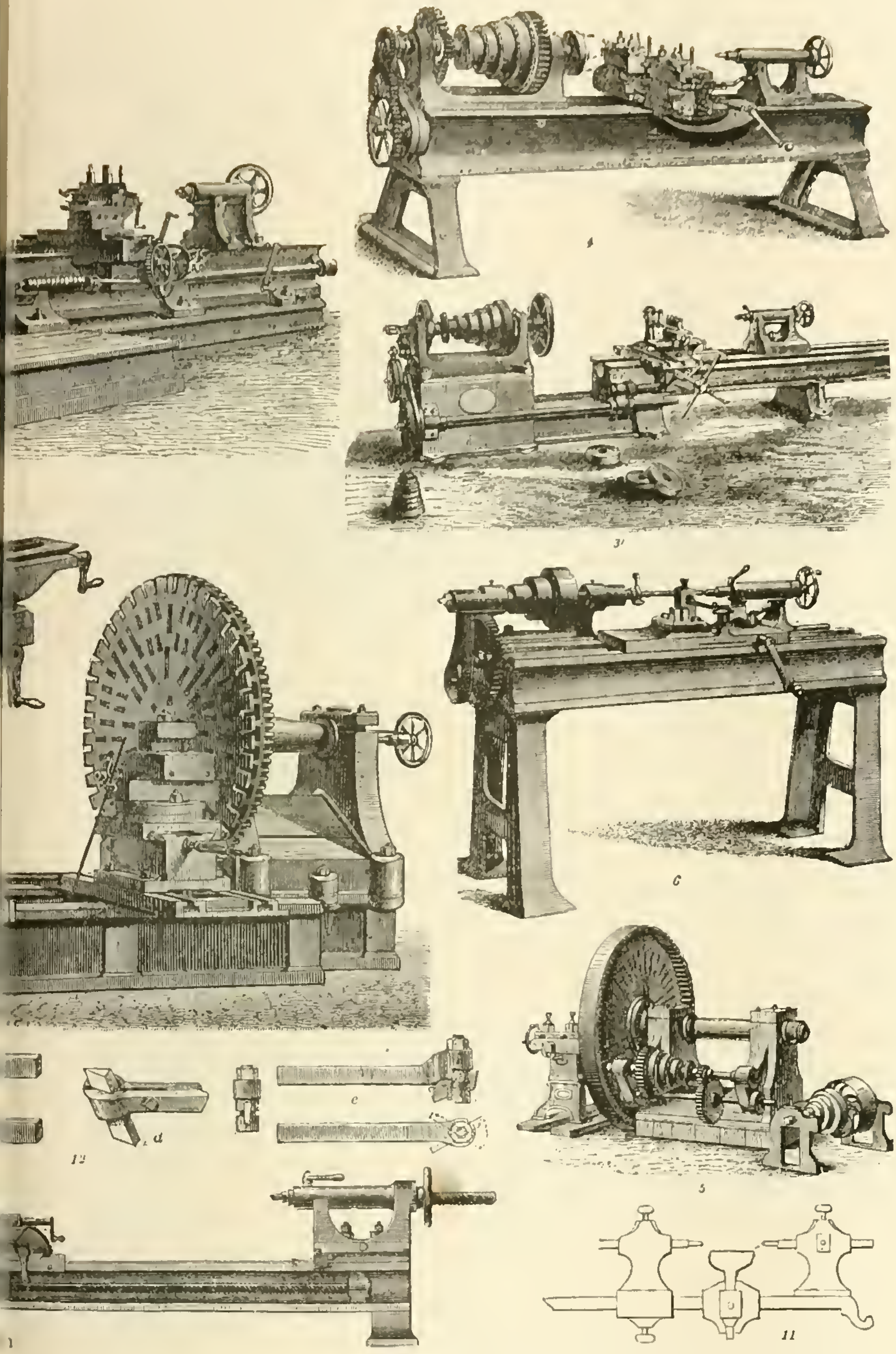
LATCH CROSS BOW.—A form of crossbow, specially adapted for sieges and for shooting at a mark. This was the weapon used by the Genoese at Agincourt in 1420.

LATERAL COMMUNICATIONS.—In warfare, communications which should be kept up between the different portions of an army when moving from one common base by different roads towards an enemy, so that, in case of a concentration being required on any particular point, instructions and orders can be readily carried out, and the different portions of the army brought together with rapidity. To prevent any obstruction to communications being kept up, especially when advancing towards the enemy, the several roads on which the army marches should not, if possible, be separated by rivers, morasses, or a mountain ridge; rivers would not be so objectionable, as they might be forded or crossed by bridges. Several roads tending in the same direction, with easy means of concentration, is the most satisfactory way of moving an army.

LATHE.—A machine in which the object revolves while it is shaped by a cutting tool applied to it. The art of turning is of great importance in gun-construction and is extensively applied in mechanics, the most delicate articles of luxury and ornament, equally with most ponderous machineries being produced by it. As an art, it dates from a very early period, and Theodorus of Samos (about 560 B. C.) is named by Pliny as its inventor; but long before this period, the *potters wheel*, the earliest and the simplest form of turning machine, was in general use, as is evidenced by numerous references in Holy Writ. The immense variety of work performed by lathes or turning machines necessitates great variations in their construction; but their mode of operation is always the same, and consists in fixing the work in position by two pivots or otherwise, causing it to revolve freely round an axis of revolution, of which the two pivots are the poles, and holding a chisel or other cutting tool so as to meet it during its revolution, taking care that the cutting tool be held firmly and steadily, and moved about to different parts of the work till the required shape be obtained. Lathes are generally divided, with respect to the mode of setting them in motion, into *pole*-lathes, *foot*-lathes, *hand-wheel* lathes; and *power*-lathes; with respect to the species of work they have to perform, into *center*-lathes, which form the outside surface, and *spindle*, *mandrel* or *chuck* lathes, which perform hollow or inside work, though this distinction is for the most part useless, as all lathes of good construction are now fitted for both kinds of work. *Bed*-lathes are those used by turners in wood, and *bar*-lathes for the best sort of metal work; and the small metal center-lathe employed by watchmakers is known as a *turn-bench*. The primitive and most simple form of lathe for wood-cutting is the pole-lathe. It consists of two planks or beams placed horizontally side by side with a narrow space between them, which, being firmly supported at a convenient height, constitute the *bed;* of two uprights or *puppets* rising from the bed, one of them stationery at the left end, and the other sliding along over the slit between the beams, and capable of being fastened at any required point by a projecting tenon and wedge beneath; of a *treadle* below and parallel to the bed: and of an elastic *pole* or *lath* (whence some derive the name lathe) fixed to the ceiling above. This form of lathe is well adapted for turning long thin cylinders of wood, the piece to be turned being held fast at each end by the conical iron or steel point projecting from the inner face of each puppet. Motion is communicated to the work by a cord which is fastened to the lathe overhead, wound twice or thrice round the work, and then attached to the treadle below. When the workman presses his foot on the treadle, the work commences to revolve rapidly, unwinding the cord towards the treadle, and winding it up on the side next the pole, causing the latter to bend considerably. During this period, the workman has been holding his cutting-instrument to the work; but after the treadle has been quite pressed down, he removes his foot, and the reaction of the bent pole causes the work to revolve in an opposite direction, till the pole has straightened itself; and during this latter revolution, no cutting is done. When the whole piece is to be turned, the cord must be moved from an unfinished to a finished part of the work. For the pole, an elastic steel bow and string are substituted



GEARING, LATHES, etc. 1. Foot-lathe. 2. Screw-cutting lathe. 3. Spindle-lathe. 4. Lathe with two drills
pivot-lathe. 12. Wood and metal-turner's tools. 13. Copying turning bench. 14. Turner's tools. 15



ver-lathe. 6. Small power-lathe. 7. Wheel-lathe. 8, 9. Cross support. 10. Spindle-lathe. 11. Jeweler's
support.

when the work is light or fine, the cord being attached to the middle of the string, and the bow fastened to the ceiling by its center. The advantage of the pole-lathe is that it never acquires an impetus in the direction of the cutting motion, for whenever the pressure on the treadle is removed the reaction of the pole takes effect; but the great waste of time during the straightening of the pole and rising of the treadle has caused the abandonment of this machine for the foot-lathe. The foot-lathe, the most common and generally useful form of lathe, differs from the former in having a *head-stock* or *fast-head* in place of the left-hand stationary puppet. This head-stock, consists of two supports or puppets firmly connected at their base, and fastened at right angles to the bed by means of screws. The outer puppet is pierced for a screw and the inner one is supplied with a steel collar, within which the mandrel carrying the speed-pulleys turns. The left end of the mandrel is concave, so as to allow the steel point of the screw to fit closely. A rest, which slides along the slit between the two beams of the bed, and which may be clamped at any point, and elevated or depressed as is found necessary, is used by the workman for the purpose of leaning his cutting-tool upon, in order to afford it a greater steadiness. The pulleys on the spindle and mandrel are of different sizes, and so arranged that when the endless band is placed on the left-hand pulleys, an extremely rapid motion is communicated to the mandrel, the motion being reduced more and more as the band is transferred more to the right, till, at the extreme right, the rotatory motion is much slower than that of the spindle. When the foot-lathe is required for center-work, the inner end of the mandrel, is furnished with a point; but when hollow or inside work is to be done, it must be armed with a screw. In this latter case, certain contrivances, known as *chucks*, for holding the work, are screwed on to the end of the mandrel. Some of these most commonly used are the *screw-chuck*, which shows on its right side a flat circular surface, from the center of which projects a large, coarse, conical screw for holding firmly any large piece of wooden work; the *hollow chuck*, a strong, circular cup with perpendicular sides, into which one end of the work is firmly fastened by a mallet, or, if too small, by four screws working inward through its sides; the *drill-chuck*, of a cylindrical form similar to the last, but with a square cavity for holding drills, the instrument, and not the work, being made to rotate in this instance; and the *concentric chuck*, a most ingenious piece of mechanism—a flat plate with two slits almost to the center, and in line of a diameter, within which slits works a spindle, with screw-ends carrying two steel studs, whose heads project through the slits above the surface on the right side; these heads carry two curved pieces, which serve as clamps to hold the work; and as the spindle-screws are of the same fineness, and with right and left threads, the revolution of the spindle either removes both further from the center or brings both nearer to it; hence, when the studs are once set at equal distances from the center, they always remain so, and the work may be removed and replaced without danger of destroying the adjustment. All these chucks are of metal, and are mostly employed for heavy work; turners of wood or ivory preferring wood-chucks, which can be altered as required, and secured by an iron ring round the outside, to prevent splitting. The cutting-tools employed are various; gouges are used to rough out the work—if soft wood—after which chisels with a straight oblique edge are employed; the instruments for harder materials, such as ivory or bone, are smaller than the former, and have their sharp edges "better backed;" for inside-work, drills are first employed to make an opening, and then cutting-tools of various shapes are employed, according to the form which is wished to be given to the interior surface. Fig. 2 represents a full set of twelve tools for use with the lathe. To avoid the imperfections in the workmanship arising from unsteadiness of hand in the workman, the *slide-rest* is employed. This valuable addition is furnished with two motions, one toward the work, and the

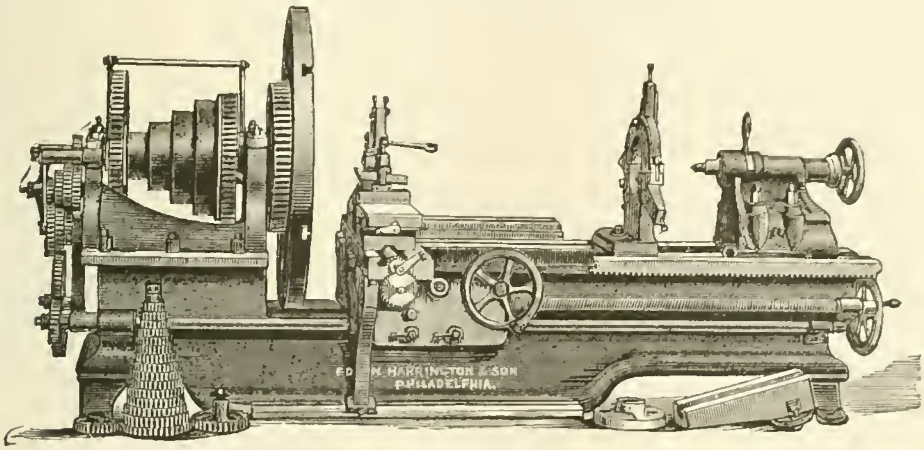


Fig. 1.

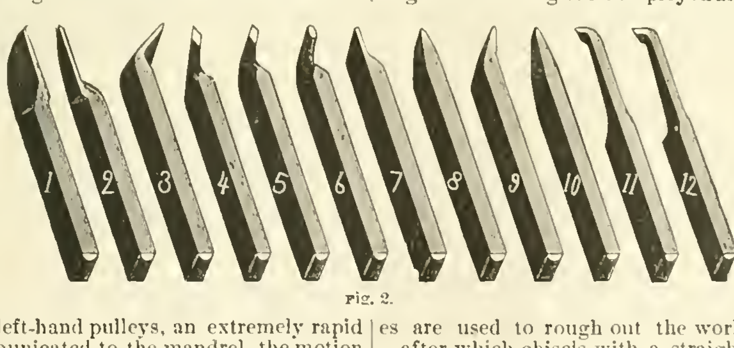


Fig. 2.

other along, parallel, or at any inclination to it, according as cylindrical or conical figures are required; there is a socket for the chisel, which is firmly held in its place by a screw; and after the slide-rest has been adjusted, the operator has only to move the rest forward or sideways, as may be required, the motions being effected by two screws and winches. The *hand-wheel* lathe is similar to the former, but so much larger as to require two workmen, one of whom is employed in setting the instrument in motion by turning a wheel. The *power*-lathe, represented in Fig. 1, is similarly set in motion by horse, water, or steam power, and is used for heavy metal-work, as piston-rods, iron columns of various kinds, wheels, artillery, etc. This machine differs from the foot-lathe chiefly in the substitution of rack-work, and wheels and pinions, for the endless band, and for manual labor, in the various adjustments of the machine, such as in moving forward the tail-stock, etc.; and in the mandrel being supported by both puppets of the head-stock. Fig. 3. shows an improved shafting attachment, and when used in connection with the lathe, makes a convenient arrangement for turning a large amount of shafting. The latest patented device in this line is the Pond shaft turning attachment with a rotary force pump. It consists of a reservoir bolted to the sliding rest, having strong housings to be bored to receive plain split rings for size and steadying, or fluted rings that will mill to size. Three cutting tools precede and one water polishing tool follows above rings, and are all on front side of shaft to be turned; on back of shaft opposite the cutting tools is an adjustable support. The pump attached to reservoir driven from lathe-counter, forces water on to each cutting tool. Pressure of each stream can be regulated as desired. The reservoir is so constructed that it catches the falling water which is pumped again without waste. The reservoir may be readily removed, leaving regular lathe for general work.

In wood-turning, the wood is prepared by an axe and rasp, must be lightly though firmly pressed against by the cutting-tool; while metal-work must be cleaned from the sand of the mold or scales of the forge, and in turning, requires less care. Soft woods must be made to revolve with great rapidity; very hard woods and brass require much less velocity; wrought iron and copper, still less; steel, a further diminution of speed; and cast iron, the least velocity of all. After the work has been duly shaped, it requires to be polished; and this is effected while it is still in the lathe and rotating, by applying shark's skin to wood, pumice-stone and chalk to ivory and horn, and emery, tripoli, or putty powder to metals. Hitherto, we have supposed that the axis of revolution of the work is fixed, and consequently that all work was turned to present a transverse circular section; but other forms of section may be easily obtained. The general mode of obtaining these non-circular figures is by screwing on to the mandrel an apparatus, by means of which the work can be thrown out of the center of rotation at regular intervals; but as each different class of form requires a separate kind of apparatus, it is impossible here to describe the operations in detail. One species, however, known as *rose-engine turning*, and employed for producing involved curvilineal figures, such as appear on bank-notes and on ornamented gold, silver, or gilt work, is so peculiar and ingenious as to call for more special notice. In this species, the standards which support the mandrel are no longer fixed at right angles to the bed, but are capable of oscillating backward or forward in a plane parallel to the plane of rotation of the mandrel, and are so acted on by a spring that when pushed to one side they are at once restored to their former position on the pressure being withdrawn. Suppose, then, a metal wheel with its rim waved or indented, fastened concentrically on the mandrel, and the mandrel, pushed aside by a fixed steel point or roller, applied to the rim of the wheel; the reaction of the spring against the pressure of the roller will keep the latter in close contact with the waved rim throughout, and will produce a definite oscillatory movement of the mandrel of the chuck, and the work fastened on it, and consequently—the cutting or graving tool being firmly held by the slide-rest—definite deviations from a circle in the lines marked on the face of the work. The wave-rimmed wheel, called a *rosette*, may be replaced by another, and that by a third, and so on till a sufficient number of different waved lines are obtained. A number of rosettes are generally strung at once on the mandrel, and the fixed guide is brought into gearing by means of a steel band called a rubber, with one rosette after another. Similar concentric curves of greater or less perimeter are obtained by removing the slide-rest from, or bringing it nearer to, the axis of revolution. See *Axle-lathe*, *Engine-lathe*, *Hand-lathe*, *Heading-lathe*, *Shafting-lathe*, *Spinning-lathe*, and *Turning*.

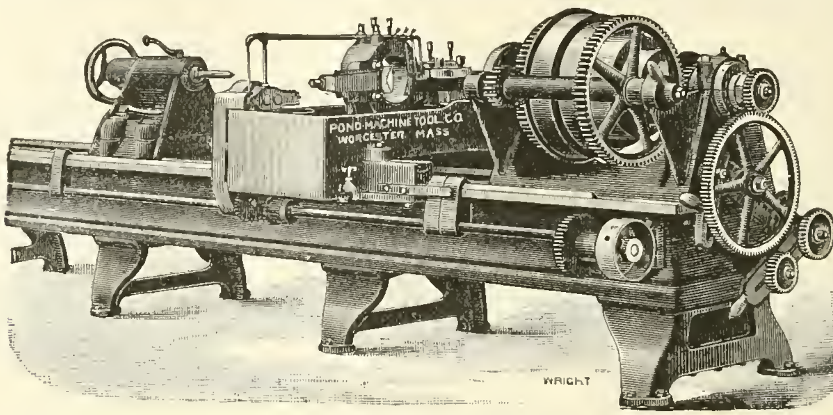


Fig. 3.

LATIGO STRAP.—A strong strap of leather used with the aparejo-cincha to tighten the aparejo. It is about 6 feet long, 1½ inches wide at one end and tapering to ½ inch at the other. See *Hammer-cloth* and *Packing*.

LATRINES.—Conveniences for soldiers in camps and barracks. Much attention has of late been devoted to their construction, a large percentage of the army sickness having been traced to their defective and impure condition.

LATTE.—A *straight* saber used by the cuirassiers in France.

LATTICED.—Latticed, or Treille, in Heraldry is a term applied to a shield covered with a decoration resembling fretty, but differing in this respect, that the pieces do not cross over and under each other: those directed from dexter chief to sinister base are placed uppermost and *cloué*, that is have nails inserted at the joints. See *Heraldry*,

LAUNCH.—To launch a gun or other object forward or backward is to move it in the direction of its axis. If the weight is such as to require levers or handspikes, they are placed, usually, on opposite sides, and the power applied by bearing down, at the same time carrying the free end of the lever in a direction contrary to that in which the object is to be moved,

LAUNDRESS.—A camp woman, usually the wife of a soldier, employed to wash soldier's clothing.

LAUREL.—By the ancient Greeks, the laurel was called *daphne*; it was sacred to Apollo. Berry-bearing twigs of it were wound round the forehead of victorious heroes and poets; and in later times, the degree of Doctor was conferred with this ceremony whence the term *Laureation*; and, according to some the term *Bachelor*. And to this day a laurel crown is the emblem of honor to which poets, artists and warriors aspire.

LAVURE.—The grains, dust, or detached pieces of metal which fall in casting cannon.

LAW.—Blackstone says Law means the rules of human action or conduct. This definition is too wide, for it is confined only to such rules as Courts, supported by proper authority, will enforce. The Law of Nature consists of those laws which are common to all mankind, and are supposed to be, as nearly as can be conjectured, independent of the accidents of time and place. The Civil or Municipal Law of a nation is what is commonly understood by the term Law, when applied to a particular country. The "Civil Law" is also sometimes used *par excellence* to denote the old Roman Law as embodied in the *Institutes* of Justinian, the Code, and other parts of what is commonly called the *Corpus Juris Civilis*, Many of the leading doctrines of that Law have been adopted by modern nations. England is the civilized country which has adopted the least from the Code of Law, while Scotland follows Continental nations in adopting the Roman or Civil Law to a large extent, and on many subjects in adopting it entirely. The Law of Nations is subdivided into Public International Law, and Private International Law, or the *comitas gentium*. Law is often used in England as contradistinguished from equity, but this is chiefly due to the accidental circumstance that there is a subdivision of Courts into Courts of Law and Equity, according to the nature of the remedy given. Law is also often in popular parlance distinguished from Justice, the latter being supposed to be perfect in its nature, or as near the standard of perfection as can be supposed; whereas there are numberless cases of injury, hardship, and oppression which, owing to human infirmity, no system of human laws can adequately redress; and this is often adduced as confirmation of the doctrine of future rewards and punishments. Law is also sometimes subdivided into Criminal Law, Constitutional Law, etc., according to the particular subject matter. See *Articles of War*, *Execution of Laws*, *International Law*, *Martial Law*, and *Military Law*.

LAW OF ARMS.—Certain acknowledged rules, regulations, and precepts, which relate to war, and are observed by all civilized nations. The Law of Arms also shows how to proclaim war, to attack the enemy, and to punish offenders in the camp, etc.

LAW OF NATIONS.—Such general rules as regard the Embassies, reception and entertainment of strangers, intercourse of merchants, exchange of prisoners, suspension of arms, etc. See *International Law*.

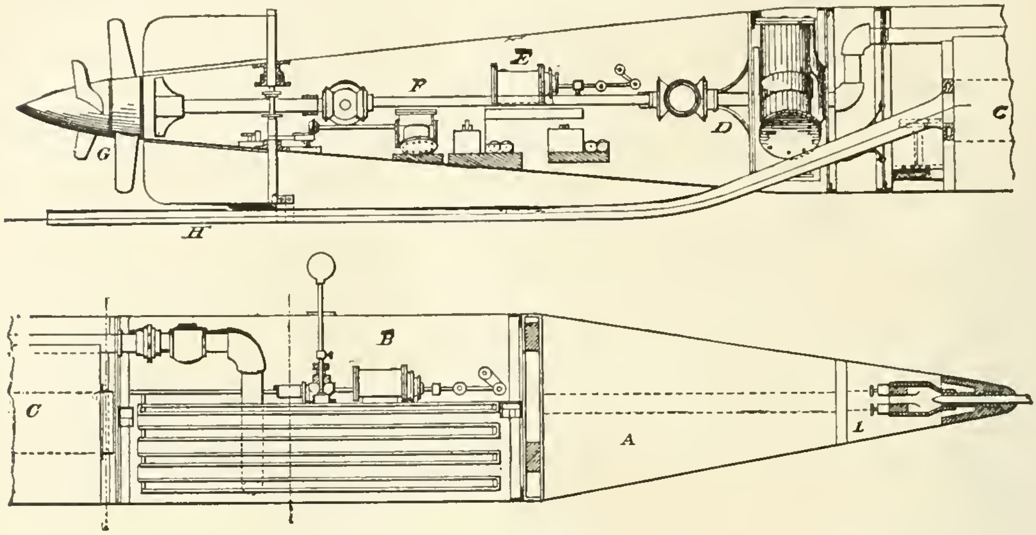
LAWS OF WAR.—The recognized rules for the conduct of civilized warfare. These rules relate to the treatment of prisoners, non-combatants, spies, traitors, etc.; the disposition of private property, the rights of capture, occupation and conquest, the establishment of blockades, the rights and obligations of neutrals, etc.

LAYETTE.—A three-sided tray or box without a cover, used to carry powder from one mortar to another in powder-mills.

LAYING A GUN. In gunnery, pointing a gun so that the projectile shall strike the object aimed at. This is effected by bringing the top of the notch of the hind sight, the apex of the foresight (whether muzzle or trunnion), and the object in line. In laying a rifled gun, the scales for elevation and deflection must be first adjusted. This being done, No. 1 of the gun's crew proceeds to lay the gun. He places himself in rear of the gun, bringing his eye to a level with the top of the hind sight, and about 6 inches in rear of it, and, when laying guns where it is necessary to stoop, places his feet so that the body is well balanced, steadying himself by leaning on the gun with his arm, and gives the necessary orders for elevating or traversing, until the gun is laid as above; with field guns he himself elevates or depresses. With guns fitted with a traversing bar, the final adjustment is given by No. 1 himself. In laying a gun, it is well to avoid putting the back of the nail on the top of the sight, the hand to cover the eye, holding the tangent scale, or other peculiarity. In breech-loading and muzzle loading rifled guns, provision is made in the sighting to meet what is known as the *constant deflection* of such guns caused by rifling. To provide also against deflection by wind or other inaccuracies, such as one wheel being higher than another, a deflection scale is attached to each gun. Formerly, guns which had no tangent scale were elevated by means of the quarter sights or quadrant.

LAY TORPEDO.—From the date of the destruction of the rebel ram *Albermarle*, in 1864, by a spar torpedo invented by W. W. Wood and John L. Lay, Col. Lay has devoted his entire time to the invention and construction of submarine torpedoes. Several forms of Lay spar torpedoes to be operated on ship-board are in use in the Russian Navy. The torpedo or explosive charge, usually of dynamite, is fixed to the end of a long spar, and is thrust out from a swift torpedo boat, or armor-clad ship, under the hull of a vessel sought to be destroyed, and there exploded. The electrical self-propelled torpedo boat of Lay's invention is in extensive use in Europe, especially in Russia; and two such boats are owned by the United States Government. Some of the Russian boats were built in the United States. The boat is a spindle; in length, some twelve or fifteen times its diameter. The boats are built from 600 pounds to 2½ tons in weight, and cost from $3,000 to $15,000 each. Each boat carries a propelling engine, the motive power being usually carbonic acid gas, retained in a chamber or reservoir, under a pressure of 600 to 1,000 pounds per inch when the reservoir is first charged. The throttle valve is opened and closed by a magnet, or by a gas cylinder actuated by a magnet. The boat carries a coil of telegraph cable, of about the specific gravity of water. As the boat advances, the cable is reeled off, and passes out of the boat through a pipe, which conveys it back past the screw propeller. When the cable reels out, sea-water is permitted to enter the cable compartment, and so maintain the specific gravity of the boat. The rudder can be set to port or starboard, or held amidships, by means of an engine controlled by a magnet in connection with the telegraphic cable.

The boat will usually run just under the surface of the water, but can be raised or lowered in the water by the admission or ejection of water-ballast, the water being forced out of the ballast chambers by the pressure of gas from the gas reservoir when a cock controlled through the wire is turned; or the boat may have rudders to deflect it upward or downward in the water, these rudders being controlled in the same way as the steering rudder. The sight rods, or target rods which project above the water have the forward side painted of a color such as not to be easily distinguished from the water; the side toward the operator is bright colored. These target rods may be fixed on the boat, or may be made to turn down or to telescope into the boat, the movement being controlled in such case by a gas cylinder controlled by a magnet. The firing-pin when thrust in, by encountering an obstacle, cuts out a resistance coil and closes an electric circuit through the cable to fire the charge, which is in the front part of the boat; or the operator on shore or ship-board who directs the boat through the telegraphic cable may fire the charge by a touch of the firing key on the key-board. The shore or operating end of the cable is connected with an electric battery through a switch-board. Suitable keys on the switch-board control the throttle-valve, steering-gear, and all other operative mechanisms on the boat, by a current through a single electric wire. The ingenious electrical devices by which so much is accomplished, are the inventions of Mr. George Haight, Colonel Lay's idea having been to have a separate wire in the cable for each machine on the boat. The front end of the boat, which carries the charge, is sometimes made detachable, and is thrown off from the boat before firing; generally, however, the boat is to be sacrificed with the enemy which it seeks to destroy. The operator, by watching the sight targets through a telescope, is enabled to guide his boat to the enemy with certainty, or, if the enemy is beyond his reach, he can direct the boat back, and by cutting out the firing circuit on his switch-board the boat can be safely handled, as it carries no percussion firing mechanism. The lay torpedo boat can be controlled at a distance of more than a mile and a half. As recently improved, it will run for distances of nearly a mile at the rate of about thirteen knots. The difficulty in obtaining higher speed has been the tendency of the compressed gas to freeze by expansion. Dr. Kellogg, of Hartford, Conn., and Mr. Haight have each devised apparatus to utilize the heat of seawater to prevent freezing, and with the sea at summer temperatures, very good results have been obtained, in increasing the speed of the boat. Mr. G. H. Reynolds, of the Delameter Works, New York, has also made valuable improvements. Messrs. Geo. Haight, W. H. Wood, and William Winsor, of New York, have recently invented an improvement by which the danger of freezing of the gas is substantially done away with, and a speed at the rate of sixteen knots is said to have been attained, with a probability of still further increase. The mechanism by which this increase of speed is obtained is not yet divulged. The Whitehead fish torpedo, of English invention, is somewhat like the Lay torpedo in the fact that it is of spindle shape, is driven by a screw from a gas engine inside, and carries a bursting charge. Here the resemblance ends, as the torpedo, when once pointed and started, is no longer under control, but must go its course, wherever that may tend. As it has less speed and is much more expensive than a rocket of equal size, it would seem to be much less desirable. See *Torpedoes*.



THE LAY TORPEDO (Longitudinal Section).

A. Dynamite Chamber. D. Propelling Engine. G. Propellers.
B. Gas Reservoir Compartment. E. Engine for Operating Diving Rudders. H. Cable Tube.
C. Cable Compartment. F. Steering Engine. I. Firing-pin.

LAZARUS.—A military Order formed at Jerusalem by the Christians of the West when they were masters of the Holy Land. They received pilgrims under their care, and guarded them on the roads from the insults of the Mohammedans. This Order was instituted in the year 1119, and was confirmed by a Bull of Pope Alexander IV. in (1255), who gave it the rule of St. Augustine.

LAZY TONGS.—Before the *lazy tongs*, or pantograph, as it is now known, was introduced much time was spent in contriving some ingenious make-shift to properly transmit the reduced motion from the cross-head or trunnion of the engine. Fig. 1 shows how the Bacon pantograph attachment is applied to one of the adjusting nuts which steady the cross-head on the brass ways, while the cross-head lies in a horizontal plane, as in many of our old-fashioned horizontal engines. One of these adjusting screws is lifted a little, the two long links are shut under each side of the screw underneath the head, and the head then screwed down upon them, making it perfectly rigid, but at the same time not altering any adjustment of the engine. Here a little point must be borne in mind by the party who is applying this device. It will be seen, by reference to Fig. 1, that we have attached the device to the back end of the cross-head on the outside of the guide, and that we must allow the cross-head to travel precisely as far one way as the other, and must take the end of that side of the cross-head to which we have made the attachment for our center line, and not calculate from the center nut shown on that side of the cross-head. Now the post, the top of which is shown in Fig. 2, which supports the other end of the pantograph, must be exactly square with the portion of the cross-head to which we have attached the pantograph, when the cross-head is in precisely the center of its travel. In other words, we must allow the difference between the central nut and the one on the end, as shown, from which to obtain our central line. The arms of the pantograph are shown shut up as much as they can be when attached properly. The support of that end of the pantograph from the post, which is shown at its outer arms, and the cord-screw in the short cross-bar, must be precisely in line when the pantograph is in this position,

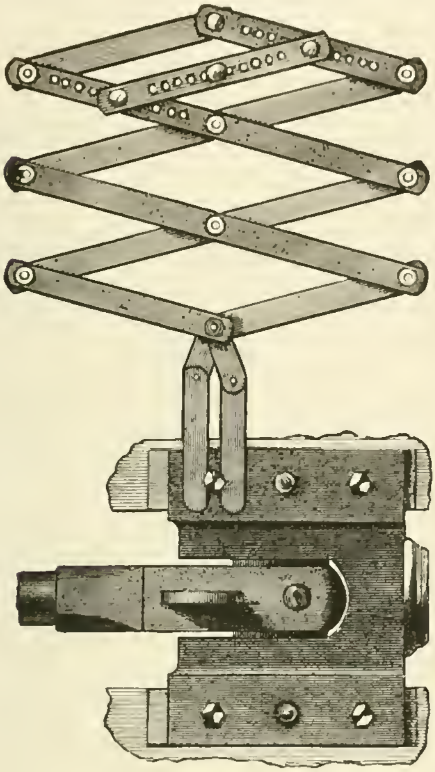


Fig. 1.

else the diagram is worthless. The end of the post must be high enough, so that the pantograph lies perfectly easy and without any cross-friction or draught. Fig. 2. shows the application of the attachment to a

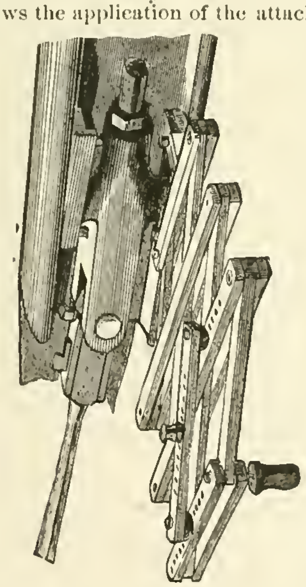


Fig. 2.

perpendicular guide or cross-head, which is vertical. In this particular case the two links are run under the connection between the cross-head proper and the brasses or guides. The head of the post is also shown in Fig. 2. In Fig. 3, we have the Corliss guide where the links are put under the adjusting screw at the top. This may be done by boring a hole into the cross-head and screwing in a piece of three-eighths round iron, the outer end of which is flattened, and has an eye drilled through it, then drop the tapering stud on the out end of the pantograph into the eye whenever it is desired to use the pantograph. Fig. 4 shows the old-fashioned pendulum attached to a vertical guide or way. In this case, a little slot in the lower end of the pantograph

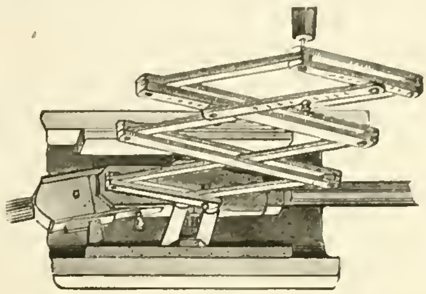


Fig. 3.

is necessary; the links may not necessarily be used in the positions shown, but may be brought up at right angles, leaving the slot to make allowance for the circle described. This attachment avoids drilling, tapping, taking out the screws that confine the gibs, or defacing the engine anywhere. On slow-moving or condensing engines these attachments can be applied so that the pantograph can at any time be hooked on while running, and diagrams can be taken from the high or low pressure cylinder, from the pumps, standpipe, or anywhere that is necessary. It is a simple little convenience, and, as has been

Fig. 4.

so clearly and frequently shown, it saves a great deal of vexation and delay, and ensures more accuracy in the work, if only a little pains are taken. One point must also be observed in using the pantograph—that is, to allow a little leeway between the carrying pulleys of the indicator and the cord-peg. This attachment is solely manufactured and for sale by the American Steam Gauge Company, of Boston. It costs very little, and it is certainly a labor-saving and an annoyance-preventing device. See *Pantograph.*

LEAD.—1. The slight *forward* inclination of the axle-tree-arm is called the *lead;* the *hollow of the arm* and *lead* together are termed the *let* of the arm. 2. A bluish-white metal of considerable brilliancy, which soon disappears on exposure to the air, owing to the formation of a thin film of oxide. It is so soft that it may be cut or beaten into thin sheets, but in ductility and tenacity it is low in the scale of metals. It is readily fusible at a temperature of about 625°, and at a higher temperature it absorbs oxygen rapidly from the air, and the oxide thus formed volatilizes in the form of white fumes. The combined action of air and water on lead is a subject of great practical importance, in consequence of the metal being so frequently employed in the construction of cisterns and water-pipes. The lead becomes oxidized at the surface, and the water dissolves the oxide; this solution absorbs the carbonic acid of the atmosphere, a film of hydrated oxycarbonate of lead ($PbO.HO + PbO,CO_2$) is deposited in silky scales, and a fresh portion of oxide of lead is formed and dissolved, and in this way a rapid corrosion of the metal ensues. This action is materially increased by the presence of some salts and diminished by the presence of other salts in the water.

Pure lead is of very rare occurrence. Almost all the lead of commerce is obtained from galena, the native sulphite of lead, by a process to be presently explained. The lead thus obtained is often *nearly* pure, and to obtain it *perfectly* pure it should be reduced with black flux from oxide left by igniting pure nitrate or carbonate. The compounds of lead with oxygen are four in number—viz., a suboxide Pb_2O, which is a black powder of no importance; a protoxide, PbO, which is the base of the ordinary salts of the metal; a binoxide, PbO_2: and red lead, which is a compound of the two last-named oxides, and is usually represented by the formula $2PbO,PbO_2$. The protoxide is commonly known as *Litharge.* It is obtained on a large scale by the oxidation of lead in a current of air, when it forms a scaly mass of a yellow or reddish tint. If the oxidation be effected at a temperature below that required for the fusion of oxide, a yellow powder, termed *Massicot*, is obtained. Litharge is much used by the assayer as a flux; it enters largely into the composition of the glaze of common earthenware, and it is employed in pharmacy in the preparation of plasters. A mixture of 1 part of Massicot with 10 of brickdust, made into a paste with linseed-oil, forms the compound known as *Dhil Mastic*, which, from the hardness with which it sets, is frequently employed to repair defects in stone-facings.

The most important of the salts of the protoxide of lead are—1. The *Carbonate* (PbO,CO_2) which occurs native as a beautiful mineral in transparent needles or fibrous masses, and which is prepared under the name of *White Lead* on a large scale as a pigment by a process to be subsequently described. The carbonate is insoluble in water, unless it is largely charged with carbonic acid. It is quickly blackened by exposure to hydrosulphuric acid (sulphureted hydrogen), either in the form of gas or in solution, and this is a serious drawback to the use of the lead salts as pigments. 2. The *Sulphate* (PbO,SO_3), which occurs native in white prismatic crystals, and is formed as a heavy white precipitate on adding sulphuric acid or a soluble sulphate to a soluble lead salt. 3. The *Nitrate* (PbO,NO_5), which is formed by dissolving lead or its protoxide in dilute nitric acid. 4. The *Chromates*, of which the principal are the neutral chromate or *Chrome Yellow* (PbO,CrO_3), and the dichromate or *Orange Chrome.* These are much used in pigments, and in calico-dyeing. 5. The *Acetates.* The ordinary or neutral acetate ($PbO,C_4H_3O_3+3aq.$) is prepared on a large scale by the solution of litharge in distilled vinegar, and evaporation, when the salt is obtained in four-sided prisms, or more commonly in a mass of confused minute white crystals, which at 212° lose their water of crystallization. From its appearance, and from its sweetish taste, it derives its name of *Sugar of Lead.* It is much used both in medicine and in the arts. Basic acetate of lead, regarded by some chemists as a diacetate, and by others as a triacetate, and commonly known as *Goulard's Extract*, is prepared by boiling a solution of sugar of lead with litharge, and adding alcohol, when the salt separates in minute transparent needles. It is the active ingredient of *Goulard Water*, which is imitated by the *Liquor Plumbi Diacetatis Dilutus*, and of *Goulard's Cerate*, which is imitated by the *Ceratum Plumbi Compositum* of the London pharmaeopœia. The best tests for solutions of the salts of lead are the formation of a black sulphide with hydrosulphuric acid, or hydrosulphate of ammonia, insoluble in an excess of the reagent; of a white insoluble sulphate with sulphuric acid, or a soluble sulphate; of a yellow chromate with chromate of potash; and a yellow iodide with iodide of potassium. All the salts of lead, insoluble in water, are soluble in a solution of potash. Before the blow-pipe on charcoal, the salts of lead yield a soft, white bead of the metal, surrounded by a yellow ring of oxide.

Lead was largely worked by the Romans in Great Britain, and pigs with Latin inscriptions have been frequently found near old smelting-works. The mining of lead in England was formerly regulated by curious laws; some places, such as the King's Field, in Derbyshire, having special and peculiar privileges. It was the custom in this district not to allow the ore under any circumstances to leave the mine till it was measured in the presence of an official called a *bar-master*, who set aside a 25th part as the King's cope or lot. Up to a comparatively recent period, persons were allowed to search for veins of the ore without being liable for any damage done to the soil or crops. Lead ore is pretty generally distributed, but by far the largest supply of this metal is obtained from Great Britain and Spain, the former country yielding some 75,000 tons per annum, and the latter probably an equal supply. Nearly a fourth of the total British produce is procured from the Northumberland and Durham district, where there exists, at Allenheads, one of the largest mining establishments in the world. Scotland and Ireland furnish only a very small quantity. With the exception of a little from the carbonate of lead, all the supplies of this metal are obtained from the sulphide of lead or galena. The lead ore, when taken from the mine, is broken up into small pieces, "hotched," and washed, to separate impurities. Sulphide of lead, when tolerably pure, is smelted with comparative ease. It is first roasted in a reverberatory furnace. From 20 to 40 cwts. of galena are put into the furnace at a time, either with or without lime. In about two hours the charge becomes sufficiently roasted. During the process, the larger portion of the ore (PbS) takes up four equivalents of oxygen, and becomes sulphate of lead (PbO,SO_3), a little oxide of lead (PbO) is also formed, while another portion remains unaltered as sulphide of lead. After it is roasted the ore is thoroughly mixed together, and the heat of the furnace suddenly raised. This causes a reaction between the unchanged and the oxidized portion of the ore, and reduces much of the lead, sulphurous acid being at the same time evolved. In the third stage, lime is thrown in and mixed with slag and unreduced ore. When this becomes acted on, the whole of the lead is practically separated from the ore, and is then run off at a tap-hole.

In some districts, the roasted ore is smelted on a separate ore-hearth called the Scotch furnace, where the heat is urged by bellows. Peat and coal are used as the fuel. This is a slower mode of smelting than the last, but yields a purer lead. During the operation of smelting, a considerable quantity of lead is volatilized, and carried off as *fume* or *smoke*, which, when allowed to escape into the atmosphere, not only involves a loss of lead, but destroys all vegetation for some distance around the works, and poisons cattle and other animals feeding near them. Much attention has of late been paid to the obviating of these evils, and several plans are in use for the purpose. Where it can be done no method is more effective than simply conducting the smoke from the furnaces through a long horizontal flue—say a mile in length—to a vertical stack. The fume condenses on the sides, certain openings being left for the purpose of collecting it. About 33 per cent. of the fume thus recovered consists of metallic lead. When lead contains antimony and tin as impurities, they are separated by fusing the metal in shallow pans, and allowing it to oxidize at the surface. In this way the antimony and tin form oxides, and as such are skimmed off.

Lead is an important metal in the arts. Rolled out into sheets, it is largely used for roofing houses, for water-cisterns, and for water-pipes. It is also of great service in the construction of large chambers for the manufacture of sulphuric acid. Its value for the manufacture of shot is well known. Alloyed with antimony, etc., it is largely consumed for type-metal, and with tin, for solder. Much lead is also required for the manufacture of pewter, Britannia Metal, etc.

Of the compounds of lead, other than alloys, which occur largely in commerce, the following are the principal: *White Lead* or *Carbonate of Lead*, a substance very extensively used as white paint, and also to form a body for other colors in painting. As much as 16,000 tons of it are annually made in England. White lead is still largely made by the old Dutch process which consists in treating metallic lead, cast in the form of stars or gratings, in such a way as to greatly facilitate the absorption of carbonic acid. These stars of lead placed in earthenware vessels, somewhat like flower-pots, and containing a little weak acetic acid, are built up in tiers in the form of a stack, and surrounded with spent tan or horse-dung. The heat given out from the dung volatilizes the acid, which, along with the air, oxidizes the lead. The acetic acid changes the oxide into the acetate of lead, and this is, in turn, converted into the carbonate by the carbonic acid given off from the hotbed. By this process, metallic lead requires from 6 to 8 weeks for its conversion into white lead. Several less tedious processes for the manufacture of a white paint from lead have been tried at various times, but the only one now practiced is that for the production of an oxychloride of lead, by acting on raw galena with hydrochloric acid. *Minium, Red Lead, or Red Oxide of Lead*, is much consumed in the manufacture of flint-glass and porcelain, and to some extent as a pigment. It requires to be made of very pure lead, as a slight trace of copper would impart a color to glass. Minium is prepared by heating *Massicot*, or protoxide of lead, to a temperature of 600° F. in iron trays, in a reverberatory furnace, carefully avoiding fusion. More oxygen is thus gradually absorbed; and a compound of the protoxide and the peroxide of lead is formed, having a bright red color, which is the red lead of commerce.—*Litharge* has been already noticed.

LEAD COATING PROCESS.—The process of lead-coating projectiles, chemically, as adopted by Ordnance Officers, is as follows: 1. The projectiles must be turned off smoothly and brightly. 2. Keep them in a pickle or solution of zinc and vitriol (proportion three pounds of zinc to each pound of vitriol,) until they show a metallic appearance; about 20 pounds of vitriol to 100 shells of nine pounds, and enough water to cover the surface to be coated; the projectiles being set upright in a wooden box lined with lead. The zinc prevents the acid from acting too violently on the iron. 3. After the pickle, immerse them in clear water, and then in a bath of one pound of lime to 2¾ gallons of water. 4. Rub the surface with rags and sand until a clear metallic appearance shows itself; wipe dry with rags and saw-dust; brush off the saw-dust. 5. Heat the projectiles to that degree that a drop of water thrown on them will boil at once. 6. Dip them in a solution of one part of sal-ammoniac to four parts of water (hot.) 7. Then cover them with a thick layer of powdered sal-ammoniac. 8. Being perfectly dry, dip them into the molten zinc until they have the same temperature as the zinc. 9. Wipe off the dripping zinc with gloves previously saturated with the solution of sal-ammoniac (6). The gloves must have dried without being wrung. 10. Cover them again with powdered sal-ammoniac. 11. Dip them into molten pewter for about half a minute. (For projectiles of hardened iron the coating with zinc is dispensed with.) 12. Wipe off the dripping pewter with the sal-ammoniac gloves. 13. Cover them again with the powdered sal-ammoniac. 14. Put them in the mold and pour the molten lead in. The process to the zinc coating (8) is the same or similar to the galvanizing, only more caution is taken to have very smooth surfaces. The process from the tin coating to the casting must be done quickly. The mold for the final casting is of cast iron, made of two halves, working on a heavy hinge, and connected to a heavy bottom plate, and opened and shut by a pair of long handles. The inside must be polished. Its interior diameter must be a little longer than the diameter of the finished coated projectile. The mold, prior to casting, is warmed so that drops thrown on will boil at once, and receives a coating of grease, which should be allowed to dry before casting. The casting is tested by making incisions which will show whether it adheres firmly to the iron or will peel off. The projectile is finished by turning off in the lathe the lead coating to the desired dimensions; prove them, and screw in the bottom or head-screws. See *Coated Projectiles*.

LEADERS.—Long paper tubes of small diameters inclosing a strand of quick-match. They are used to communicate fire rapidly from one point to another. The velocity of combustion is from 1 to 2 yards per second, depending upon the size of the tube, being more rapid as the tube is smaller.

Leaders are made by rolling a strip of thin paper, 25 inches wide, as obliquely as possible, on a ramrod, or cut the paper into trapezoids 4 inches wide at one base and 2¼ at the other; paste the edges of the strips 0.25 inch, and roll them on a ramrod so that one end shall be enlarged, funnel-shape. When dry, pass a strand of quick-match through, and let it project about an inch at each end.

To unite them into a long line, insert the end of one into another a distance of .75 inch, and tie them with a thread. If the line be long, first stretch a piece of twine, and attach the leader to it every few feet. See *Fireworks*.

LEADING.—The clogging of the grooves of a rifle with lead from the bullet; one of the principal obstacles against continuous accurate shooting. It is obviated by covering the bullet with a paper patch or by using a lubricant in the canellures.

LEADING COLUMN.—The first column that advances from the right, left, or center of any army or battalion.

LEADING FILE.—The first two men of a battalion or company that marches from right, left, or center, by files. See *File-leader*.

LEADING FLANK.—When a line breaks into column in order to attack an enemy, the Leading Flank is that which must always preserve the line of *appui* in all movements in front. The first battalion, or company of every column which conducts, is called the head or leading flank of that column.

LEADING QUESTION.—In the proceedings of Military Tribunals, a question to a witness which suggests the desired answer. Such questions are objectionable except under certain conditions.

LEAD OUT.—A command in the mounted service to cause the horses to be taken from the stable or picket line preparatory to mounting or harnessing.

LEAF SIGHT.—A form of elevating rear sights, consisting of several hinged leaves of different heights. It is usually attached to the tangent sight, and is often called a *Sliding Leaf-head*. See *Sight*.

LEAGUE.—1. A measure of length of great antiquity. It was used by the Romans, who derived it from the Gauls, and estimated it as equivalent to 1500 Roman paces, or 1.376 modern English miles. The League was introduced into England by the Normans, probably before the battle of Hastings (1066), and had been by this time lengthened to 2 English miles of that time, or $2\frac{3}{10}$ modern English miles. At the present day, the League is a nautical measure, and signifies the 20th part of a degree—i. e., 3 geographical miles, or 3.456 statute miles. The French and other nations use the same nautical league, but the former nation had (until the introduction of the metrical system) two land-measures of the same name, the legal posting-league = 2.42 Eng. miles, and the league of 25 to the degree, which is = 2.76 statute English miles.

2. The term generally employed in the 16th and 17th centuries to designate a political alliance or coalition. The most famous Leagues were those of Cambray, Schmalkald, Nürnberg, etc. But the name has a peculiar importance in the history of France,

as applied to the opposition organized by the Duke of Guise to the granting of the free exercise of their religion and political rights to the Huguenots. This League, known as the Holy League, was formed at Péronne, in 1576, for the maintenance of the Roman Catholic Religion in its predominance; but the object of the Guises was rather to exclude the Protestant Princes of the Blood from the succession to the throne. For an account of the civil war that ensued, see *Histoire de la Ligue* (5 vols., Par. 1829).

LEAGUE OF MARBACH.—Under the rule of Count Frederick of Hohenstaufen and his successors, Suabia became the most rich, civilized, and powerful country of Germany, and the Ducal Court was the resort of the Minnesingers; but the wars of the Guelphs and Ghibellines, and the quarrel with the French respecting Naples, put an end to the Dynasty in 1268. The Ducal Vassals in Suabia rendered themselves almost independent, and professed to acknowledge no lord but the Emperor. During these dissensions arose the Lordships of Würtemberg and Baden, with numerous lesser States, holding direct of the Crown, and opposed to them the Cities, which strove also for an equal independence, and at last, in reward of important service, obtained in 1347 great additional privileges. A number of them united to make common cause against the neighboring Feudal Lords in 1376 (known as the *First Suabian League*); an opposite league was formed between Würtemberg, Baden, and 17 towns in 1405, called the League of Marbach; and both took part in the war of Swiss Independence, the former in support of the Swiss, the latter of the Austrians. At last, the towns, which had been rapidly increasing in wealth and power, decided at Ulm, in 1449, to form a standing army, and a permanent military commission, for the forcible preservation, if necessary, of peace and order; and the Count of Würtemberg, the most powerful of the opposite party, having joined them, was appointed Military Chief of the League, which ultimately grew up into the *Great Suabian League*, and exercised both administrative and judicial authority over the whole country, effectively repressing feudal quarrels. In 1512, Suabia became one of the ten circles into which Germany was now divided, received its complete organization in 1563, and retained it almost without change till the dissolution of the Empire in 1806. But during this period, the wars of the towns with Würtemberg, the Peasants' War, of which Suabia was one of the foci, the Thirty Years' War, and those between France and the Empire, destroyed the democratic constitution of the towns, and with it their energy, and then their prosperity disappeared, leaving now no relic which could suggest their former great political importance.

LEAGUER.—1. The camp of a besieging army; less often a camp in general; a siege or beleaguering. 2. A confederate, or one who unites in a league.

LEAST SQUARES.—The method of Least Squares, in astronomy and problems of motion, is the best mode hitherto discovered of obtaining the most correct result from the number of observations upon any phenomenon. These observations are assumed to differ slightly from each other, and to be all of equal value, that is, taken under equally favorable conditions, and with equal instruments. The ordinary and long established mode of approximating to the truth in such cases, is by finding the arithmetic mean, and accepting it as the correct result; but in all cases where the result required does not come directly from observation, but requires to be discovered by calculation, this simple and useful method is inapplicable, and that of 'Least Squares,' which gives more probable corrections, is adopted. The method is founded on a theorem which was first propounded by Legendre in 1806, more for the sake of insuring uniformity among calculators than from any belief in its intrinsic value; but it was afterwards thoroughly discussed and proved by Gauss and Laplace, that "if the mean of a number of distinct observations be so taken, that the sum of the squares of its differences from the actual observations (generally designated *errors*) shall be a minimum, this mean will be, under these circumstances, the correctest obtainable value." The process by which the mean thus obtained is shown to be the most trustworthy approximation is too long for insertion here; but it may not be undesirable to give an example of the most common form of the method as occurring in astronomy. Let there be a series of equations—

$$\begin{aligned} X &= x + y + 2z \\ X_1 &= 3x + 2y + 5z \\ X_2 &= 4x + y + 4z \\ X_3 &= -x + 3y + 3z \end{aligned}$$

where the unknown quantities are x, y, and z, connected by various (the more the better) equations with X, X_1, etc., quantities which must be determined by actual observation. Suppose the value of the quantities thus found to be 3, 5, 21, and 14, then since by hypothesis all these four observations are erroneous, the errors are $3 - X$, $5 - X_1$, $21 - X_2$, $14 - X_3$, or

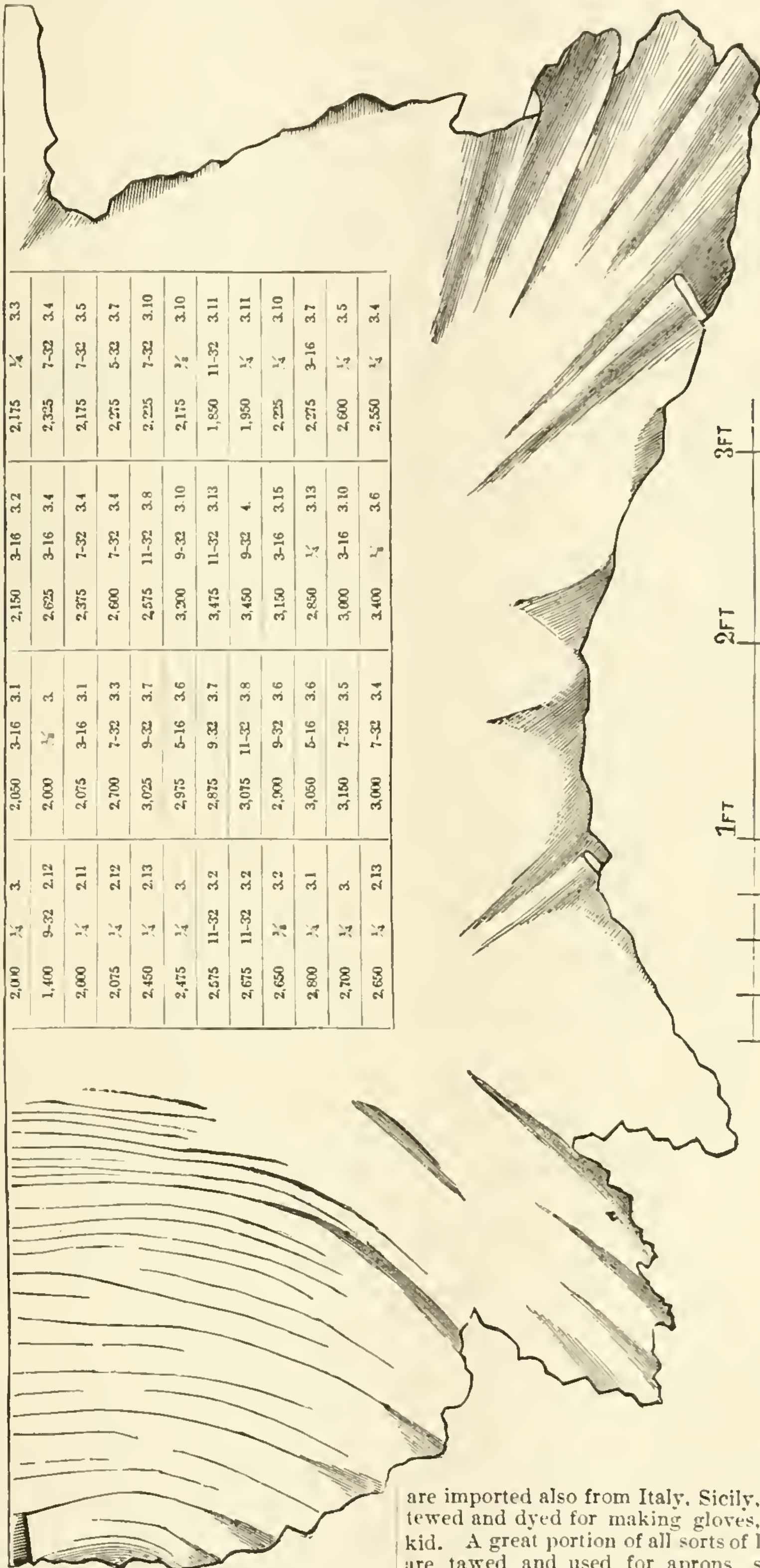
$$\begin{aligned} &3 - x - y - 2z, \\ &5 - 3x - 2y - 5z, \\ &21 - 4x - y - 4z, \\ &14 + x - 3y - 3z. \end{aligned}$$

The squares of these four errors are now added together; and, to find the values of x, y, and z, which will render this sum (call it S) a minimum, we must differentiate S with respect to x, y, and z in turn, and putting each of these partial differential coefficients equal to zero, we obtain the three equations, $-88 + 27x + 8y + 30z = 0$; $-76 + 8x + 15y + 25z = 0$, and $-157 + 30x + 25y + 54z = 0$; from which the most trustworthy values of x, y, and z can be found by common algebra.

LEATHER.—The skins of animals chemically altered by the vegetable principle called tannin, or tannic acid, so as to arrest that proneness to decompose which is characteristic of soft animal substances. Its invention reaches beyond the dawn of history and was probably among the earliest germs of civilization; for as the skins of animals would naturally be among the first articles of clothing, any means of preserving them more effectually than by drying would be highly prized. The discovery that bark had this effect was doubtless the result of accident. The principle of its action was unknown up to the present century; and the same unvarying method has been employed from the earliest times until the last few years, when the invention of new processes has much faciliated the manufacture.

The skin of all animals used in the production of leather consist chiefly of gelatine, a substance which easily enters into chemical combination with the tannic acid found in the bark of most kinds of trees, and forms what may be termed an insoluble *tanno-gelatin*. This is the whole theory of tanning, or converting the skins of animals into leather. Formerly, oak-bark was supposed to be the only tanning material of any value; but lately very numerous additions have been made to this branch of economic botany.

In addition to the process of tanning in making leather, there are other modes, one of which is *tawing*, another *dressing in oil*. The following are the skins which form the staple of our leather manufacture: ox, cow, calf and kip, buffalo, horse, sheep, lamb, goat, kid, deer, dog, seal, and hog. These are consumed, in a great degree, in the construction of military equipments and appliances. The term *pelt* is applied to all skins before they are converted into leather. When simply made into leather in the state we find in shoe-soles, it is called, "Rough Leather;" but if, in addition, it is submitted to the process called currying, it is termed "Dressed Leather." The following trade-terms are in general use: hides or crop-hides, butts and backs, bends, offal, and skins. The complete hide when rounded, with the cheeks, shanks, and belly-pieces, etc., pared off, is called a *butt;* the pieces cut off constitute the *offal;* and *skins* are all the lighter forms of leather, such as sheep, goat, deer, etc.



2,000	¼	3.	2,050	3-16	3.1	2,150	3-16	3.2	2,175	¼	3.3
1,400	9-32	2.12	2,000	⅛	3.	2,625	3-16	3.4	2,325	7-32	3.4
2,000	¼	2.11	2,075	3-16	3.1	2,375	7-32	3.4	2,175	7-32	3.5
2,075	¼	2.12	2,700	7-32	3.3	2,600	7-32	3.4	2,275	5-32	3.7
2,450	¼	2.13	3,025	9-32	3.7	2,575	11-32	3.8	2,225	7-32	3.10
2,475	¼	3.	2,975	5-16	3.6	3,200	9-32	3.10	2,175	⅜	3.10
2,575	11-32	3.2	2,875	9-32	3.7	3,475	11-32	3.13	1,850	11-32	3.11
2,675	11-32	3.2	3,075	11-32	3.8	3,450	9-32	4.	1,950	¼	3.11
2,650	⅜	3.2	2,900	9-32	3.6	3,150	3-16	3.15	2,225	¼	3.10
2,800	¼	3.1	3,050	5-16	3.6	2,850	¼	3.13	2,275	3-16	3.7
2,700	¼	3.	3,150	7-32	3.5	3,000	3-16	3.10	2,600	¼	3.5
2,650	¼	2.13	3,000	7-32	3.4	3,400	⅛	3.6	2,550	¼	3.4

Sheep and lamb skins are imported (in the wool) in large quantities from Australia and the Cape of Good Hope. The latter with the cape skin, are used for book-binding, gloves, etc. Lamb-skins are imported also from Italy, Sicily, and Spain, and tewed and dyed for making gloves, in imitation of kid. A great portion of all sorts of lambs and sheep are tawed and used for aprons, sewing harness, plaster-skins, tying up bottles, lining shoes, and other jobbing and inferior purposes. *Deer-skins* are dressed by the oil process, and form a great portion of the so-called *shamoy* leather, which derives it name from the chamois of the Alps, from the skin of which it was formerly made. *Dog-skins* are tanned or tawed for gloves, and for thin shoes and boots. *Seal-skins* are manufactured into the so-called "patent leather," by varnishing their upper surface. The manufacture of this kind of leather has of late become of great importance to the London, Edinburgh, and Newcastle tanners. *Hog* or *pig skins* are imported from Russia and other countries, and many are supplied by Scotland; their use is chiefly in the manufacture of saddles, etc. *Walrus* and *Hippopotamus hides* are tanned in considerable numbers for the use of cutlers and other workers in steel goods, "buffing-wheels" being made of them often an inch thick, which are of great importance in giving the polish to metal. Lately, belts for driving machinery have successfully been made from them. *Kangaroo-skins* of various species are tanned or tawed in Australia, and form a kind of leather in great favor for dress-boots.

The first process in making *tanned sole leather* is to soak the skins or hides in water for a greater or less time, to wash and soften them; they are then laid in heaps for a short time, and afterwards hung in heated rooms, by which means a slight putrefactive decomposition is started, and the hair becomes so loose as to be easily detached. This process of "unhairing" is mostly followed in America; but in Great Britain milk of lime is used for soaking the hide till the hair loosens. Hides or skins intended for dressing purposes, such as shoe, coach, harness, or book-binding, after the hair is taken off by the lime, have to be submitted to a process called "bating," for the purpose of reducing the thickening or swelling occasioned by the introduction of the lime, and for cleansing the skin from grease and other impurities. This is effected by working the skins in a decoction of pigeons' or dogs' dung and warm water, and no dressing-leather is ever submitted to bark or shumac without undergoing this process.

The first attempts at improvement in tanning were the method invented by Mr. Spilsbury in 1823, and the improvement on this method by Mr. Drake, of Bedminster, in 1831. The principle consisted in causing the *ooze* or *tan-liquor* to filter through the hides under pressure. For this purpose, in Drake's process, the edges of the hides were sewed up so as to form a bag. The bags being suspended, were filled with cold tan-liquor, which gradually filtered through the pores of the hides, and impregnated them with the tannin. The processes by infiltration, however, have been entirely abandoned for heavy leather, as they have the effect of rendering the leather porous and deficient in firmness.

Various patents for improvements in tanning have been in operation of late years. Herepath and Cox, of Bristol, tied hides to each other to form a long belt, and pressed them between rollers, to squeeze out the partially exhausted tan-liquor from the pores, so that a stronger liquor might be absorbed. Messrs. J. and G. Cox, of Gorgie Mills, near Edinburgh, made an improvement on this mode by attaching the hides to a revolving drum, so that the hides press on each other on the top of the drum, but hang suspended in the tan-liquor from the lower part; and thus, by the hides being alternately in and out of the liquor, the tanning is quickly effected.

Tawing consists in dressing the skins with antiseptic materials, so as to preserve them from decay; but by this operation no chemical change is effected in the gelatine of the skins; hence, tawed leather can be used in the manufacture of glue. In tawing, the first process is careful washing, next dressing them with lime, then removing the hair or wool, and lastly, steeping them in some one or more of the various mixtures which are used for converting skins into leather by this method.

Besides *tanning* and *tawing*, many kinds of leather require the currier's art to bring them to the state of completion required for military purposes. The currier receives the newly tanned skins, and finds them harsh to the feel, and rough on the flesh-side. He removes all the roughness by carefully shaving with a peculiar knife. After soaking in clean water, he then scrapes the skin with considerable pressure upon a scraping-tool or *slicker*, and thus removes any irregularities. The moisture is then removed as much as possible, and oil, usually cod oil and tallow, are rubbed over the leather, which is laid aside to dry completely, and as the moisture leaves it, the oil penetrates. When quite dried and saturated with the oil, the skin is rubbed on a board with rounded ridges, by which a peculiar grained appearance is given, and the leather is rendered very pliable. In currying, almost every variety of leather requires some variation in the processes employed, but the currier's object is in all cases to give a suppleness and fine finish to the skins.

Morocco Leather, formerly an article of import from the Barbary coast, is now prepared in large quantities in this country from goat-skins; sheep-skins are also used for imitation. It is always dyed on the outer or grain side with some color, and the leather-dresser in finishing gives a peculiar ribbed or a roughly granulated surfaace to it, by means of engraved boxwood balls which he works over the surface.

Russia Leather is much valued for its aromatic odor, which it derives from the peculiar oil of the birch-bark used in tanning it. The fact that this odor repels moths and other insects, renders this leatber particularly valuable for binding documents; a few books in a library, bound in Russia Leather, being effective safeguards against insect enemies. It is also said to destroy or prevent the vegetable evil called mildew, to which books are so very liable.

The drawing represents a side of leather, and is made to the scale of one inch to the foot; the marks show the size and shape of the specimens tested, and the figures give the strain in pounds at which each piece broke, the permanent elongation in fractions of an inch, and weight in ounces and drachms. The pieces were each 11¼ inches long by 2 inches wide, and were taken out of the exact portion of the hide on which they are marked.

These test were made by Messrs. Riehlé Brothers, at the testing department of their works, for the obvious reasons of determining by actual experiment, the tensile strength of the different portions of a side of leather.

These tests have been the means of awakening new interest in important investigations, as to the comparative value of sides of leather for special military purposes, and as to the best means of producing the best results. Until comparatively lately the testing of iron and other metals, excepting by the crudest methods, was almost entirely neglected, but now testing has become a necessity, and the value of metals is determined between buyer and seller by their endurance under certain tests that are brought to bear upon them, and that correspond to the special use that they may be required for. This, no doubt, will also be the method of determining the value of leather, especially that used for belting, etc., and the comparison of tests made with patented and rubber belting is interesting and useful. See *Testing Machines*.

LEATHER CANNON.—A variety of cannon introduced by Gustavus Adolphus into the army on account of their mobility. Undeniable evidence, however, of their earlier existence, though of a smaller size, is found in the "Landeshuter Harnisch-Kammer-Inventarium" of 1562, in which mention is made of a "Lange lederne Buchse mit Kugel-Modell." Although Gustavus Adolphus improved and perfected the leather cannon which he introduced into his army in 1626, and used in the siege of Wormditt, yet neither he nor the German Freiherr Melchior von Wurmbrandt, nor the North British Baron Robert Scot, can be regarded as the inventor. The invention is evidently of much earlier date. A leather mortar for firing shells, on exhibition in the Arsenal at Venice, was, the Venetians assert, made in 1349; it is very likely, however, that its origin is somewhat earlier. One is here reminded of the many substitutes for metal ordnance, especially of the wooden cannon (entirely bound with iron hoops), which are frequently mentioned in the period from 1525 to 1530.

The leather cannon varied from a 1-pr. to a 4-pr. The bore consisted of a copper cylinder, of the thickness of three-fourths of the diameter of the ball used. The length of the cylinder was sixteen calibers; cascable and breech were screwed into the cylinder. The vent, of copper, was screwed into the breech. The entire length of the bore was covered with iron hoops, over which a number of ropes were wound, which, in turn, were covered with several layers of varnish. Over these layers another round of ropes was wound, and over this was spread a layer of cement. This process was repeated until the coat was of the thickness of two calibers; the last coating consisted of tarred leather, which gave the cannon its name. The charge amounted to one-fourth, rarely one-third, of the weight of the ball; the cannon was loaded only with canister. Canister-shot, until that time only used in sieges, was introduced by Gustavus Adolphus into the field service, and consisted mostly of musket bullets, though old pieces of iron were very often used. The shot were put into wooden and tin boxes, linen bags, and sometimes only in rude wicker baskets. The leather cannon, of 90 lbs. weight, with its light carriage, was easily drawn by two men. This cannon, however, by no means met the high expectations entertained of it. Already in 1631 the Swedes ceased using this nature of gun, because at the battle of Breitenfeld it not only became so overheated that the charges ignited of themselves, but it also gave a very short and unreliable range. In 1629, a certain Lieutenant Wolf Muller, of Chemnitz, circulated the report that he was in possession of a secret for the construction of leather cannon which had many and decided advantages over metal ordnance. The Elector of Saxony ordered Colonel von Schwalbach to investigate and to report as to its worth. The report of the Colonel was found to be favorable, and expressed in these words:—"Owing to their light weight, easy transportation, and saving of powder, as well as the advantagos they offer in the field against the enemy, and in mountainous and swampy regions, in which latter places heavy cannon can seldom be used at all, such pieces cannot be too highly regarded," etc. The Elector ordered the construction of two leather cannon, for which were given "fifty-seven florins three groschen ready money; seventeen florins three groschen for sixty pounds pewter; fifty-one florins three groschen for two and one-fourth hundred-weight refined copper. Of the copper, the coppersmith received two hundred-weight, with which he made a tube four and one-half ells long, weighing ninety pounds, and used twelve pounds for muzzle and vent. The waste in melting twice amounted to sixteen pounds, the remainder was left to the smith as pay for his work." The trial with these leather guns could not have been very satisfactory, if we may judge from the following item in a record of weights of the Armory at Dresden, June 14, 1630: "Inventory of the weights of copper and pewter of the *burst leather pieces* in the Elector's Armory at Dresden:—Copper, one-half hundred-weight, twenty-six pounds; pewter, thirty-four pounds." No mention being made of these guns at a later period, it is taken for granted that this one failure was thought sufficient to cool all enthusiasm for leather cannon.

LEAVE OF ABSENCE.—The permission which officers and soldiers of an army obtain to absent themselves from duty. In the British service, in applying for leave, the War Office form is used. The General Commanding has the power to grant leave within monthly returns. For special duties, the officer who is to perform the work in the interim is to be named in the application for leave. The application of a Medical Officer goes first to the principal Medical Officer in the division or garrison; that of a Paymaster to the War Office, accompanied by a certificate from a Board that his accounts are satisfactory, cash balance correct, acting Paymaster engaged, and declaration made that the real Paymaster is answerable for substitute. The application of an officer proceeding on *sick leave* must be accompanied by a medical certificate. If the officer is not likely to rejoin soon, it is usual for the Medical Board to ask the General to assemble the Board, or to get him to apply to the Horse Guards, should the regulations point out this to be the course to be pursued. In the Indian military service, leave of absence includes three kinds:—1. Furlough in or out of India on sick or general leave; 2. General leave on private business, or on sick certificate in India, or short leave to sea; 3. Privilege leave. In the rules which govern an officer's *furlough in* or *out of* India, there is no distinction between *sick* and *general leave* with respect to allowances, hitherto drawn, both being included under the general term, furlough; provision, however, is made for the obtainment of leave under medical certificate without all the restrictions applicable to furlough when taken without it. In the rules under the head of furlough, it is shown that an officer of the Indian Army must serve six years after his return from England or elsewhere, after taking furlough, before he is entitled to any more leave counting as service: but should the officer in question have accumulated leave, so that after two years' absence he has still one or two years leave due him, he will be permitted three years after his return to proceed again on leave without loss or appointment. *Short leave*, not exceeding three months, may be taken to sea on certain conditions; but absence from India for any longer period is treated as furlough. *Privilege leave* for sixty or ninety days (depending upon the part of the country an officer is cantoned in), in each year, is granted to all officers in military employ without loss of allowances; should this time be exceeded, it must be converted into general leave, unless sickness has been the cause of detention.

In the United States service leaves of absence are not granted so that a company will be left without one of its *commissioned officers*, or a garrisoned post without two commissioned officers and competent medical attendance; nor is such leave granted to an officer during the season of active operations except on urgent necessity.

No leave of absence exceeding seven days, except on extraordinary occasions, when the circumstances must be particularly stated, is granted to any officer until he has joined his regiment or corps, and served therewith at least two years. In giving permission to apply for the extension of a leave of absence, the term of the extension is stated. The term of the extension approved by the Department Commander is regulated by the season and the usual opportunities for reaching the officer's station, so that he may not be absent during the time for active operations. Leaves of absence are granted for periods specified as "one month," "one month and ten days," "two months," etc., instead of so many days, and commences on the day the officer departs from his proper station. The expiration of his leave must find him at his post. Leave for one month, beginning on the first day of a calendar month, expires with the last day of the month, whatever may be its number of days. Commencing on an intermediate day of a month, the leave will expire with the day preceding the same day in the next month. The day of departure, whatever the hour, is counted as a day of absence; the day of return, whatever its hour, as a day of duty. The Commander of a post way take leave of absence not to exceed seven days at one time, or in the same month, reporting the fact to his next Superior Commander; and in time of peace the Commander of a post may grant leaves of absence not to exceed seven days at one time, or in the same month. A Department Commander may grant leaves for one month, or extend to that period those granted by Post Commanders: a Military Division Commander, for two months, or extend one month a leave granted by a Department Commander under him; the General of the Army, four months, or extend to that period a leave already granted. Applications for leaves of absence for more than four months, or to officers of Engineers and Ordnance, or officers of the General Staff or serving on it (Aides-de-Camp excepted), for more than one month, are referred to the Adjutant General for the decision and orders of the Secretary of War. Officers are not permitted to leave the United States, to go beyond sea, without a special permission from the War Department. Officers of the army traveling or stopping in foreign countries, whether on duty or leave of absence, are expected to avail themselves of all opportunities, properly within their reach, for obtaining information of value to the military service of the United States, especially that pertaining to their own arm or branch of service. Verbal permits for less than twenty-four hours are not counted as leaves of absence. But for every other absence of whatever duration, the date of departure and return is noted on Post, Regimental, Department, and Division Returns against each officer borne thereon. Permission to hunt is not considered as a leave of absence or charged as such if the officer, on his return to his station, files with his Commanding Officer a certificate that his absence has been solely employed in hunting, and furnishes as complete a description of the country passed over as circumstances permit. Officers when absent on account of sickness or wounds, or lawfully absent from duty and waiting orders, receive full pay; when absent with leave for other causes, full pay during such absence, not exceeding in the aggregate thirty days in one year, and half-pay during such absence exceeding thirty days in one year. When absent without leave, they forfeit all pay during such absence, unless the absence is excused as unavoidable.

By an Act of Congress approved in 1876, an officer may permit his leave to accumulate for a period not exceeding four years. He may, moreover, enjoy five months' continuous leave on full pay, if the fifth month of such leave is wholly distinct from the four year period. An officer on leave over this time receives half-pay only. When an officer is absent under certificate of disability duly accepted, on account of sickness or wounds, he is entitled to the same pay as if an order had been issued granting him a sick-leave. Officers absent on certificate of disability should so arrange that the certificates may cover entire calendar months, and not monthly periods commencing with intermediate days. The pay-account of every officer on leave should, throughout the period of his absence, exhibit the date of commencement of leave, the authority for his absence, and in case the account is for the month in which the absence terminates, the date of return to duty. In all cases the day of departure or relief from duty is counted as a day of absence, and the day of return as a day of duty. In determining the portion of a leave of absence for which an officer is entitled to full pay, no time is considered outside of a period of four successive leave years, including the leave year or years in which the absence is taken. The leave year is reckoned from June 20th to the following June 19th inclusive. In estimating the period of absence during any one leave year, each and every day's absence is included. Every officer who is dropped by the President from the rolls of the Army for absence from duty three months without leave, forfeits all pay due or to become due. See *Furlough* and *Sick-leave*.

LE BOULENGE CHRONOGRAPH.—In this instrument the time between two events is ascertained by noting the distance of the *free* fall of a heavy body during the interval, the beginning and end of this distance being made to accord with the occurrence of the events by means of the galvanic current. It can be used not only as a micro-chronometer, but directly as a velocimeter. The drawing shows the instrument ready for use, for taking velocities, and for measuring minute intervals of time To obtain velocities at once, two electric circuits are established, a fixed distance, say fifty meters, apart, in such a manner as to be successively broken by the projectile in its flight. The first current circulates through the electro-magnet A, whose armature is a long cylindrical rod C, called the *chronometer*, furnished with two enveloping zinc tubes, D and E, called *recorders*. The second current passes by the electro-magnet, B, whose armature, the shorter rod, F, is called the *registrar*. The third active element of the instrument is the *indenter*, consisting of a circular knife, fixed in a mainspring, which can be cocked by means of a catch on a lever.

On the breaking of the first circuit, the chronometer falls vertically; on the rupture of the second the registrar falls in its turn, depresses the free end of the lever, and thus releases the mainspring; the knife juts forward, strikes the falling chronometer, and indents the upper recorder. As shown below, a very simple relation holds between the dent thus obtained and the velocity of the projectile which caused it. Even with this brief description, a moment's thought will show that the lower the velocity the higher up shall the recorder be indented.

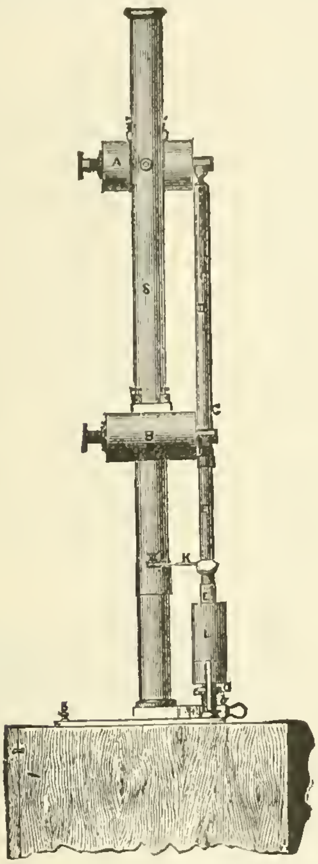
The above succint account of the action of the instrument is sufficient for a comprehension of its theory. As an *origin* of reference for the falls of the chronometer, we take the dent imprinted on the lower recorder, when the knife is "let off," while the chronometer is suspended. Let h be the height above the origin of the dent due to the shot; then, as the chronometer followed the law of falling bodies from the beginning of its movement up to the time it was struck by the knife, we have $T' = \sqrt{\frac{2h}{g}}$ as the time corresponding to this fall. It would also be the time of the trajectory between the targets (giving a velocity of $\frac{50}{T'}$ meters to the projectile), provided the chronometer began its fall at the precise instant the first, and the knife struck it at the precise instant the second current was broken. But this is, in reality, not so; for, after the breaking of the first current, a certain interval, ϕ, elapses before the electro-magnate is sufficiently demagnetized to permit the fall of the chronometer, which will accordingly be retarded by this time, and the observed duration of trajectory will be too small by the same quantity.

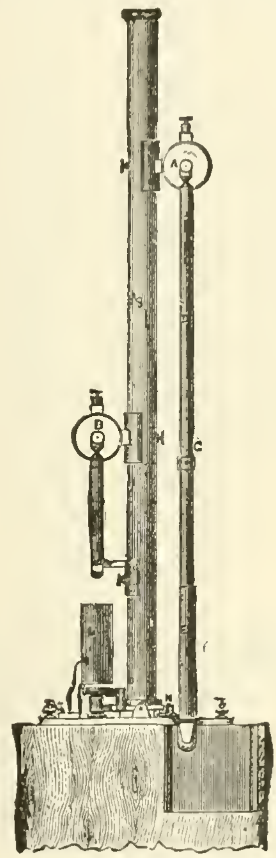
On the other hand, from the breaking of the second current up to the instant of the knife striking the chronometer, the following intervals elapse: o' for the sufficient demagnetization of the electro-magnet, B. t' for the fall of the registrar to the disk of the indenter. t'' for the release of the catch. t''' for the knife to clear the horizontal distance to the falling chronometer. The observed time T' is then too great by the quantity $(o' + t' + t'' + t''')$, and too small by ϕ. For the true time of flight, T, we have, therefore, $T' - (o' + t' + t'' + t''' - \phi) = T' - t$. For $T = \phi$, we have $T' = t$, whence to obtain the value of t we have only to break both circuits simultaneously, and note the resulting time of fall; since after this common rupture, there passes the time ϕ before the chronometer falls, and $(o' + t' + t'' + t''')$ before it struck; until it is dented there elapses then the time $(o' + t' + t'' + t''' - \phi)$ or t. As will be shown presently, the instrument can be so adjusted as to give t a constant value, say $0''.15$. Whenever desirable, we can very readily ascertain whether the apparatus is thus adjusted or not, by using the *disjunctor*, which is in both circuits. If the resulting dent is 110.29mm above the origin (the height corresponding to 0″.15 at Watertown Arsenal), then the instrument is properly set. Dependent upon this condition, we can fix in advance the height corresponding to any given velocity of projectile. For example, with an initial velocity of 500 meters, the projectile will pass over the 50 meters' interval between the circuits in 0″.1, and the instrument will record 0″.15+0″.1, or 0″.25, and the height will therefore be

$$H = \frac{9.8037 \times 0''.25^2}{2} = 306.36^{mm}.$$

Reciprocally, if the shot gives a dent 306.36mm above the origin, we conclude that the projectile was moving with a velocity of 500 meters. The heights corresponding to all velocities within the ordinary limits of experiments have been calculated and inscribed

also serves as a stand for mounting it. After unpacking the box screw on the sectional iron tripod, then stand it independently of the floor, so that it may be subject to as little vibration as possible, and fasten securely in its place the triangular plate that carries the indenter and column. The electro-magnets are commonly attached by passing the threaded stems through the column, and then tightening with the milled nuts. The disjunctor should be placed very near the instrument, within easy reach of the operator. Ordinarily one seven-inch chromic potash cup will be found sufficient for the registrar circuit, and three cups for the chronometer. As so little power is required, we would recommend, if easily attainable, that Daniell's or Hill's batteries be used as giving most constant action. Two recorders are put on the chronometer. These tubes should be lightly tapped, before being slipped on, to insure a snug fit. Care must be taken that the lower recorder rests closely against the bob.





on a metal rule, furnished with a sliding index, which thus affords a simple means for *directly* measuring the velocity of the projectile fired. The shot having given the indent, we adjust the rule to the chronometer, slide the beak of the index into the notch, and read off the velocity.

As has already been stated, when it is desired to measure velocities directly, two targets must be set up 50 meters apart. The chronometer circuit passes through the first, and the registrar through the second, the disjunctor being in both. Should local difficulties intervene to prevent the targets being set up exactly 50 meters apart, multiply the velocity read from the scale by the constant ratio $\frac{D}{50}$ where D is the actual space in meters. For transport, the different parts of the instrument are packed in a box, which

The currents being properly established and sufficiently strong to enable the magnets to maintain the rod-armatures, the next step is the adjustment of the apparatus, which comprises these three operations: 1. Leveling the instrument. 2. Regulating the power of the electro-magnets. 3. Fixing the height of the disjunctor-reading. The instrument is set up for firing in the same manner as for taking a disjunctor reading. To avoid confusion, numbered ink-marks, about one-sixteenth of an inch apart, are made around the bases of the two recorders, and each mark is successively brought in line with the cut on the ring as the firing progresses, by which means the dents are made on equidistant straight-line elements. The zincs can thus receive about twenty dents, and then be turned end for end and receive twenty more. The shot having given a dent, apply the rule to the chronometer in the manner described for tracing the disjunction circle, bring the vernier-knife against the edge of the notch, clamp it, and read off the velocity. The experiments for the day being over, the date is inscribed on the proper recorder, and, if deemed necessary, it may be filed for future reference. If the foregoing directions as to the setting-up and adjustment of the instrument are carefully followed, not only will there be no appreciable variation in the disjunctor-readings before any shot, but they will, remain constant from round to round. See *Breger Chronograph*, *Chronoscope*, *Disjunctor*, *Indenter*, and *Micro-chronometer*.

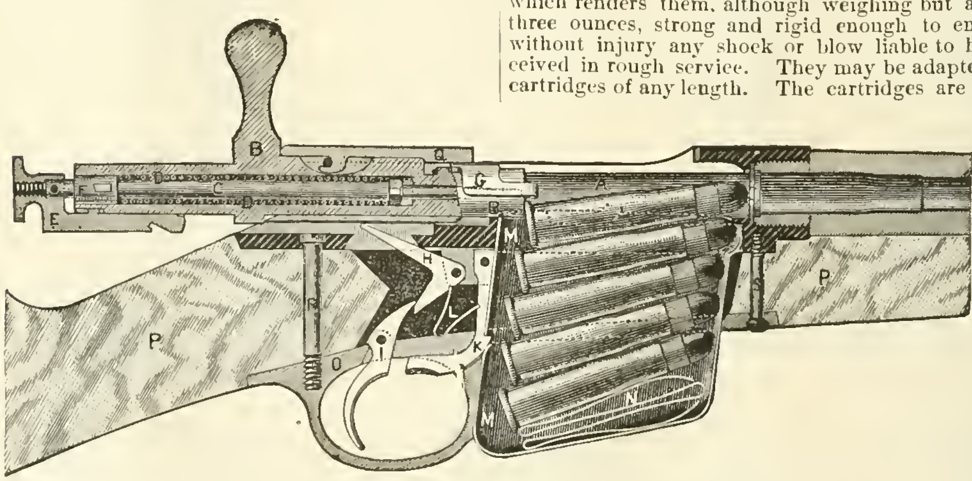
LEE.—A term employed in target practice to denote the quarter to which the wind is directed, as distinguished from *windward*, or the part *whence* the wind comes. Also written *Leeward*.

LEEK.—The Welsh emblem, in consequence of a command from Dewi, or David, afterwards Archbishop of St. Davids', in 519. On the day that King Arthur won a great victory over the Saxons, Dewi is said to have ordered the soldiers to place leeks in their caps.

LEE MAGAZINE-GUN.—This gun, patented in 1879 in Europe and America, is entirely novel in principle and not only obviates all the objections found in tubular magazine systems, but has numerous and marked advantages peculiar to itself. The arm is of the bolt class, which years of use in the armies of Russia, France, Italy, Prussia, and other great powers, has proved to possess all the essential qualities of a military weapon. The drawing gives a sectional view of this gun with the magazine in place, and it will be noticed that the parts are few in number. The resistance in this gun is direct, and is taken on both sides of the receiver; a lug being constructed on the lower side of the bolt and opposite the shoulder on the bolt handle, which locks itself firmly into a recess made for that purpose in the receiver, thereby affording an equal bearing on each side instead of on one side only, as in most other bolt systems. The extractor, also, is of new design, having direct action and great power.

notch cut on the extractor-spring next the shoulder of the bolt handle, the extractor-spring, Q, is pressed forward, releasing the hook on its under side, from the pin with which it engages when in place. This releases the extractor-spring and the extractor, and the bolt may then be drawn out of the receiver. By pressing forward and downward on the lug of the key-sleeve, F, it is released from the bolt, together with the thumb-piece, E, the firing-pin, C, and the mainspring, D. To assemble the bolt and its parts, the pieces, E, C, and D, are placed in their proper position, and the lug of the key-sleeve, F, is pressed upward into its locking-notch in the bolt. Returning the assembled bolt into its place in the receiver, lay the extractor in its notch on the bolt and place the extractor-spring in position, giving the bolt a sharp push forward, and the hook will engage itself on the pin on the bolt-rib created for the purpose, and the arm is ready for use. For simplicity, strength, ease of manipulation, rapidity and certainty of fire, this system is not excelled as a single fire breech-loader by any other in use.

To change this single fire breech-loader to a magazine arm, consists simply in introducing through a slot or opening cut through the stock and receiver, forward of the trigger guard, a magazine made to contain five (more or less) cartridges, which insertion or removal can be effected more quickly than a single cartridge can be loaded into or ejected from any ordinary single breech-loader. The magazine is held in place by the magazine catch, K, which engages into a notch or depression in the rear of the magazine, as shown in the drawing, and can be released in a moment by an upward pressure on the magazine catch, K, at its lower end, where it projects downward into the trigger guard. The magazine is retained so firmly and secure in position that it is impossible for it to become accidentally released, no matter how roughly the arm is used or how severe a shock it may receive. These magazines are pressed into shape from one piece of metal, and are strengthened by a rib made on their rear and bottom interior, which renders them, although weighing but about three ounces, strong and rigid enough to endure without injury any shock or blow liable to be received in rough service. They may be adapted to cartridges of any length. The cartridges are held



NOMENCLATURE.

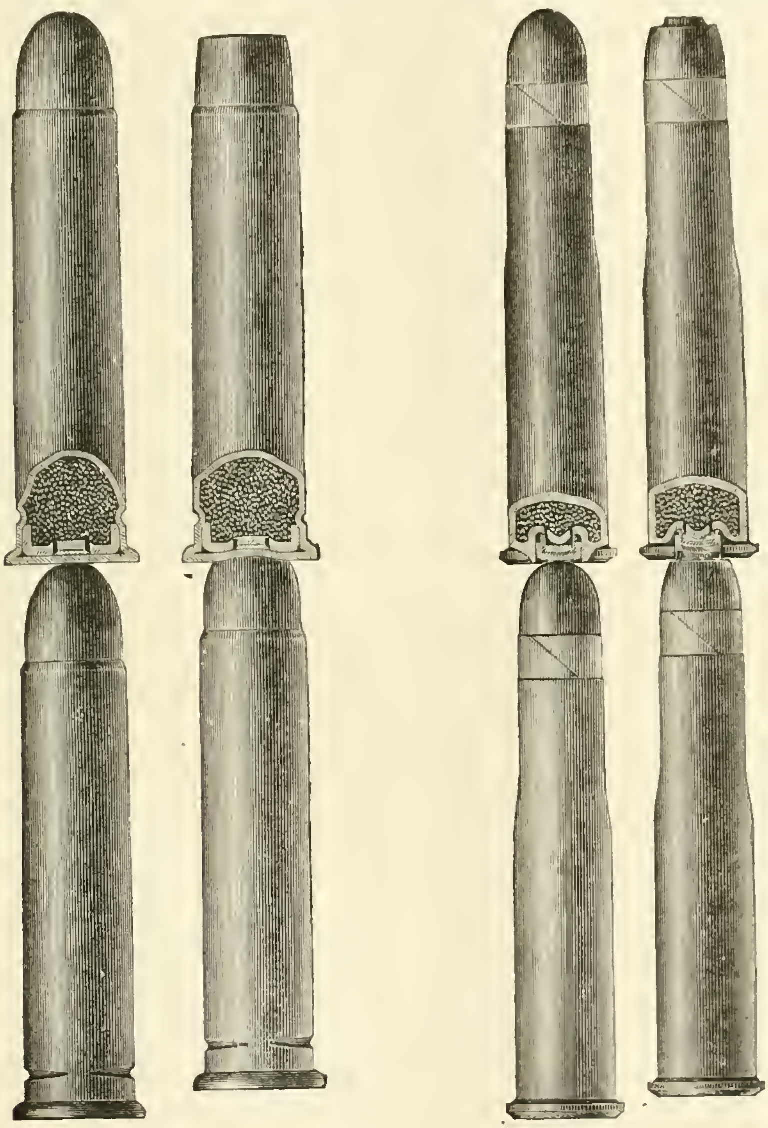
A. Receiver.
B. Bolt.
C. Firing-pin.
D. Main-spring.
E. Thumb-Piece.
F. Key-sleeve.
G. Extractor.
H. Sere.
I. Trigger.
K. Magazine-catch.
L. Sere-spring.
M. Magazine.
N. Magazine-spring.
O. Trigger-guard.
P. Stock.
R. Tang-screw.
S. Guard-screw.

The arm can be carried while loaded with perfect safety by withdrawing the thumb-piece, E, to the half-cock notch, which operation fixes the bolt firmly to its closed position, and locks the firing-pin backward clear from the cartridge until the thumb-piece is drawn back to full-cock, when the piece may be fired. The ease and rapidity with which this arm can be dismounted and assembled is noticeable. By inserting the point of a knife or screw-driver into the

in a nearly horizontal position, the flange or head of each being in advance of the one below it, as shown, rendering it impossible for anything to impinge upon the primer of either cartridge, and thus obviating every possible danger of premature discharge in the magazine. The cartridges are fed upward into the system by the magazine spring, N, as required, and being held strongly in position, no deformation of the bullet is possible. By actual experiment, the bullet of cartridges so held, and exposed to the recoil received from one hundred shots fired in the arm, showed no diminution in length.

The simplicity of the magazine mechanism proper of this arm is unequalled and remarkable, consisting only of three pieces — the magazine, M, the magazine-spring, N, and the magazine-catch, K, and *incidentally*, a small spring which operates in a slot in the side of the receiver, and projects over the opening through which the cartridges pass upward from the magazine, forming a bottom to the receiver, while the arm is being used as a single loader. The complexity of the magazine mechanism in most repeating arms, with the consequent liability to breakage or derangement, has been one of the objections offered to their adoption for military purposes. When the magazine is put into place (accomplished either by pressure or by a sharp tap of the hand), the head of the upper cartridge is relieved of its tension against the inclined flanges on the rear and upper part of the magazine, by its pressure against the under side of the bolt, B (the upper edge of the rear wall of the magazine being slightly hollowed to the shape of the bolt). The rearward motion of the bolt in opening the breech draws back the upper cartridge, relieving its front end from the hemispherical depression in which it rested; the spring, N, lifts the bullet end of the cartridge upward, and free from the magazine, the bolt moving backward just far enough to allow its front end to pass in rear of the head of the cartridge, which head, thus relieved, rises by the pressure of the spring, N, sufficiently to engage the end of the bolt. The forward movement of the bolt then carries this cartridge into the chamber of the barrel. On opening the system and withdrawing the bolt, the extractor ejects with certainty the exploded shell, and the same operations apply until the magazine is exhausted.

It is intended that two or more magazines shall be furnished with each arm, which are to be carried, charged, in the cartridge box or pocket of the soldier. The magazines can be charged with cartridges (five is the number recommended that they shall contain), each in less than five seconds. It is quite practicable that all ammunition issued to troops be contained in these magazines, which may be made, if required, very light, of skeleton form, and of such cheap construction as will admit in action of their



A B C D

being dropped and left on the field, as are the exhausted shells of expended cartridges. The arm can be used as a single loader until the need of rapid firing becomes apparent, when at the word of command, the charged magazines may be inserted and used. The least intelligent soldier can obey this order without looking at the arm. While removing or inserting the magazine, the arm should be held firmly at the grip by the soldier's RIGHT hand, in a vertical position. It is believed that the feature of *detachability*, as arranged in the Lee system, will particularly commend itself to the minds of military authorities. The ease, rapidity, and certainty, with which the charged magazines can be inserted into, or removed from the arm, places it in the power of the officers of disciplined troops to positively control the expenditure of ammunition. The soldier may use his arm as a single loader until the vital moment when a rapid fire is needed. At the order a loaded magazine can in an instant be inserted, and a volley of five, to be immediately succeeded by five, ten, or fifteen more shots (if as many as four magazines be supplied), rapidly delivered. It will require but little drill to teach the ordinary soldier to deliver twenty-one well directed shots from this gun in forty seconds. Experts at the Armory fire that number easily in *thirty* seconds. Using the *detachable magazines*, the necessity of all *cut-off* appliances is obviated, and the danger of the soldiers becoming so confused in the heat and excitement of action as to err in the proper adjustment of the cut-off, need not be feared.

This arm possesses evident advantages over all magazine-guns having tubular magazines, placed under or above the barrel, or in the butt-stock. In such magazines the cartridges ride lengthwise, one following another; the bullet of one coming directly in contact with and resting on the primer of the cartridge next it. All of the cartridges are forced toward the breech mechanism by a spiral spring, which must be of sufficient strength to support the weight of the column of cartridges, and force them into the receiver or breech of the arm as fast as required, and of necessity it must have very considerable stiffness or strength. A French army cartridge, which is about the average weight of military cartridges in use, weighs more than $1\frac{4}{10}$ ounces. The weight of a column of five such cartridges would be seven ounces, four-fifths of which weight would in a tubular magazine, rest upon the point of the bullet of the last cartridge, and which bullet comes directly in contact with the primer of the cartridge in advance of it. Add to this compressive force the possibility of the cartridge having extra sensitive primers, and the soldier or marksman may reasonably shrink from the possibility of an accident which would probably kill, or maim for life. It is hardly necessary to allude to the demoralizing effect a single instance of premature explosion of a cartridge contained in the tubular magazine of a military weapon would have upon the soldiers of a command armed therewith. Such an accident would probably at least seriously wound the operator, and the knowledge that such casualties are possible would cause the men to shrink from bringing their arms to the shoulder, and if fired at all, their guns would be held at arm's length, as far as possible from the person, without aim or probable effect.

Another serious disadvantage pertaining to all tubular magazine systems, is the unavoidable deformation of all cartridge bullets carried therein. In the drawing, A, shows perfect cartridges (with inside primers), as in position while contained in a tubular magazine-rifle, at "Order Arms"; B, shows one of the cartridges with its head depressed, the fulminate of the inside primer compressed, and the bullet flattened. C, shows perfect cartridges (with outside primers) as in position while contained in a tubular magazine-rifle at "Order Arms"; and D, shows one of the cartridges with its bullet flattened and compressed ($\frac{12}{100}$ of an inch), and the primers deformed; the deformity in each case being due to the recoil of 100 rounds. Even the ordinary jolting incident to an infantry march, greatly aggravated in the case of cavalry, will in a short time so batter and deface the point of the lead bullet—thus increasing its diameter—as to materially impair its accuracy in flight, besides rendering it difficult to force it into place in the chamber of the barrel, and with the possibility of wedging the enlarged bullet so tightly into the chamber—the cartridge being only part way home—that any attempt to withdraw the charge may separate the bullet from the cartridge case, leaving the lead jammed into the chamber, removable only by use of a rammer introduced through the muzzle. The soldier, baffled and confused by any failure of his arm—which failure is liable to occur at the supreme moment which decides the fate of battle—will be less efficient than if armed with the obsolete muzzle-loader, which, although slow, is supposed to be tolerably sure. A final objection to all tubular magazine systems is that the balance of the arm is constantly being changed. Each cartridge expended from the magazine alters the relative weight which one extremity of the arm bears to the other, and must radically affect the accuracy of the soldier's him. See *Magazine gun.*

LEFAUCHEUX GUN.—A breech-loading gun of peculiar merit. The under-guard of the barrel formed of two pieces of iron having a joint, is maintained in a right line by a rigid plate which supports it. This plate may be made to revolve on its axis with a horizontal backward and forward movement, by the action of the hand, when it withdraws its support from the under-guard, which forthwith yields and severs the breech from the rest of the barrel. The chamber which is to receive the cartridge thus is exposed and the piece is loaded. The cartridge itself at its base is provided with a large cap, from which projects a pin or small nail; this fits an opening in the breech of the gun, and the hammer strikes it and so fires the piece. To breech-loading military rifles constructed on the Lefaucheux system it would be impossible, or at least impracticable, to add the bayonet; for the use of the bayonet in actual conflict would be almost certain to lead to a complete separation of the two parts of the piece.

LEGATE—LEGATION.—As commonly used in modern times the word Legate is applied to the person charged by the Pope of Rome to represent him, or the Roman Church, at the seat of Government of a foreign country, or at the seat of a bishopric of the Church. But the word need have no such restricted use. It was employed by the Romans under the Republic, before the Church controlled Rome, to indicate any person sent by the Government on a special mission of importance to another Government, or even to a Conquered Province; when a Legate frequently became acting Governor by virtue of such commission. *Legatus* among the Romans was a synonym of Ambassador. Envoy Extraordinary, Legate, Ambassador, are three words signifying nearly the same thing: the first two indicating a fresh or special appointment for a specific object, and the last a more permanent mission. The term Legation includes all that appertains officially to the position of a Legate, an Ambassador, or an Envoy Extraordinary, viz., his Secretaries, Attaches, Family, and Residence. We speak of the Residence of the American Legation, but by "A call at the Legation" one may mean a call on any officer or any of the families of the officers of the Legation, meaning then by Legation the seat of residence of its members.

LEGION.—A legion in the Roman military system, corresponded in force and organization to what in modern times we should call a *corps d'armée*. It differed in constitution at different periods of Roman history. In the time of the Republic, a legion composed 4,500 men, thus divided: 1,200 *hastati*, or inexperienced troops; 1,200 *principes*, or well-trained soldiers; 1,200 *velites*, or skirmishers; 600 *triarii*, or *pila-*

ni, veterans forming a reserve; and 300 *equites*, knights who acted as cavalry, and belonged to families of rank. During this period the legions were formed for the season, standing armies being of later growth. The hastati, principes, and triarii, formed three separate lines, each divided into 10 *maniples* or companies, 120 men each in the case of the two front lines, and 60 men in the triarii. A maniple was commanded by a Centurion or Captain, who had a Second Centurion, or Lieutenant, and two Sub-officers, or Sergeants, under him: as non-commissioned officers, there was a *Decanus*, or Corporal, to every squad or tent of ten men. The senior Centurion of each line commanded that line, and had therefore functions corresponding to a modern Lieutenant-colonel. The *primipilus*, or senior Centurion of the triarii, was the most important regimental officer, and commanded the legion in the absence of the Tribunes. The 300 cavalry formed a regiment of ten *turmæ*, or troops of 30 horsemen, each under three *Decurions*, of whom the senior had the command. The velites were light troops, not forming part of the line of battle; had apparently no officers of their own; and were attached to the 30 maniples in equal proportions. The Staff of the legion consisted of six Tribunes, who managed the paying, quartering, provisioning, etc. of the troops, and who commanded the legion in turns for a period each of two months. This command, although inconvenient, lasted till the times of the civil wars, when a *Legatus*, or Lieutenant-general, was appointed a permanent Commandant of the legion. The offensive weapons of the hastati and principes were two barbed iron-headed javelins, one of which was hurled at the enemy on the first onslaught, while the other was retained as a defense against cavalry. The triarii had long pikes. In addition to these arms, every soldier bore a very short, strong, cut-and thrust, two-edged sword. The legionaries' defensive armor consisted of a plumed hemlet, breastplate, iron-bound boot for the right leg, and a semi-cylindrical shield 4 feet long by 2½ broad. The velites had no defensive armor, were lightly armed, and in action usually operated for flanking purposes. Each maniple bore an ensign aloft, and each legion had its distinguishing eagle. Up to the time of Marius, service in a legion was sought as honorable occupation, and men of some means were alone eligible; but Marius enlisted slaves, and turned the legions into corps of a purely mercenary army. At the same period, the manipular formation was abolished, the three lines were assimilated, and the legion was divided into 10 cohorts, each of three maniples. Soon the cohorts were raised to 600 men, making the legion 6,000 infantry, besides cavalry and velites. It was ranged in 2 lines of 5 cohorts each; but Cæsar altered the formation to 3 lines, of respectively 4, 3, and 3 cohorts. During the latter Empire, the legion became complex and unmanageable; many sorts of arms being thrown together, and balistæ, catapults, and onagers added by way of artillery. Having so degenerated from its pristine simplicity and completeness, the legionary formation was soon overthrown amid the incursions of the victorious barbarians. See *Thundering Legion*.

LEGIONARII.—The second of three classes of soldiers in the Roman Army; the soldiers of the legions.

LEGION OF HONOR.—An Order of merit instituted under the French Republic in 1802 by the First Consul, as a recompense for military and civil services. It was ostensibly founded for the protection of republican principles and the laws of equality, and for the abolition of differences of rank in society, every social grade being equally eligible; but its real aim doubtless was, by popularizing the idea of personal distinction, to pave the way for establishment of the Empire and of the more exclusive titles of nobility that were to accompany it. The proposal for its institution was at first violently opposed by the legislative body and the tribunate, on democratic grounds, and carried eventually by a very narrow majority. The Order originally comprised three classes—Grand Officers, Commanders, and Legionaries. The class of Grand Officers was, on the coronation of Napoleon I., divided into Knights of the Grand Eagle (the highest class), and Grand Officers. On the restoration of the Bourbons, the legion was retained, but remodeled so as to lose much of its original character. The eagle was called a cross, and the effigy of Henry IV. replaced that of Napoleon. The Knights of the Grand Eagle became Grand Crosses, the Legionaries were transformed into knights, and the numerous educational institutions, founded by Napoleon for the children and relatives of the members of the Order, were much reduced in scale. In 1837 a new military class called Officers was admitted. Under the presidentship of Louis Napoleon, part of the property of Louis Phillippe, which had been restored to the State, was set apart as an endowment for the legion, and new regulations were made regarding the pensions of the different classes. The original form of decoration was reintroduced, which under the Second Empire was somewhat modified. As worn then, it consisted of a cross of ten points of white enamel edged with gold, the points connected with a wreath of laurel proper, and in the center, with an azure circle charged with the words "Napoléon III., Empereur des Français," was a head of the Emperor. The cross is ensigned by the imperial crown of France, and worn attached to a red ribbon. The Grand Officers also, as a general thing, wore on the right breast a silver star charged with the imperial eagle. The same star was generally worn on the left breast by the Knights Grand Cross, and their cross was attached to a broad red ribbon which passes over the right shoulder. The vast numbers of this Order, and the insignificance of many of the persons on whom it has been conferred, have detracted much from its value. The number of members in 1872 was 69,179; but the law passed in that year, that only one new member should be added for every two vacancies, reduced the membership in the next five years (1877) to 59,208. The revenue of the College of the legion has been augmented by the addition of property belonging to Louis Philippe. Out of this fund pensions are paid to those members of the Order who have served in the Army or Navy; the civilian members receive no pension. By the existing statutes, candidates in times of peace must have served in some military or civil capacity for 20 years; exploits in the field or severe wounds constitute a claim in time of war. Two distributions take place in the year. The nomination of military persons takes place on parade, and of civil in the Courts of Justice. No ignoble punishment can be inflicted on a member of the Order so long as he belongs to it. To rise to a superior rank, it is indispensable, at least for natives of France, to have passed through the inferior grades.

LEGS.—Human legs are not unfrequently borne as charges in Heraldry, sometimes naked, sometimes booted, and they may be coupled, *i. e.*, cut evenly off, or erased, cut with a jagged edge, and that either at the thigh or below the knee. The knee when represented is always embowed. A remarkable device of three legs in armor, conjoined at the thighs, and flexed in triangle, forms the insignia of the ancient Kingdom of Man, with the appropriate motto, *Quocunque jeceris stabit*. The classical symbol of the Island of Sicily (Trinacria) was formed of three naked legs similarly conjoined, and the triple-mountained Isle of Man might have awakened in its Norman Sovereigns some recollections of their Mediterranean conquests.

LELEGES.—An ancient and warlike people which peopled the Islands of Ægean, and is supposed to have been of Pelasgic origin. Authorities differ as to its exact identity, some having confused the Leléges with the Carians, with whom they are said to have united in support of the Trojans. Homer represents Altes, King of the Leléges, as having been the father-in-law of Priam. Pausanias considers Lelex, the founder of this race, to have been a foreigner from Egypt, and that he became King of Megara. According to this authority, the grandson of Lelex, Pylus by name, founded the city of Pylus in Messenia with a colony of Megarian Leléges. The last that is recorded of the Leléges is that they joined the Carians in colonizing the west coast of Asia Minor.

LENGTH OF BORE.—The *slow rate* of burning of mealed powder, which was originally used in cannon, led to the belief that the longest pieces gave the greatest ranges. In spite of much experience to the contrary, this belief was entertained, even after gunpowder received its granular form; and several pieces were made of enormous length, with the expectation of realizing corresponding ranges. A culverin was cast during the reign of Charles V. which was 58 calibers long, and fired a ball weighing 36 lbs.; but on trial, this piece was found to have actually less range than an ordinary 12-pdr. gun. The experiment of reducing its length, by successively cutting it off to 50, 44, and 43 calibers, was tried, and it was found that the range increased at each reduction until it gained 2,000 paces.

That the length of the bore has an important effect on the velocity of the projectile, will be readily seen by a consideration of the forces which accelerate and retard its movement in the piece. The *accelerating* force is due to the expansive effort of the inflamed powder, which reaches its maximum when the grains of the charge are completely converted into vapor and gas. This event depends on the size of the charge, and the size and velocity of combustion of the grains. With the same or constant accelerating force, the point at which a projectile reaches its maximum velocity depends on its density, or the time necessary to overcome its inertia. The *retarding* forces in action, are—1st. The friction of the projectile against the sides of the bore: this is the same for all velocities, but is very different for all the different metals; 2d. The shocks of the projectile striking against the sides of the bore: these will vary with the angle of incidence, which depends on the windage, and the extent of the injury due to the lodgment and balloting of the projectile; 3d. The resistance offered by the column of air in front of the projectile: this force will increase in a certain ratio to the velocity of the projectile and length of the bore. As the accelerating force of the charge increases up to a certain point, after which it rapidly diminishes, as the space in the rear of the projectile increases, and as the retarding forces are constantly opposed to its motion it follows, that there is a point where these forces are equal, and the projectile moves with its greatest velocity; it also follows that, after the projectile passes this point, its velocity decreases until it is finally brought to a state of rest, which would be the case in a gun of great length. The length of bore which corresponds to a maximum velocity depends upon the projectile, charge of powder, and material of which the piece is made; and taking the caliber as the unit of measure, it is found that this length is greater for small-arms which fire leaden projectiles than for guns which fire solid iron shot, and greater for guns than for howitzers and mortars, which fire hollow projectiles. It may be broadly stated that with suitable powders, the following relations should exist between the charge and the length of bore, in order that there may be a profitable use of the charge:—

Charge.	*Length of bore.*
$\frac{1}{3}$ the weight of shot.	About 26 calibers.
$\frac{1}{2}$ " " " " . . .	" 30 "
$\frac{2}{3}$ " " " "	" 35 "

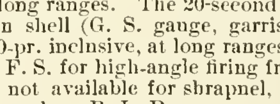
In each case a greater length of bore would give increased velocity, but it would be obtained at the expense of additional weight, which can be better utilized elsewhere in the gun. See *Cannon.*

LENGTH OF CANNON.—In smooth-bore guns, the distance between the rear of the base ring and face of the muzzle, measured in a line parallel to the axis. The length of B. L. R. guns is measured from behind the breech to the face of the muzzle, the breech screw not being included, and the length of M. L. R. guns from the neck of the cascable to the face of the muzzle. The length of a mortar is the whole distance from face to breech, measured along the axis. The length of guns is sometimes expressed by their calibers; but this, except with smooth-bore guns, is a very inaccurate method of comparing the lengths of rifled guns. To say with smooth-bore guns that they were so many calibers long, was sufficiently accurate, because the weight of charge and shot was always in proportion; but with rifled guns, which not only differ in this respect very greatly from smooth-bore guns, but even among themselves, to speak in this manner is very misleading. A 68-pr. gun has about the same length of bore as the 8-inch rifled gun, and is consequently the same length in caliber; but, as the charge of the latter is double that of the former, the number of expansions with an 8-inch gun is only half of what it is with a 68-pr. The more scientific way, is to designate the length of bores by the number of expansions of the charge.

LENGTH OF FUSE.—This expression has reference to the period a fuse is required to burn, the time being determined by the range. Fuses (time), such as are used with M.L.R. English guns, burn a certain number of seconds, viz., 5, 9, and 20 seconds respectively. The use and object of these different fuses are as follows: The 5-second fuse is used with shrapnel shell (G. S. gauge), up to the 80-pr. inclusive. This fuse is very necessary for F. S. shrapnel shell, which must be burst with great accuracy to develop its power. The 9-second fuse is used with common and shrapnel shell (G. S. gauge), up to 80-pr. inclusive, at long ranges. The 20-second fuse is used for common shell (G. S. gauge, garrison service), up to the 80-pr. inclusive, at long ranges. It is only used in the F. S. for high-angle firing from the 7-pr. gun. It is not available for shrapnel, as it has no powder-channels. B. L. R guns use fuses of the same lengths as above. The following will be found, as a general rule, nearly correct for getting the length of fuse with muzzle-loading rifled guns. Divide the number of hundreds of yards in the range by 2, and add 1 up to 1,000 yards, 2 up to 2,000 yards, and so on, for length of fuse in tenths of inches.

LENGTH OF PROJECTILES.—This length necessarily varies in the different descriptions of projectiles for the same gun, inasmuch as it is to some extent subordinate to the consideration of bringing them all (with certain exceptions) to the same weight, but it has been decided that a length of two calibers at least is necessary for very accurate shooting, and it is desirable for good *vis viva*, or destructive effect on impact, at any but very short ranges, to have the weight great in proportion to the caliber, or in fact to the surface of resistance, and of course this is favored by an increased length of projectile.

LENS.—A circular section of any transparent substance, having its surfaces either both spherical, or



one of them plane and the other spherical. A ray of light in passing through a lens is bent towards its thickest part; hence lenses are either convex (thickest in the middle) or concave (thickest at edges). The former make the rays more convergent than before, the latter make them more divergent. The point to which the rays converge, or from which they diverge, is called a focus—principal focus when the rays are parallel. The focus for a convex lens is real, i.e., the rays actually pass through it, and form an inverted image smaller or larger than the object according as the object is at a distance greater or less than twice the principal focal length; but the image is erect and magnified if the object be within the principal focal length. For a concave lens the focus is virtual—the rays seem to come from it and form an erect image smaller than the object.

The lenses in the drawing, though they may be of the same focal length, have peculiar properties which render them suitable for particular optical instruments; thus, the convexo-plane lens has only one-fourth of the aberration of a plano-convex, or two-thirds of an equi-convex or equi-concave of the same focal length; but, in general, the equi-convex is the most desirable form. Aberration has been to opticians what refraction is to the astronomer, an unwelcome intruder, which spoils his finest theories, and limits the accuracy of his results. This aberration has, indeed, been destroyed by combining lenses of equal and opposite aberrations, as for instance, uniting, by means of Canada balsam, a double convex with a double concave. A still better method would be the formation of lenses having one side spherical, and the other of an ellipsoidal or a hyperboloidal form; but this has not yet been successfully accomplished. Convex lenses of glass, rock-salt, ice, etc., may be used as "burning-glasses," since radiant heat is refracted according to the same laws as light—the hot focus being nearly coincident with the luminous one. Platinum, gold, etc., have been fused in three or four seconds by this means.

LEOPARD.—The leopard has been described by some Heralds as the issue of the pard and lioness; and the circumstance that such hybrids are unproductive, is assigned as a reason for appropriating that animal to the armorial ensigns of Abbots and Abbesses. However, the representations of leopards, at least in English Heraldry, are so exactly like those of the lion passant gardant, that it has been made a question whether there is any difference between the two, and it has more especially been a keenly-contested point whether the three animals in the royal escutcheon of England were lions or leopards. In early times we find them blazoned in both ways, and the true solution of the *quæstio vexata* seems to be, that at one period the heraldic leopard came to be considered as a mere synonym for the lion passant gardant, though the two animals were originally regarded as distinct. In the infancy of Heraldry, before distinctive appellations were invented for the different attitudes of animals, it was customary to draw a lion in the attitude since called rampant, and a leopard as passant gardant. This difference of position sufficiently indicating which animal was meant, they were otherwise similarly represented, and no attempt was made to exhibit the spots of the leopard. By and by, as coats of armor were multiplied, it became necessary to difference them by varying the position of the animals depicted; and the blazoners of those days, thinking more of attitude than of zoology, had recourse to a compromise in their nomenclature. The lion was naturally supposed to be rampant and in profile, the leopard passant gardant. When the conventional animal that might stand for either was passant and in profile, he was designed a *lion-leopardé*; and when rampant gardant he was a *leopard-lionné*. The king of beasts was very early assumed as his appropriate insignia by the Sovereign of England, as well as by the Sovereigns of other countries in western Europe. The lion was at first borne singly, and his natural attitude, like that of other lions, was considered to be rampant. But when a second and third lion were added, it became less convenient to draw them in the rampant attitude, and the lions became lions-leopardé or passant, as seen in the seal of King John; a further change of position to passant gardant made them heraldically leopards. Edward III., Edward the Black Prince, and Richard II., speak of their crest of the leopard. Nicholas Serby was designated Leopard Herald in the reign of Henry IV.; and it was not till the middle of the 15th century that the lions of England regained their original name. Though leopards, properly so called, hardly occur in English Heraldry, having passed into lions passant gardant, their heads or faces are occasionally borne. If no part of the neck is shown, the proper blazon is a leopard's face; if a portion of the neck is drawn, it is a leopard's head, erased or couped, according as it is cut off evenly or with a jagged edge.

LESGHIANS. A body of 300,000 people, inhabiting the mountains of western Daghestan in the Caucasus (Asiatic Russia), and speaking various languages. For many years they made a brave resistance to Russian aggression. Since 1859 they have been peaceable. Their religion, a modification of Islamism, is called Muradism, and was founded about 1830 by a native Prophet.

LESSE. A machine covered with rawhides, used as a mantelet by the ancient Greeks for different purposes.

LETTER BOOK.—A book containing the entry of all official letters written by the Commanding Officer, or under his direction, to the public departments, and to individuals, on regimental business. It contains an alphabetical index, and a separate index for the public departments. It need not be preserved beyond three years, after it is completed, care being taken to keep copies of such letters as may be likely to be required for reference.

LETTER OF MARQUE.—The commission authorizing a Privateer to make war upon, or seize the property of another nation. It must be granted by the Lords Commissioners of the Admiralty, or by the Vice Admiral of a distant Province. Vessels sailing under such commissions are commonly spoken of as *Letters of Marque*. Making war without Letters of Marque by a private vessel, is piracy. Letters of Marque were abolished among European nations at the Treaty of Paris, in 1856.

LETTRE DE PASSE.—A paper which was formerly signed by the Kings of France, authorizing an officer to exchange from one regiment to another.

LETTRES DE CACHET.—The name given to the famous warrants of imprisonment issued by the Kings of France before the Revolution. All Royal Letters (*Lettres Royaux*) were either *Lettres Patentes* or *Lettres de Cachet*. The former were open, signed by the King, and countersigned by a Minister, and had the great Seal of State appended. Of this kind were all ordinances, grants of privilege, etc. All Letters Patent were registered, or *enterinated* by the Parliaments. These checks on arbitrary power did not exist with regard to Lettres de Cachet, also called *Lettres Closes*, or sealed letters, which were folded up and sealed with the King's little seal (*cachet*), and by which the Royal pleasure was made known to individuals or to corporations, and the admistration of justice was often interfered with. The use of Lettres de Cachet became much more frequent after the accession of Louis XIV. than it had been before, and it was very common for persons to be arrested upon such a warrant, and confined in the Bastile, or some other State Prison, where some of them remained for a very long time, and some for life, either because it was so intended, or, in other cases, because they were forgotten. The Lieutenant General of the Police kept forms of Lettres de Cachet ready, in which it was only necessary to insert the name of the individual to be arrested. Sometimes an arrestment on Lettres de Cachet was a resource to shield criminals from justice.

LEVEE.—This term originally meant visits of ceremony paid in the morning among persons of rank. It is now understood to mean an assembly at Court, on state occasions, of those of Her Majesty's subjects who are entitled to the privilege of presenting themselves before the Sovereign. The privilege of holding levées is also accorded to Her Majesty's representatives at home and abroad, to the Field Marshal Commanding in Chief, and other high Functionaries.

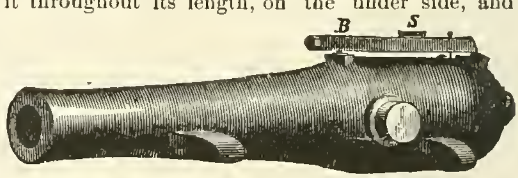
LEVEE EN MASSE.—A general rising of the people of any country, either for the purpose of self-defense, or to answer the intention of its governing powers. See *Levy*.

LEVELERS.—A party which arose in the army of the Long Parliament, when it overawed that body, and sent the King to Hampton Court in 1647. They determined to level all ranks, and establish an equality of titles and estates througout the Kingdom. Several of the officers belonging to this party were cashiered in 1649, and on the departure of Cromwell for Ireland, at the close of that year, they raised mutinies in various quarters, and were put down by Fairfax with bloodshed. They were not only treated as traitors by the King, but persecuted by Cromwell as dangerous to the State. In politics their fundamental principles included: 1. The impartial authority of the law; 2. The legislative power of Parliament; 3. Absolute equality before the law; 4. The arming of the people for securing the enforcement of the laws, and the protection of their liberties.

LEVELING.—Level is a term applied to surfaces that are parallel to that of still water, or perpendicular to the direction of the plum-line; it is also applied to the instrument employed in determining the amount of variation from perfect levelness. The instrument ordinarily is a cylindrical glass tube very slightly convex on one side, and so nearly filled with water, or what is better, with alcohol, that only a small bubble of air remains inside. The level is then mounted on a three or four legged stand, with its convex side upwards, and by means of a pivot and elevating screws, is made capable of assuming any required position. If the level be properly constructed, the bubble should lie *exactly* in the middle of the tube when the instrument is properly adjusted, and, at the same time, the line of sight of the telescope attached to the level should be accurately parallel to the surface of still water. In ordinary levels, this first condition is seldom seen, and, instead, two notches are made on the glass to mark the position of the two extremities of the bubble when the instrument is level. The tube and bubble should be of considerable length to insure accuracy. A very handsome level of precision, constructed by Fauth and Company, United States, for the Coast and Geodetic Survey, is employed for the most exact work. It can also be used as a gradienter, the micrometer screw for raising or depressing the telescope being made with the utmost exactness, and being provided with a graduated head. The telescope has an aperture of 1½ inches, and 16 inches focus, with two astronomical eye-pieces, magnifying 40 and 60 times respectively. The pivot-rings are of phosphor-bronze, and rest on agate. The striding level is chambered, and one division equals 3 seconds of arc. The horizontal circle, of five inches diameter, divided on silver, reads to 30 seconds; the center is of steel; clamp and spring tangent motion.

Custom has established the measurement of absolute levels from the average surface of the ocean—the mean between high and low water—as the zero level; when reckoned from any other zero level, they are relative levels. Leveling, or finding the difference between the levels of two or more points, is designated by the term hypsometry in geodesy. There are three principal and independent methods of leveling. The first depends upon the fact that the surfaces of fluids at rest are perpendicular to the direction of the force of gravity; upon this is based the common level. In the second method, trigonometrical leveling, we must know, first, the zenith distance, or the angle between the zenith of the station and the object whose height we wish to find (making a correction for the effect of refraction,) and, second, we must know or accurately determine the horizontal distance from the station to the object determined usually by triangulation. In accurate work a careful adjustment of the theodolite, the instrument used in this method, is necessary. Local attraction sometimes causes a deflection of the plumb-line, thus affecting measurements of zenith distance. Atmospheric refraction is a more important element of uncertainty, for which reason the horizontal distance should not exceed 12 or 15 miles. The coefficient of refraction is irregular, and varies with the temperature and pressure of the atmosphere; it is most steady and nearest its minimum between 10 A. M. and 2 P. M. From the above data, the difference in level is easily calculated. The weight of the atmosphere bearing upon a unit of surface diminishes in a geometrical progression as the heights increase in an arithmetical progression; therefore, by the third method, heights are determined with the barometer. Physicists have constructed numerous formulæ embodying the law of Mariotte, and introducing corrections for temperature, expansion of air, and the effect of latitude and height upon the action of gravity. It is believed that considerable accuracy can be attained by this method, particularly if the annual means of temperature and pressure for the stations whose difference in level it is desired to find are substituted in the formulæ. Aneroid barometers have been graduated to indicate heights up to 12,000 or 16,000 feet; they give only approximate results. If a delicate apparatus for determining the boiling point of water be used, the corresponding heights taken from a table will give the reading of the barometer at that point, so that the instrument itself can be dispensed with. This depends upon the fact that the boiling-point of water decreases as the pressure of the atmosphere becomes less. Ses *Theodolite* and *Y Level*.

LEVELING BAR.—A square steel bar with parallel faces, somewhat longer than the distance between the sights on the largest gun. The rear end is bevelled at an angle of 60°, the angle at which the sight is placed. It has a central line marked on it throughout its length, on the under side, and



along the bevelled end. It has also marked on its sides, near the forward end, the distance at which the sights should be placed for each class of gun. It is also fitted with screws for bringing it to a level. The leveling-bar being laid on the front sight, and its bevelled end taking against the rear sight-bar, bring it to a level with the spirit-level and screws. This will give the true guide for angle of rear sight-bar, and the latter's proper plane. As soon as rear sight-box is fitted, bore hole for same through rear sight-mass. The hole is bored with the rear sight-box *on*, and the latter is kept down in its place by a sling around cascabel set up by a handspike. The rear sight being fitted true as to the leveling-bar, again level the arm of sighting-tompion, and stretch the thread back over the gun, this time bringing the thread to the exact middle of the rear sight-notch. Now, in theory, the thread ought to come directly over the inital point of the base-ring, and over the mark already accurately laid off on the front sight-mass; but practically this is never the case, as it is *almost impossible* to fit a rear sight-box so true as to bring the middle of the sight-notch in the exact line of sight already laid off. It will be found, upon stretching the thread the second time, that it will fall a trifle one side or other of the initial point on base-ring. So, virtually, it is necessary again to lay off a line of sight. With a measure take the distance that the thread falls to one side of the initial point on base-ring. Take this same distance that the thread is out, and lay it off horizontally on the cross-bar of the vertical sighting-arm. Of course, when the thread is also moved this distance on the sighting-arm, the thread will fall the same distance to one side on the front sight-mass; therefore mark this last point where the thread falls over the front sight-mass, and thus is established the second and final line of sight. Also mark the point where the thread now crosses the base-ring, and this is the final initial point to be marked for a full due on the base-ring. Where the thread crosses the front sight-mass, hold the front sight itself directly under the thread. When the front sight mass was lined out, at the same time with the rear sight-mass a regulation distance was given from base-ring to center of front sight-mass, and from this central point the mass was marked out and cut. See *Cannon Sights*.

LEVELING RODS.—The various leveling-rods used by American engineers are made in two or more parts, which slide from each other as they are extended in use.

these depressed surfaces are painted white, divided into feet, tenths and hundredths of a foot, and the feet and tenths figured. The front piece reads from the bottom upward to seven feet, the foot figures being red and an inch long, the tenth figures black, and eight-tenths of an inch long. When the rod is extended to full length the front surface of the rear half reads from seven to thirteen feet, and the whole front of the rod is figured continuously and becomes a self-reading rod thirteen feet long. The back surface of the rear half is figured from seven to thirteen feet, reading from the top down; it has a scale also by which the rod is read to two-hundredths of a foot as it is extended. The target is round and made of sheet-brass raised on the perimeter to increase its strength, and is painted in white and red quadrants; it has also a scale on its chamfered edge, reading to two-hundredths of a foot. When a level of less than seven feet is desired the target is moved up or down the front surface, the rod being closed together and

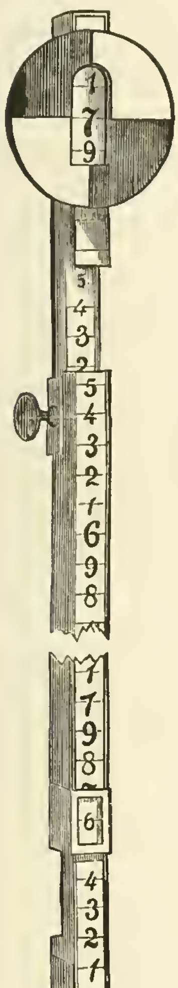


Fig. 1.

Fig. 2.

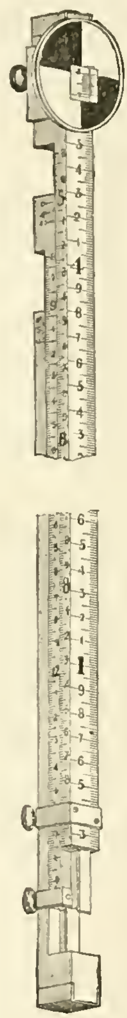


Fig. 3.

Fig. 4.

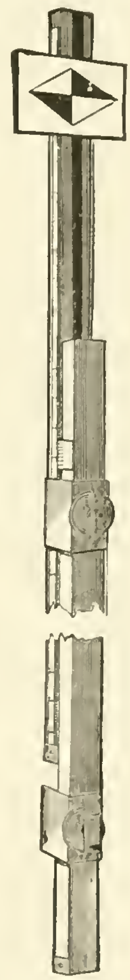


Fig. 5.

The *Philadelphia rod*, shown in Fig. 1, is made of two strips of cherry, each about three-fourths of an inch thick by one and a half inches wide and seven feet long, connected together by two metal sleeves, the upper one of which has a clamping-screw for fastening the two parts together when the rod is raised for a higher reading than seven feet. Both sides of the back strip and one side of the front one are planed out one-sixteenth of an inch below the edges; clamped; but when a greater height is required the target is fixed at seven feet and the rear half slid out, the scale on the back giving the readings like those of the target to two-hundredths of a foot.

The *Troy rod* shown in Fig 2. is a self reading rod up to six feet, or can be read by a vernier on the rear piece to thousandths of a foot as usual. It has two targets as shown, both fastened to the front half of the rod, the lower one having its center line just three-tenths above the end, and the target exactly six feet above the lower. There is a clamping piece with screw on the back of the rod below the target, by which the two parts are clamped together when desired. The face of the front piece is recessed like that of the Philadelphia Rod, painted white, divided to feet and hundredths, and figured as represented. The side of the front half is divided to feet and hundredths, read by a vernier on the top of the rear half to thousandths, and figured from the top downwards, beginning with three-tenths, that being the height of the center line of the lower target. When a level of less than six feet is taken on the rod the observation is made by the lower target, and the reading is direct as given on the side ; but when a greater height is taken the upper target is sighted upon, and six feet added to the reading on the side in every instance, and thus a reading up to twelve feet readily obtained.

The *New York rod* is made of maple, in two pieces, sliding one from the other, the same end being always held on the ground, and the graduations starting from that point. The graduations are made to tenths and hundredths of a foot, the tenth figures being black, and the feet marked with a large red figure. The front surface, on which the target moves, reads to about six and a half feet; when a greater height is required, the horizontal line of the target is fixed at the highest graduation, and the upper half of the rod, carrying the target, is moved out of the lower, the reading being now obtained by a vernier on the graduated side, up to an elevation of twelve feet. The mountings of this rod are differently made by different manufacturers. We shall give those which are mostly used. The target is round, made of thick sheet brass, having, to strengthen it still more, a raised rim, which also protects the paint from being defaced. The target moves very easily on the rod, being kept in any desired position by the friction of the two flat plates of brass which are pressed firmly against the two alternate sides, by small spiral springs, working in little thimbles attached to the band which surrounds the rod. There is also a clamp-screw on the back, by which it may be securely fastened to any part of the rod. The face of the target is divided into quadrants, by horizontal and vertical diameters, which are also the boundaries of the alternate colors with which it is painted. The colors usually preferred are white and red ; sometimes white and black. The opening in the face of the target is a little more than a tenth of a foot long, so that in any position a tenth, or a foot figure, can be seen on the surface of the rod. The right edge of the opening is chamfered, and divided into ten equal spaces, corresponding with nine-hundredths on the rod ; the divisions start from the horizontal line which separates the colors of the face. The vernier, like that on the other side of the rod, reads to thousandths of a foot. The clamp, which is screwed fast to the lower end of the upper sliding-piece, has a movable part which can be brought by the clamp-screw firmly against the front surface of the lower half of the rod, and thus the two parts immovably fastened to each other without marring the divided face of the rod.

Fig. 3 represents another form of this favorite rod, introduced by the Messrs. Gurley, United States. In this rod, a third or fourth piece is added to the two of the old rod, giving thus a rod of greater length, and at the same time making it more compact and portable. The divisions, the verniers, readings, and target are the same as those of the old rod. There are two varieties of the three-parted rod, one sliding to allow a reading of thirteen feet and the other extending to fourteen feet; the first when closed is only five feet long, the last but a little over five and a half feet. The four-parted rod is, when closed, but five feet in length, but can be extended to sixteen feet.

The *Architects' rod* is a very light and simple sliding rod made of maple, in two parts, each seven-eighths of an inch square, and when closed, about five feet six inches long. As shown in Fig. 4, the front half is divided on two sides to feet, tenths, and hundredths, reading by verniers on the target and side to thousandths of a foot. The target is smaller than those of the rods already described, but of sufficient size, and moves on the closed rod when levels of less than five feet and four-tenths are to be taken. When a greater height is needed the target is fixed at the highest division, the front half carried above the rear part and clamped at any point desired, by the clamp-screw, as shown, the height being now read off by the vernier on the lower half up to ten feet. This rod is adapted for use with any level, and is so light and efficient that we believe it will come into general use ; when it is to be used by an architect, the divisions are made in feet, inches and sixteenths, and no verniers are then required.

The *Boston rod*, shown in Fig. 5, is formed of two pieces of light mahogany or baywood, each about six feet long, and sliding easily by each other in either direction. One side is furnished with a clamping piece and screw, and a small vernier at each end, the other or front piece carries the target and has on each side a strip of satinwood inlaid upon which divisions of feet, tenths and hundredths are marked and figured. The target is a rectangle of wood fastened on the front half, is painted black and white, and has its middle line just three-tenths above the end of the rod. Each tenth of the rod is figured decimally in three figures or to hundredths of a foot, and by the verniers is read to thousandths. The target being fixed, when any hieght is taken above six feet, the rod is changed end for end, and the divisions read by the other verniers ; the height to which the rod can be extended being a little over eleven feet. This kind of rod is very convenient from its great lightness, but the parts are made too frail to endure the rough usage of this country, and therefore American engineers have generally given the preference to others, made heavier and more substantial.

In addition to the above, there is what is termed a *Telemeter rod*, formed of two pieces of pine, each three and a half inches in width, seven-eighths of an inch thick, and six feet long. Both sides of the rods are painted white, the inner surfaces being also recessed to protect the divided surface, with divisions in black of feet, tenths, and hundredths, and figured, the feet in red, the tenths in black. The two pieces are connected by a strong iron hinge, and folded in transportation; when in use, they are opened, laid flat, and joined firmly in line by a wooden bar, about eighteen inches long, held to each piece by two strong brass screws, which enter into metal sockets secured in each part of the rod. This is a self-reading rod, and is often used in connection with the micrometer wires to ascertain distances by a simple observation in the same manner as the Philadelphia rod.

A rod of English make is sometimes used, in which the two smaller upper parts slide out of a larger and lower one which answers as a case ; when closed the rod is five feet long, and extends to fourteen feet. It is divided on a recessed face to feet, tenths, and hundredths, the divisions being painted and figured like those of the Philadelphia and Telemeter rods. This is also furnished with divisions in meters, decimeters, and in centimeters ; length when closed one and a half meters, and sliding out to four meters. See *Y Level*.

LEVER.—This, the most simple and common, but, at the same time, most important of the seven mechanical powers, consists of an inflexible rod—straight or bent, as the case may be—supported at some point of its length on a prop which is called the *fulcrum*, and having the *weight* to be moved and *power* to move it applied at other two points. In the accompanying illustrations, AB is the lever, F the fulcrum, A and B the points of application of P and W, the power (or pressure) and weight respectively. If the arms AF and BF be equal, the power P and the weight W must also be equal to produce equilibrium; if the arm of the power, A F, be longer than the arm of the weight, BF, then, to produce equilibrium, the power P must be less than the weight W, and *vice versâ*; if AF be double the length of BF, then P, to produce equilibrium, must be half of W; and, generally, as is shown in the elementary treatises on mechanics, *the power and weight are in the inverse ratio of their distances from the fulcrum.* This is equally true for straight or bent levers; but the distance of the power and weight from the fulcrum is not, in all cases, the actual length of the arms, but the lengths of perpendiculars from the fulcrum upon the directions of the power and weight. The principle holds good, whatever be the relative positions of the power, weight and fulcrum; and as there can be three different arrangements of these, we thus obtain what are called "the three kinds of levers." *The first kind* (Fig. 1) is where the fulcrum is placed between the power and the weight; the balance, spade (when used for raising earth), the see-saw, etc., are examples of this; and scissors and pincers are examples of double levers

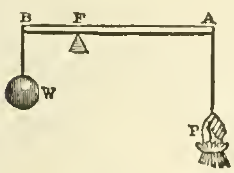


Fig. 1.

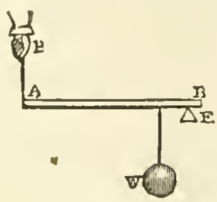


Fig. 2.

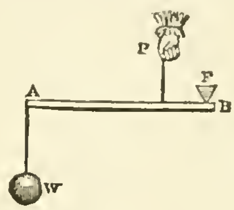


Fig. 3.

of the same kind. Levers of *the second kind* (Fig. 2) are those in which the weight is between the power and the fulcrum; examples of this are the crowbar, when used for pushing weights forward, the oar—the water being the fulcrum, and the row-lock the point of application of the weight—and the wheelbarrow; and of double-levers of this kind we have the nut-crackers as an ordinary example. In levers of *the third kind* (Fig. 3), the power is always between the weight and the fulcrum. Fishing-rods, whips, umbrellas, and most of the instruments used with the hand alone, are levers of the third kind; and shears, tongs, etc., are examples of double levers of this class. It is evident that, to produce equilibrium in levers of the first kind, the power may, according to the ratio of the lengths of the arm, be either greater or less than the weight; in the second kind it must always be less; and in the third kind, always greater. This is expressed in technical phrase by saying that the first kind of lever gives a *mechanical advantage* or *disadvantage*, the second always gives a mechanical advantage, and the third always a mechanical disadvantage. Levers of the second kind, having the same mechanical advantage, are, when

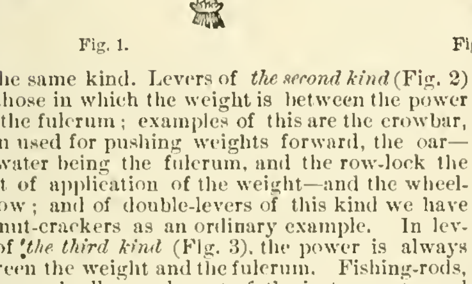


Fig. 4.

worked by man, twice as powerful as those of the first kind, because in one case he uses his muscular force as the power, in the other case only his weight. Levers of the third kind are used when velocity, or a large extent of motion, is required at the expense of power, and we consequently find this form much used in the structure of the limbs of animals. The structure of the human arm (Fig. 4), is a very good example of this; the fulcrum is the socket (C) of the elbow-joint, the power is the strong muscle (the *biceps*), which passes down the front of the *humerus*, and is attached at A to the *radius* (as shown); the weight is the weight of the forearm, together with anything held in the hand, the two being supposed to be combined into one weight acting at B. By this arrangement, a large extent of motion is gained, by a slight contraction or extension of the muscle.

When a large mechanical advantage is required, this may be obtained, without an inordinate lengthening of the lever, by means of a very simple combination of them. Here the levers have their arms in the ratio of 3 to 1, and a little consideration will make it plain that a power (P) of 1 lb. will balance a weight of 27 lbs.; but in this instance the particular defect of the lever as a mechanical power shows itself prominently; for if the weight has to be lifted 2 inches, the power requires to be depressed (2×27 or) 54 inches; and, as the extent of the power cannot be largely increased without inconvenience, the advantages of this machine are confined within narrow limits. See *Mechanical Powers.*

LEVER HITCH.—A knot similar to the drag-rope knot or woolding-stick hitch. It is used for tightening ropes, but instead of turning the woolding-stick round, it is applied on the principle of the lever.

LEVER-JACK.—An adjustable fulcrum with a lever fifteen feet long, used chiefly for greasing the axles of traveling carriages. It consists of a wooden stand, made of two uprights and framed into one bed. Two lever-plates (cast brass) are fastened to the large end of the lever by screws, and prevent the lever from slipping on the fulcrum-pin. See *Mechanical Maneuvers.*

LEVER-RING.—A wrought-iron ring, fitting on the circular part of the breech-screw of the Armstrong gun. It is kept in place by two split keep-pins which work in a groove round the breech-screws. The object of the lever and tappet arrangement is to give a powerful momentum in tightening up and releasing the vent-piece from its seat in the gun.

LEVER SHEARING-MACHINE.—It is evident that in all punching or shearing-machines, driven by a belt, there must be a conversion of the rotary motion of the driving pulley into a reciprocating motion of the punch or shear blade. To obtain the requisite power, many revolutions of the driving pulley must occur to one stroke of the punch. In crank machines, the whole pressure of the cut comes directly on the crank pin, which must perform a good portion of its revolution under this heavy strain at whatever speed the crank shaft may be running. This limits the power of such machines to the practical pressure sustainable on a given surface at a given velocity. When the vertical slide which carries the punch is operated by a lever, the sliding motion of the part of the lever in contact with the vertical slide is almost inappreciable: the pressure extends over large surface with little motion; so with the fulcrum pins over which the lever works; with very little and very slow motion of these parts much pressure is admissible, while the long end of the lever is operated upon by the lifting cam acting under comparatively light pressure. Added to this economical use of power, with the very greatly diminished frictional resistance, comes the possibility of so shaping the cam which is designed to lift the lever as to cause the motion of the punch to be about uniform through the whole length of the stroke, to return quickly, and then to dwell during any required portion of the revolution of the cam-shaft at the top of its stroke. Therefore, in comparing machines using the crank or eccentric with those employing the level and cam, if in both cases the same pulley, belt, and gearing is used, running at the same rate of speed, and making the same length of stroke at the punch or shear blade, it will be found that there is a capability of punching larger holes or of shearing thicker plates when the cam and lever are used than when the crank or eccentric is employed. On the lever punch and shears is arranged a four-toothed clutch on the main shaft, to be used in stopping and starting the plunger. This admits of quicker work than when the cam is shifted on the main shaft. The tail end of the lever is made to drop on a block of wood held in a box at the back of the machine, and the adjustment of the length of block to limit the fall of the lever enables the stroke to be controlled, and in thin metal to carry the punch close to the plate with less drop than when thicker iron is being punched, so obtaining a longer dwell for setting the plate.

In the Seller's machine, the heavy wrought iron lever in the housing easily raises the blade by its own gravity, and the cam which moves the lever is so shaped as to cause the motion of the blade in cutting to be at a uniform rate of speed. Returning quickly it dwells for some time at the top of its stroke, thus giving ample time to shift the plate for the next cut. In the earlier machines, the lifting-cam was moved sideways from under the lever when it was desired to stop the machine. This could only be done when the cam was free from pressure at the end of the stroke, and in starting again the cam could only be pushed in when in proper position in regard to the lever. The cam is now kept in position under the lever and is attached to or detached from the shaft by means of a four-toothed clutch, which, while it can only be withdrawn at the completion of the stroke, yet at the same time will permit the starting again to be effected in any one of four positions of the driving wheel in relation to the cam, thus saving much time, and also preventing the damage to the machine likely to arise from working the cam only partly under the lever.

The shear blades are placed so as to be right for trimming edges of plates, not for cutting bar iron. Operated by a heavy wrought iron lever within the housing. Independent stop motion by means of a four-toothed clutch in the housing. Blades rest open when clutch is out of gear. Vertical motion of blades $1\frac{1}{4}$ inches. Can be used to shear plates of iron $\frac{1}{16}$ inch thick. Fast and loose pulleys on the machine 36 inches diameter, 7 inches face, which should make 114 revolutions per minute. See *Angle Shearing-machine*, *Power Shears*, and *Shearing-machine*.

LEVER SHEERS.—A contrivance consisting of a long, heavy spar, with one end resting on the ground, and the other supported on two short spars, crossed and securely lashed together. The butt-end of the spar is heavily weighted, and is usually sunk a little in the ground, resting against a board or slab of wood, to prevent the earth from yielding to the pressure of the force acting in a direction parallel to the spar, and tending to force the end of it into the ground. A rear guy is also employed, to prevent short cross spars, or sheers, from falling to the front. The pressure of the spar or lever at the point where the short spars cross prevents them from inclining to the rear.

LEVET.—A blast of a trumpet probably that by which soldiers are called in the morning. This term is now obsolete.

LEVIGATION.—A process of the laboratory for converting different substances to a smooth, uniform powder by grinding them between two flat surfaces. The same process essentially is used in grinding paints, printing inks, and drugs.

LEVY.—The compulsory raising of a lot of troops from any specified class in the community for purposes of general defense or offense. When a country is in danger of instant invasion, a *levée en masse* is sometimes made—i. e., every man capable of bearing arms is required to contribute in person towards the common defense. On less urgent occasions, the levy may be restricted to a class, as to men between 18 and 40 years of age. At other times, a levy of so many thousand men of a certain age is decreed, and the districts concerned draw them by lot from among their eligible male population. In armies sustained by volunteering, the levy, which is a remnant of barbarous times, is unnecessray; but the system was frequently resorted to in France before the enactment of the Conscription Laws: 1862 has shown great levies in the United States of America; and in any country where great danger is apparent, and volunteers are not sufficiently numerous, recourse must at all times, be had to a levy of the people.

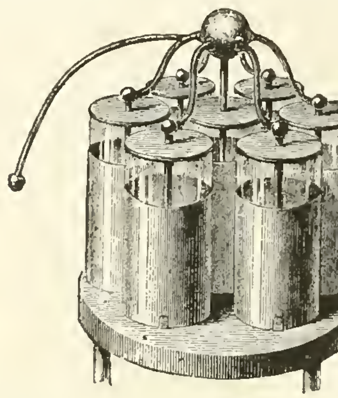
LEWIS.—An ingenious mode of lifting heavy weights. It consists of three pieces of iron, two of them wedge-shaped, and the third straight, which, when placed together with the straight piece in the center, form a dove-tailed wedge. The wedge is inserted in a hole of similar shape, cut either in stone or in metal. To the end of each of the pieces a ring is attached, throughw hich a horse-shoe ring is passed, and to this the rope or chain is securely fastened.

LEWIS HOLES.—The holes, in which the shell-hooks work in the 10-inch and 13-inch, mortar shells. They take the place of the early *lugs*, which are objectionable because of being knoced off in transport or piling.

LEWIS-RICE MAGAZINE-GUN.—This gun belongs to that system in which a fixed chamber is closed by a moveable breech-block rotating about a horizontal axis at right angles to and below the axis of the barrel; in front, the lock is conaled. The breech-block is operated by a lever, and is locked by a cam. The cam is held in position by a spring, one branch of which serves as a trigger-spring. The breech-block is simply a box containing the firing-pin, a bell crank lever, one arm of which controls the motion of the firing-pin, the mainspring, trigger-spring, etc. The box is closed by a cover, in a slot in which is situated the extractor. In operating the lever, so as to open the block, a point bears against the surface of the cam, presses it forward, and unlocks the piece. During the unlocking, the lower arm of the firing-pin lever is so moved by the nose of the cocking-lever as to cause the upper arm to retract the firing-pin. When the lever has been rotated sufficiently, the trigger-spring causes the nose of the trigger to enter the full-cock notch; at the same time the shoulder of the cam rides over the point of the trigger. The piece cannot then be fired until the cam is in its seat. The extractor is a flat blade, turning on the same axis as the lever, and operated by the shoulders of the slot in the cover of the breech-block in which it lies. The magazine is in the butt-stock. It is loaded at the side, near the rear, by first withdrawing the magazine-tube nearly its full length. When the breech-block is opened, a cartridge is forced by the magazine spring against the cartridge-stop As the block is closed, the stop descends, due to its arm working in a slot on the inner surface of the receiver, and the cartridge enters the chamber. A fork on the upper surface of the receiver prevents the cartridge being thrown out when the block is closed, and also guides it into the chamber. A cut-off is situated on the left side of the receiver. It may be so set as to prevent the breech-block opening far enough to allow cartridges to feed from the magazine. The piece may then be used as a single-loader. As a magazine gun, 3 motions are necessary to operate it, viz.: opened, closed, fired. As a single-loader, 4 motions are necessary, viz.: opened, loaded, closed, fired. This gun carries 5 cartridges in the magazine and one in the chamber. If the breech-block be opened, the six cartridges may be loaded directly in the magazine. See *Magazine-gun*.

LEYDEN JAR.—The principle of the Leyden jar was discovered by Muschenbroeck at Leyden in 1745, hence its name. Gralath, in Germany, 1746, continued the electric battery by combining a series of jars; and finally Drs. Watson and Bevis, by covering the outside of the jar with tinfoil, brought it to the complete state in which we now have it. The mouth of the jar is generally closed by a wooden stopper, through which passes the stalk of a brass knob or ball, surmounting the whole. The connection between the inside coating and the ball is completed by a chain extending from the stalk to the bottom of the jar. If this jar be put on an insulating stool, so that sparks can pass from the prime conductor of a machine to the knob, when the jar is thus insulated, one or two sparks pass, and then the charge seems complete, for no more sparks will follow, though the action of the machine is continued; or if they do, they are immediately dissipated from the knob in a brush discharge. If then, however, the knuckle of the experimenter be brought near the outer coating, sparks begin again to pass freely; and for every spark of + electricity that passes between the machine and the knob, a corresponding spark of the same name at once passes between the knuckle and the outer coating. This continues for some appreciable time, and then the jar appears to be again completely saturated. It is now said to be fully charged. The outside of the jar can, in this state, be handled freely, and if it be still on the insulating stool, so may also the knob, although when the hand first approaches, it receives a slight spark. But if, when the experimenter has one hand on the outer coating, he bring the other hand to the knob, before it can reach it, a straight, highly brilliant spark passes between the knob and his hand, and he experiences a shock of great violence. If he try the same thing again, a feeble spark and shock again ensue, and the jar is now thoroughly discharged. As it is highly inconvenient, if not dangerous, to discharge the jar through the body, *discharging tongs* are used for that purpose, which consist of two brass arms ending in balls, and moved on a hinge by glass handles.

A very instructive experiment may be made when the coatings are fitted to the jar so as to be removed at pleasure. After the jar is charged, it is put on an insulating stand. The inside coating is lifted out by the knob, and a slight spark is got by the hand in doing so. The jar is now taken up by one hand, and the outside coating is removed by the other, and, as before, another feeble spark is got. The whole is now built up in inverse order and discharged, when the spark is nearly as brilliant as when it is discharged at once without such dissection. From this it may be positively argued that the charge of the jar lies in the glass and not in the coatings, and that it is very likely that in all cases it is in the dielectric the charge resides; that the conductors, which are usually looked upon as the seat of the charge, are merely the limiting surfaces or exponents of it. A portion of the total charge may reside in them, but no more than is found on two similar contiguous dielectric surfaces. Taking this for granted, it is easy to explain the action of the Leyden jar. The electrifying power of the charging machine is exerted on two dielectrics—the glass of the jar and the air—the external limit in both cases being the surrounding objects which constitute the ground. The action on the air through the inside coating or the knob is quite similar to what we find in the case of any body to be charged. The action through the glass is peculiar, because we are shut out from it. The limits of this action are the inside surfaces of the inside and outside coatings. The air charge we participate in as we move in it. We are, however, quite external to the action on the glass; but if we could move about in it between the coatings, we should find things there exactly similar, so far, at least, as kind of action is concerned, to what we find in charged air. Seeing that the glass of the jar is a thin and good dielectric, and the air much thicker and more difficult to polarify, the charging power of the machine is exerted for the most part in the glass, the polarification in the air being comparatively slight. Assuming electricity to be a polarification of molecules, the electricity of the jar resides thus in glass, and to a much less extent in the air. The potential at the inner coating is the same as that at the knob, for any connected system of good conductors must be at the same potential. We judge of potential by the air charge, and thus we take the potential at the knob as the potential at the inner coating. The spark got from the knob of the insulated jar is small compared with that of the charging machine, and as sparking distance is, generally speaking, proportional to potential, the potential of the jar is much below that of the charging machine. Thus, a *Leyden jar is a contrivance for accumulating large quantities of electricity at a low potential.* The thinner the glass, the greater will be the accumulation of electricity, but the feebler will be the potential of the jar. When the electric field is limited, as in the glass of the Leyden jar, it is sometimes said to be *bound*, as distinguished from the *free* charge of an ordinary air field. When the knob of the insulated jar is touched, a spark is got, and if the finger be then removed to the outer coating, another spark, but of the opposite name, is obtained, and the knob is again prepared to give a spark, and this alternating process may be continued till the jar is emptied. When the inner coating is touched, the outer coating becomes insulated, and thus the potential always shifts to the insulated coating with an opposite name to what it had before. Each spark obtained by the finger in going from one to the other consumes so much of the energy of the charge, and so the potential is gradually lowered. When the jar is discharged by the tongs, the charge of the dielectric glass is thrown into the dielectric air. The particles of the glass, though more easily electrified than those of air, having a higher specific inductive capacity, offer a much greater resistance to discharge than those of air. At the same stage of polarification, the air gives way, while the glass still keeps polarified. Hence a jar with glass only a fraction of an inch in thickness can give rise to an air-spark of several inches; besides this, the charge in the glass is somewhat uniformly distributed. In the air, with the tongs, the force of the charge is concentrated on a certain region of it, and the breaking down of the conductive resistance of the air is more easily effected. The feeble *residual* spark from the jar, after the first main discharge, is due to what is called *electric absorption*. Somehow, the electricity given to a dielectric is not immediately available when a circuit is offered, the dielectric taking some time to recover itself. This is observable in all solid dielectrics, but no trace of such action is found in air. The sparking or *striking distance* of the jar indicates the potential of the charge. The quantity may be measured by the turns of the charging machine. It is found that when the same quantity is given to two jars, one double the other in point of covered surface, the striking distance of the large jar is only half that of the small jar; and that to charge the large one so as to obtain the same length of spark, twice the quantity must be given. If two jars be taken of the same size, and one of them be charged, we find that, on connecting their outside coatings, a spark passes when their knobs are brought together, and that, when now the double jar is discharged, the spark is only half as long as was got from the single jar discharged directly. The quantity discharged finally in the double jar was the same as in the single jar, but the potential was half. The spark occurring at the participation of the charge accounts for the loss of potential For great power, large surfaces are necessary. This can be obtained either by constructing a large jar, or by uniting several small jars together so as to act as one. The latter method is preferable, as we can vary the surface according to the number of jars employed.



A combination of small jars united together as one is called an *electric battery*. A very convenient form of electric battery is shown in the drawing. The knobs of each jar communicate with a large central one by arms of brass moving on hinges, and the outer coatings are put in a conducting connection, by being placed on an insulated stool covered with tinfoil. The interior coatings are conveniently charged by a long projecting arm from the central knob, and the exterior ones by connecting the stool with the knob of the unit jar, or by a wire with the ground. Any jar can be thrown out of action by throwing back its arm. See *Electricity*.

LIBERTY, EQUALITY, FRATERNITY.—For nearly a century, these three words have been accepted as embodying the creed of those who maintain the rightful supremacy of the numerical majority; and they have been sounded as the watchword of that formidable movement known on the Continent of Europe as "The Revolution," of which the object was to assert this supremacy by overturning the existing fabric of society. When contrasted with the democratic creed of antiquity, the only novelty which the modern symbol exhibits consists in the proclamation of "Equality;" for "Liberty," in the widest sense—meaning thereby the ultimate extension of political power to the whole body of the citizens—has been the object of the most enlightened politicians of all ages; whilst the protest in favor of "Fraternity" is a mere sentimental commonplace, about the speculative soundness of which there never was any real difference of opinions.

The first state document of importance in which the doctrine of "Equality" is set forth is the American Declaration of Independence of July 4, 1776. This celebrated document proceeds thus: "We hold these truths to be self-evident: *that all men are created equal;* that they are endowed by their Creator with certain unalienable rights; that among these are life, liberty, and the pursuit of happiness," etc. This, as we have said, was in 1776. But as a speculative opinion, the doctrine of "Equality" had been proclaimed by Hobbes more than a century before, and from his time down to the period at which it thus received practical recognition, it had never been lost sight of by the class of speculators to which Hobbes belonged. Under different forms and from various points of view, it had been reasserted by Spinosa, Rousseau, Helvetius, and ultimately by the class of political declaimers whose works were simultaneous with the American, and immediately proceeded the French Revolution.

LIBRARIES—Military Libraries are either garrison or regimental. The former comprise large collections of books, with newspapers, games, lectures, etc., in commodious rooms, and are intended to win soldiers from the gin-shops and vicious haunts which are ever prevalent in garrison towns. Attempts have been made to provide the soldiers with books, both for instruction and amusement; but statistics prove that the men patronize few besides fiction and travels, and religious books, not at all. Regimental Libraries are smaller collections of books, which accompany regiments in their various movements. The charge for Military Libraries in the British Army was, for 1876-77, the sum of £4,085.

LICORNE—An improved howitzer introduced by the Russians in 1777. Short, light cannon intented to throw large projectiles with comparative small charges were used by the Dutch in the early part of the 17th century and came into almost general use during that century, prior to the introduction of the *licorne*. See *Howitzer*.

LICTORS.—Among the Romans, the official attendants of Magistrates of the highest rank. They carried the *fasces* before the Magistrates, clearing the way, and enforcing the use of the appropriate marks of respect. It was their duty to execute the punishments ordered by the Magistrates, such as scourging with rods and beheading. They were originally free men of the plebeian order, and not till the time of Tacitus could the office be held by freedmen. Slaves were never appointed Lictors.

LIDE.—A warlike machine which was formerly used to throw large stones against a fortified place, or upon an enemy.

LIEUTENANT.—A term applied to a variety of offices of a representative kind. Thus, in military matters, a *Lieutenant-general* personates with each division of an army the General-in-Chief. A *Lieutenant-colonel* commands a battalion for a Colonel in the latter's absence. But the title Lieutenant, without qualification, denotes the second officer and deputy, or *locum-tenens*, of the Captain in each company of cavalry or infantry. A Lieutenant in the British Foot-Guards ranks as Captain in the Army, and exchanges with a Captain in another regiment. *Captain-lieutenant*, an obsolete rank, was the subaltern who commanded the "Colonel's Company" in each regiment. —A *Second Lieutenant* is the junior subaltern of a company, and corresponds to what formerly was an Ensign. In the United States Army and Marine Service, the Lieutenant ranks next after the Captain and there are two grades, First and Second Lieutenant, the latter being the lowest commissioned officer. These grades rank with those of Master and Ensign in the United States Navy.

In the British Navy, Lieutenant is a misnomer in the case of the officer bearing that title. His functions in all respects correspond to those of a Captain in the Army, with whom he ranks, and with whom he also nearly matches in regard to pay. A Lieutenant's full pay is 10s. a day; and his half-pay ranges, according to length of services, from 4s. to 7s. a day. Six years' service afloat are requisite to qualify an officer for the rank of Lieutenant, and the candidate has also to pass a satisfactory examination in seamanship and general professional knowledge. As leaders in all minor enterprises, such as boat expeditions, cutting out, etc, Lieutenants in war time carry off most of the laurels awarded to actions of singular personal daring.

LIEUTENANT COLONEL.—The rank in the United States Army next above Major and next below Colonel, and answering to that of Commander in the Navy. In the British Army it is nominally the second officer in a regiment; but virtually a Lieutenant-colonel commands every battalion of infantry and regiment of cavalry, the post of Colonel being merely an honorable sinecure, with usually £1,000 a year attached, awarded to some General Officer. The Lieutenant-colonel is responsible for the discipline of his battalion, the comfort of his men, and ultimately for every detail connected with their organization. He is assisted by the Major and Adjutant. In the artillery and engineers, where the rank of Colonel is a substantive rank, with tangible regimental duties, all the functions of Lieutenant-Colonel are more limited, one having charge of every two batteries of artillery, or two companies of engineers. The pay of a Lieutenant-colonel varies £1. 9s. 2d. per diem in the Household Cavalry to 17s, in the Infantry of the Line. Five years' regimental service as Lieutenant-colonel entitles an officer to brevet rank as Colonel, which, while improving his position in the Army, does not, however, affect his status in his regiment.

LIEUTENANT-GENERAL.—In the United States army the rank next beneath that of General; the latter under the President, being Commander-in-Chief. It was first authorized by Congress in 1798, and bestowed upon General Washington, in view of the then anticipated war with France. After Washington's death the rank remained in abeyance until 1855, when it was revived (in brevet) by Congress for General Winfield Scott, at whose death it again lapsed. In 1864 it was again revived by special Act, and conferred on General U. S. Grant, on whose promotion by the creation of the grade of General in his behalf, Major General William T. Sherman became Lieutenant General; and, on his succession to the rank of General, Major General Philip H. Sheridan was promoted to be Lieutenant General, and so remains until the present time, 1884. See *General Officer.*

LIEUTENANT DE LA COLONELLE.—The Second Officer, or what was formerly styled the *Captain-lieutenant* of the Colonel's Company of every infantry regiment in France. See *Lieutenant.*

LIEUTENANT DU ROI.—During the Monarchy of France there was a Deputy Governor in every fortified place, or strong town, who commanded in the absence of the Governor, and who was a check upon his conduct when present. This same person was called *Lieutenant du Roi. Lieutenants des Gardes Françaises et Suisses* bore the rank of Lieutenant-colonel, and took precedence of all Captains. *Lieutenants Provinciaux d'Artillerie* were certain officers belonging to the old Erench service, and immediately attached to the artillery, who bore the title or name of the particular Province in which they were stationed. Several of these Lientenants, who had military employment under the Board of Ordnance received the rank of Lieutenant-general in the Army from the King, and could rise to the most exalted stations.

LIFE GUARDS.—The mounted body-guard of the Sovereign. In the British Army there are two corps so designated. They never leave the country except in a very great emergency. These regiments were engaged in the Peninsula, and were present at the battle of Waterloo, where they greatly distinguished themselves. The two regiments of Life Guards wear a cuirass over a scarlet tunic. Their headpiece is a steel helmet. The remainder of their dress consists of leather breeches, long gauntlets, and jack-boots. Their weapons are the sword and the carbine. See *Guards.*

LIFE OF PIECE.—An expression denoting the length or time or the number of rounds a piece of ordnance will stand before it becomes unserviceable. This is estimated in smooth-bore ordnance at from 1,000 to 1,200 rounds with service charge and one shot. Experience, however, has shown that it is not so much the number of rounds fired which destroys a gun as the high elevation given to it to obtain extensive range. Guns fired horizontally, or at no greater elevation than 5° or 6°, do not experience the great strain which a gun fired at 30° would, and the reason is obvious, as guns fired at a low elevation recoil in proportion to the relative weight and friction of the projectile; whereas, when elevated to 30°, the gun cannot recoil, the force, therefore, is exerted downwards, and the gun impinges on its support, which is comparatively immovable; thus the force which displaced the gun in the first instance is now exerted on the sides of the gun. The initial velocity is also increased with the angle of projection, which causes the shot to press more upon the charge and thus to increase the resistance of the expansion of the gases. This increased resistance also adds to the strain upon the gun. Sufficient experience has not yet been had of rifled guns to state what number of rounds the different classes of such ordnance can bear, but it may be inferred that their endurance will be considerable.

LIFE ROCKET DEPARTMENT.—That branch of the Marine Department of the Board of Trade which has the management of life-rockets, mortars, lines, buoys, and belts, divides with the National Life-boat Institution the labors connected with the prevention of shipwreck, and the rescue of shipwrecked persons. This has been the arrangement since 1855. Until that year the life-mortars in use were partly under the control of the Admiralty, sometimes under the Board of Customs, partly under the Institution just named, and partly belonging to private individuals. The Merchant Shipping Act, passed in 1854, and put in force the following year, placed the whole under a different organization. To work out properly the rocket and life-saving system, a topographical organization is in the first instance adopted. The coasts of the United Kingdom are classified into 59 coast-guard divisions or wreck-registrars' districts; and the coast-guard Inspector of each division or district has control over all the rockets, mortars, buoys, belts, and lines kept at the various seaside stations in his district. There were in 1874 about 300 such stations; some supplied with mortars, some with rockets as well as mortars, but the greater number with rockets only. Most of the mortars are Boxer's improvement on Manby's; and most of the rockets are Boxer's improvement on Dennett's. Boxer's rockets, found more effective than mortars, are made at the Royal Labratory, at Woolwich, and are supplied by the War Department to the stations, on requisition from the Board of Trade; as are likewise mortar-shot and shell, fuses, portfires, signal-lights, gunpowder, etc. At each station is kept a cart, expressly made to contain all the requisites for the rocket apparatus, ready packed. Eighteen rockets are supplied with each apparatus; and a new supply is obtained before these are exhausted. Between 1874 and 1880, the system has extended year by year in the number of stations and of men; but while the details of organization have changed, no new principle has been introduced. Simlper apparatus, consisting of life-belts and life-lines, is kept at a much greater number of stations. The system is worked by the coast-guard, the men being paid for periodical drilling, and for regular service. Special services are rewarded with gifts of money, medals, etc.

LIFE-SAVING ROCKETS.—When a life-boat is not at hand, or a raging sea and a shoal coast renders its use impracticable, a distressed ship may often receive help from shore, provided the distance be not too great for the throwing of a rope. A small rope may draw a thicker, and that a hawser, and the hawser may sustain a slinging apparatus for bringing the crew on shore. For short distances, Captain Ward's *heaving-stick* has been found useful; it is simply a piece of stout cane about 2 ft. long, loaded at one end with 2 pounds of lead, and at the other end is securely attached to a thin line. It is whirled round vertically some 2 or 3 times, and then let go; but it cannot be relied on for more than 50 yards. Kites of various kinds have been employed, but are not found to be certain enough in action. The firing by gunpowder of some kind of missile, with a line of rope attached to it, is the method which has been attended with most success. In 1791 Sergeant Bell, of the Royal Artillery devised a mode of firing a shot and line from a distressed ship to the shore. It was afterwards found to be more practically useful to fire from the shore to the ship. In 1807 Captain Manby invented his *life-mortar*, an ordinary 5½ in. 24-pounder coehorn, fixed at a certain angle in a thick block of wood. The missile discharged from it was a shot with curved barbs, something like the flukes of an anchor, to catch hold of the rigging or bulwarks of a ship. How to fasten the shot to the rope was at first a difficulty: chains were not found to answer; but at length strips of raw-hide were found suitable. To assist in descrying the exact position of a distressed ship on a dark night, in order to aim the mortar-rope correctly, Manby used a chemical composition as a firework, which would shine out in brilliant stars when it had risen to a certain height. A third contrivance of his for replacing the shot by a shell filled with combustibles, in order to produce a bright light which would render the rope visible to the crew, was not so successful.

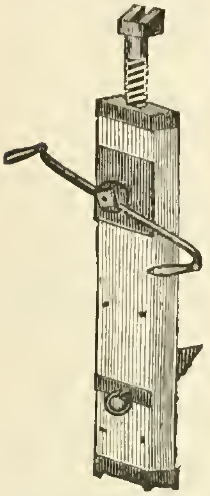
Many variations have been made in the line-throwing apparatus. Colonel Boxer has recently substituted a *bolt* for the shot, with four holes at the end; fuses thrust into these holes shed a light which marks the passage of the bolt through the air. Trengrove's rocket-apparatus, invented in 1821, consisted of an ordinary 8-oz. sky-rocket. Certain practical difficulties, however, affected it, and it did not come much into use. In 1832 Dennett's apparatus was invented. It nearly resembled the old sky-rocket, but with an iron case instead of a paper one, and a pole 8ft. long instead of a mere stick; it weighed 23 lbs., was propelled by 9 lbs. of composition, and had a range of 250 yards. A ship's crew having been saved by the aid of this rocket at Bembridge, in the Isle of Wight, the Board of Customs caused many of the coast guard stations to be supplied with the apparatus in 1834. Carte's apparatus, brought forward in 1842, depended on the use of a Congreve rocket instead of an ordinary sky-rocket. It does not appear that this apparatus was ever adopted by the authorities. Mr. Dennett next sought to improve the power of his apparatus by placing two rockets side by side, attached to the same stick; and it certainly did increase the range to 400 yards; but as the simultaneous and equal action of the rockets could not be always insured, the scheme was abandoned. Colonel Delvigne, of the French army, invented a *life-arrow*, to be fired from an ordinary musket. It is a stick of mahogany, shaped like a billiard-cue; the thicker end presses on the powder; while the thinner end, loaded with lead, is fitted with loops of string; a line or thin rope is attached to the loops, and the thin end of the stick projects beyond the barrel. The jerk, when the arrow or stick is fired, causes the loops to run down the stick to the thick end; this action has an effect like that of a spring, preventing the stick from darting forward so suddenly as to snap the line. The apparatus will send an arrow of 18 oz. to a distance of 80 yards, with a mackerel line attached. Another French contrivance, Tremblay's rocket with a barbed head, was soon adopted for the Emperor's yacht; but as it is to be fired from the ship to the shore, it partakes of the same defects as Sergeant Bell's original invention. The most effective apparatus yet invented is Colonel Boxer's. Finding that Dennett's parallel rockets on one stick do not work well, he succeeded after many trials in a mode of placing two rockets in one tube, one behind the other. The head is of hard wood; there is a wrought-iron case, with a partition between the two rockets. When fired, the foremost rocket carries the case and the attached line to its maximum distance, and the rearmost rocket then gives these a further impetus. The effect is found to be greater than if the two rockets were placed side by side, and also greater than if the quantity of composition for the two rockets were made up into one of larger size. The rocket is fired from a triangular stand, and is lighted by fuse, port-fire, or percussion-tube; the elevation is determined by a quadrant or some similar instrument.

The lines used with these several projectiles have varied greatly; but the best is found to be Italian hemp, spun loosely. It is very elastic, and when thick enough for the purpose, 500 yds. weigh 46 lbs. In Boxer's rocket, the line passes through the tail of the stick, then through the head, where it is tied in a knot, with India-rubber washers or buffers to lessen the jerk. The line is carefully wound on a reel, or coiled in a tub, or faked in a box provided with pins ranged round the interior—to enable the line to run out quickly without kinking or entangling. Dennet's faking-box for this purpose is the one now generally adopted.

Life-belts, jackets, and buoys of various kinds are used, made of cork, inflated India-rubber, etc.; but one apparatus now employed in conjunction with the life-rockets is known by the curious name of *petticoat-breeches*, or more simply, *sling life-buoy*. It is not strictly either a belt or a buoy, but a garment in which a man may be slung clear out of the water. When a rocket has been fired, and a line has reached the distressed ship, signals are exchanged between the ship and the shore; a thicker rope is pulled over the ship by means of the line, and a hawser by means of the rope. When all is stretched taut by fastening to the masts, etc., any articles can be readily slung and drawn to and fro. The petticoat-breeches, was originally invented by Lieutenant Kisbee, and consists of a circular cork life-buoy forming the top ring of a pair of canvas breeches; one of these is hauled over from the shore to the ship; a man gets into it, his legs protruding below the breeches, and his armpits resting on the buoy; and he is hauled ashore by block-tackle. The crew of a wrecked ship can thus one by one be relieved. To prevent losing the hawser and other apparatus, when the last man has left the ship, an apparatus called a hawser-cutter is used working *in* the ship, but worked *from* the shore.

After the destruction of the *Northfleet* in 1873, off Dungeness, an exhibition was organized at the London Tavern, to which the inventors of new life-saving appliances were invited to contribute. Among the apparatus were Hurst's *life-raft*, consisting of a double pontoon, bridged over, stowed outside a ship, and lowered by simply cutting the lashings; Christie's *life-raft*, a large, rectangular framework, rendered buoyant by numerous air-tight spaces, some of which are available for stowing water and provisions; and Parrott's *tubular life-raft*, composed of cylindrical air-bags made of painted canvas, supporting a flooring of sail-cloth and netting, and rendered rigid by poles fixed in various directions. Many other novelties were displayed at the London Tavern, and also at a similar collection in the annual International Exhibition, in the forms of life-boats, rafts, garments, belts, buoys, etc. See *Anchor-rocket, Boxer Life-saving Rocket, Chandler Anchor-shot, Delvigne Life-saving Gun, German Life-saving Rocket, Hooper Life-saving Rocket, Hunt Life-saving Rockets, Lyle-Emery Grapple-shot, Manby Shot, Parrott Life-saving Mortar, Rockets, Russian Life-saving Rocket, Shot-lines*, and *Signal Rocket*.

LIFTING JACK.—A geared screw, with a projecting foot or hook at its lower end, for lifting heavy weights. This jack, as used at military posts, consists of the following detailed parts: 1 *bed*; 1 *handle*; 2 *rivet-bolts* No. 2 A, to strengthen the bed; 4 *washers*; 2 *nuts*; 2 eye-plates for the braces, let into the ends of the bed, and fastened by 4 *screws*, 2 inch, and 1 *screw*, 1 inch, No. 16; 1 *stand* (cast-iron); 4 *steadying-points*, screwed into the bottom of the stand; 2 *braces*, fastened to the stand at the upper end by 2 *bolts* No. 2; 1 *screw*, same size and pitch as the elevating screw for casemate carriages; 1 *foot;* 1 *plate*, fastened to the foot by 3 *screws*, 1½-inch, No. 14; 1 *nut;* 1 *pinion* for the hoisting-screw (brass), like those for the casemate elevating screw; 1 *shaft* for pinion, kept in place by one *screw-pin* let in the stand; 1 *crank*, held to the shaft by 1 *nut* No. 4; 1 wooden *handle*, fastened by 1 *washer;* 1 *nut* No. 2; and 1 *cap-plate*, let into the head of the stand one-eighth of an inch and fastened by 4 *bolt-screws* No. 1. This jack is now quite superseded by the hydraulic-jack. The jack represented in the drawing is used for general purposes, is simple, compact and powerful. A good substitute for a jack are two handspikes placed under the axle-tree, when, with the aid of two robust gunners, the carriage can be raised to take off the wheel. The jack known as *Clerk's* is the common screw-jack of the service, in a cast-iron conical box, with metal top and triangular base. This jack is of great power, and used for heavy carriages in lieu of the "tooth and pinion" and "screw-jack." There are other jacks in the service, such as the *rack and pinion*, lifting 3 tons; *Haley's*, which varies in power from 2 to 20 tons; and *Tangye's hydraulic*, capable of lifting from 4 to 20 tons. See *Jack-screw*, and *Mechanical Maneuvers*.



LIGHT.—Optics ranks next to dynamics in the category of nearly *exact* sciences—that is, of sciences whose fundamental principles are so well known, that the result of almost any new experimental combination can be predicted mathematically. Given the forces acting on a body, the laws of motion enables us, by purely mathematical processes, to determine the consequent motion. Though we have not as yet arrived at equal perfection in optics, we are certainly far on the way, and probably have now attained nearly all the progress (independent of improvements in our mathematical methods) which will be made until the next great step in molecular physics shall give us the clue to the nature of the minute motions on which light, heat, electric currents, and magnetism depend. The most extraordinary and almost incredible predictions of theory have been verified by experiment, and at present the differences between theory and experiment may be divided into two classes, corresponding to the above exceptions. The first are those depending on the imperfections of mathematical processes, where, because, for example, as we are yet unable to obtain the exact solution of a certain differential equation, we have to content ourselves with an approximate one. But every improvement in our means of approximation is found to introduce a closer agreement between theory and experiment. This difficulty may safely be left to mathematicians. It is otherwise with the second difficulty. This depends on our ignorance of the ultimate nature of matter, and our consequent inability to apply mathematical reasoning in a perfectly correct and sufficiently comprehensive manner. Here, the experimenter's work is still required, and it is in this direction that we must in all probability now look for important extensions of our knowledge. Optics is divided into two parts *physical* and *geometrical*. Of these, the latter contents itself with assuming certain obvious experimental truths, such as the fact, that light in a uniform medium moves in straight lines, the ordinary laws of reflection and refraction, etc., and making these its basis, employs mathematics to develop their further consequences. It is thus that theory has shown how to carry to their utmost perfection such exquisite specimens of art as the best telescopes and microscopes of the present day. But these investigations, and their practical application, are wholly independent of the *nature* of light, and cannot be affected by discoveries in that direction. It is otherwise when we come to physical optics. This commences with the question: "*What is light?*" and then endeavors to deduce from the nature of light the experimental laws which, as we have seen, are assumed as the basis of geometrical optics. By two perfectly distinct classes of astronomical observations—aberration and the eclipses of Jupiter's satellites—we know that light takes *time* to pass from one body to another—the velocity being enormous—about 200,000 miles per second. Hence it follows, that either *matter* or *energy* must be transferred from a body to the eye before we can see it. Here we have at once the rival physical theories of light, which have alternately had the advantage of one another in explaining observed phenomena. It is only of late years that an *experimentum crucis* has finally decided between them—by showing one of them to be utterly incompatible with a result of observation. Newton adopted the corpuscular theory, in which light is supposed to consist of material particles—i. e., he adopted the first of the two possible hypotheses; and he gave the first instance of the solution of a problem involving molecular forces, by deducing from this theory the laws of reflection and single refraction. We shall see immediately that this beautiful investigation led to the destruction of the theory from which it was deduced. But, independent of this, there are many grave and obvious objections to the corpuscular theory; for it involves essentially the supposition of material particles impinging on the eye with the astounding velocity of 200,000 miles per second. If such particles weighed but the millionth of a pound, each would have something like ten times the momentum (*i, e.*, the battering power), and *six million* times the vis viva or kinetic energy (*i. e.*, the penetrating power), of a rifle-bullet. Suppose them a million times smaller—yet as millions of millions of them must ever be supposed to enter the eye at once, coming from every point of the surface of every visible object, it seems impossible to reconcile such a hypothesis with the excessive delicacy of the organs of vision.

It is not pretended by the advocates of the rival hypothesis, undulatory theory of light, that they understand exactly the nature of the transference of energy on which they suppose light to depend; but they take from the analogy of sound in air, and of waves in water, the idea of the existence in all space of a highly elastic fluid (or quasisolid), provisionally named the *ether*, and they suppose light to consist in the propagation of waves in this fluid. Huygens has the credit of having propounded, and ably developed and illustrated, this theory. As we have seen above, no third hypothesis as to the nature of light is admissible. Many strong arguments against the truth of the corpuscular theory had been furnished by experiment, especially in the early part of the present century; and as they were always met by further and more extraordinary properties which had to be attributed to the luminous corpuscles, the theory had become complicated in the most fearful manner; and this of itself was an almost complete disproof. Still, it held its ground, for Newton's old objection to the rival theory, viz., that on the undulatory hypothesis there should be no shadows at all (witness the analogy of sounds heard round a corner), was as yet unanswered. This difficulty was overcome by Young, to whose sagacity we are indebted for the idea of *interference*, which completely explained the apparent discrepancy. But the question between the rival theories was finally settled by Fizeau and Foucault, who, by processes entirely different, but agreeing in their results, determined the velocity of light in air and in water. Now, Newton had shown that refraction, such as that of light by water, if predicated of moving *particles*, requires that they should move faster in water than in air. Huygens, again, had clearly shown, that if such refraction be predicated of *waves*, they must move much slower in water than in air. Fizeau and Foucault found, by direct measurement, that light moves slower in water than in air. Hence, it is certain that *light consists in the transference of energy, not of*

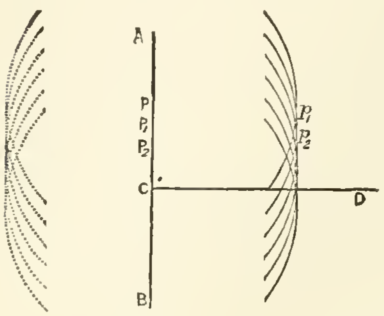


Fig. 1.

matter and the undulatory theory is based upon this fact. But, as to the manner in which energy is thus transferred, we are entirely ignorant. The common assumption is, that waves of distortion are propagated in the ether. The nature of this motion will be described under Wave. But many other modes have been suggested, one of the most notable of which is that of Rankine. Here the particles of ether are not supposed to be *displaced*, but each is merely made to turn an axis as the wave of light passes it; the particles having polarity by virtue of which they arrange themselves in similar positions when no light is passing, and by which, also, any rotation of one particle produces a consequent rotation of those in its neighborhood. For the explanation of most of the common phenomena of optics, it is quite indifferent which of these assumptions we make, and, indeed, theory has not yet been carried far enough to enable us to devise experimental methods of testing which is the more likely to be the case in nature. It cannot be too strongly insisted on that all we know at present is, that light certainly depends on the transference of energy from one part of the luminiferous medium to another; what kind of energy is transferred, vibratory or oscillatory motion, or rotation, etc., is a problem which may possibly forever remain unsolved. But vibratory wave-motion being that with which we are most familiar, as in earthquakes, sound, waves in water, etc., we naturally choose this as the most easily intelligible basis of explanation and illustration. And we shall now briefly show how the laws of linear propagation, reflection, single refraction, interference, diffraction, dispersion, polarization, and double refraction may be accounted for.

We assume, then, that light consists in a succession of waves, and for our earlier inquiries it does not matter whether they be (like those of sound) waves of condensation and rarefaction, in which the vibrations take place *in* the direction of the ray, or (like those in water) waves of distortion or displacement without condensation, in which case the luminous vibrations must be assumed to take place in some direction *perpendicular* to the ray. The phenomena of polarization and double refraction show us that the former of these hypotheses is very untenable.

Propagation of Light in a Uniform Isotropic Medium (An isotropic medium is such that if a cubical portion be taken, it possesses precisely the same properties whatever be the directions of its sides. Glass and water are isotropic, rock-salt and ice are not.)—Suppose AB (Fig. 1) to represent at any time the *front* of a plane wave which is passing in the direction CD; *i. e.*, suppose all particles of the ether in the plane AB (perpendicular to the plane of the paper) to be similarly and equally displaced. According to Huygens, we must suppose every particle, P, to be itself the source of a wave, which, from the uniformity of the medium, will spread with the same velocity in all directions. With center P, and radius

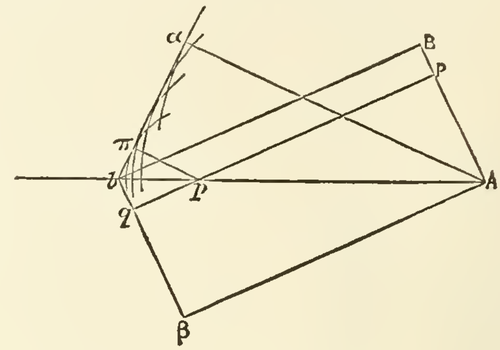


Fig. 2.

the space which light passes over in any assigned interval, t, describe a sphere represented in section by a circle in the figure Do the same for adjacent points, P_1, P_2, etc. Let p_1 be the intersection of the circles whose centers are P and P_1, p_2 that of the circles whose centers are P_1 and P_2, and so on. Then, as p_1 is *equidistant* from P and P_1, and (approximately) from all points of a small circular space between P and P_1 on the wave-front AB, all the separate wave-disturbances coming from these points to p_1 will be in the same *phase*, and will therefore combine so as to strengthen each other; while in other directions they will be in different phases and combine to destroy each other. The locus of all such points as p_1, p_2, etc., will therefore, at the end of the time t, contain all particles of the ether equally and similarly disturbed, and will thus be the new wave-front. But it is obviously a plane parallel to AB. Also the disturbance at P has passed to p_1; and, when the distance PP_1 is taken as very small, Pp_1 is perpendicular to the wave-front AB. Hence, in such a medium, it is readily seen that a plane wave remains plane, and always moves with uniform velocity in a direction perpendicular to its front. [There is a difficulty as to what becomes of the disturbance, which, according to Huygen's assumption, ought to travel *back* into the dotted portions of the spheres; and it is not easy to account for the absence of this on mechanical principles. But we are content here to take for granted that no

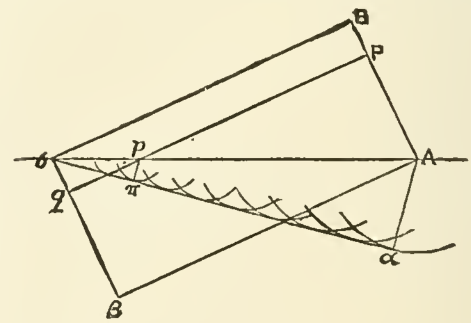


Fig. 3.

waves are propagated backward from the main wave, as a fact clearly proved by experiment.] Since a small portion of the surface of any curved wave may be considered as plane, we now see how any such wave will be propagated in an isotropic medium. Erecting perpendiculars at every point of the surface of the curved wave, and laying off along these lines the space which light passes over in a given interval, and the extremities form a new surface, which is the wave-front after the lapse of that interval. *Reflection at a Plane Surface.* Suppose AB (Fig. 2) to be a plane wave-front, moving in the direction of B*b* perpendicular to AB. Let A*b* be the reflecting surface, and let the intersection of the plane of the wave-front with the reflecting surface be a line through A perpendicular to the paper. When B has arrived at *b*, A would have arrived at *B*, and P at *q* (where *bB* is parallel to BA, and P*q* and A*B* to B*b*), had it not been for the reflecting surface. Hence, when B is at *b*, A has diverged into a sphere of radius A*B*, P from *p* into a sphere of radius, *pq;* and so for each point of the wave-front. Now, the spheres so described about A and *p* as centers obviously touch the plane *bB;* consequently they touch the other plane *ba*, which makes the angle A*ba* equal to A*bB*. Now, *bπa* is the front of the reflected wave, and A*a* is the direction in which it is proceeding. Hence, obviously, the ordinary laws of reflection. See *Catoptrics.*

Refraction at a Plane Surface into an Isotropic Medium—Here we take account of the change of velocity which light suffers in passing from one medium to another. In Fig. 3, A, P, B, *b*, *p*, *q*, and *B* represent the same as before—but suppose A*a* now to represent the space through which the wave travels in the second medium, while it would travel from B to *b* in the first. With center A, and radius A*a*, describe a sphere. Let *ba* touch this sphere in *a*. Then *ba* is the front of the refracted wave. For, if *pπ* be drawn perpendicular to *ba*, we have *pπ*: A*a*:: *bp*: *b*A:: *pq*: A*B*. Hence, while A travels to *a*, and B travels to *b*, P travels to *p*, and thence to *π*. And the sines of the angles BA*b* and A*ba*, which are the angles of incidence and refraction, are to each other as B*b* to A*a*, *i. e.*, as the velocity in the first medium is to that in the second. See *Dioptrics.*

It is quite obvious from the above figure that the *less* the velocity in the second medium the more nearly does the refracted ray enter it at right angles to its surface. As a contrast we may introduce here a sketch of Newton's admirable investigation of the same problem on the corpuscular hypothesis. Let U and V be the velocities in the two media, *a* and *B* the angles of incidence and refraction. Then the forces which act on the corpuscle being entirely perpendicular to the refracting surface, the velocity *parallel* to that surface is not altered. This gives

$$U \sin. a = V \sin. B.$$

Also the kinetic energy is increased by the loss of potential energy in passing from the one medium to the other. Hence, the square of V exceeds that of U by a quantity which depends only on the nature of the two media and of the corpuscle. This shows that V is the same whatever be the direction of the ray, and then the first relation proves that the sines of the angles of incidence and reflection are *inversely* as the velocities in the two media, *i. e.*, the refracting ray is more nearly perpendicular to the refracting surface the *greater* is the velocity in the second medium. It is very singular that two theories so widely dissimilar should each give the true *law* of refraction: and in connection with what has just been said, it may be mentioned that on the corpuscular theory a corpuscle passes from one point to another with the least *action*, while on the undulatory theory it passes in the least *time*. Hamilton's grand principle of *varying action* includes both of these. *Interference*—Fresnel's mode of exhibiting this phenomenon (whose discovery, as before said, is due to Young) is very simple and striking. An isosceles prism of glass, with an angle very nearly 180°, is placed (Fig. 4) in front of a brilliant point (the image of the sun formed by a lens of very short focus, for instance). The effect of the prism is that light which passes from O through the portion QR appears to have come from some point such as A (the image of O as seen through the upper half of the prism). Similarly the light which has passed through PQ appears to come from some point B. The light which has passed through the prism is to be received on a white screen ST. At the point T, which is in the prolongation of the line OQ, the distances TA and TB are equal; but for no other point, as U in the line ST, are UA and UB equal. Suppose U and V to be such that UA and UB differ in length by half a wave-length of some particular color, VA and VB by a whole wave-length of the same; then waves arriving at T, as if from A and B, have of necessity passed over equal spaces, and consequently their crests must truly coincide, so that at T they reenforce each other. But at U a hollow from A is met by a crest from B, so that darkness is the result. At V, again, crest and crest coincide. And so on. Hence, if we are experimenting with one definite color of light, the effect on the screen is to produce at T, V, etc., bright bands of that color, all parallel to the edges of the prism PQR. At points like U there are dark bands. And the length of a wave can easily be calculated from this experiment; for the lengths of OQ and QT can be measured, and knowing the angles of the prism and its refractive index for the particular color employed, we can calculate the positions of A and B. We have then only to measure the distance TV between the centers of the two adjoining bright bars, and then geometry enables us to calculate the difference of the lengths of VA and VB, which, as we have seen, is the length of a wave. The results of this experiment show how very minute are these wave-lengths for visible rays. Thus for

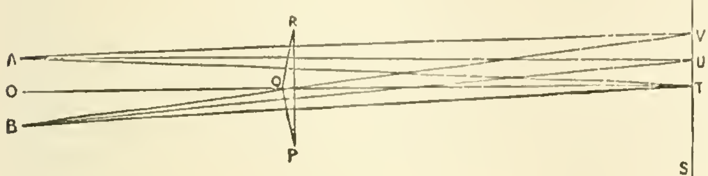


Fig. 4.

	Inch.
Extreme Red, the wave-length in air is ...	0.0000266
" Violet, " " "	0.0000167

These are, roughly, the $\frac{1}{40000}$ and the $\frac{1}{60000}$ of an inch. Seeing, then, that light describes 200,000 m. per second, the number of waves which enter the eye per second are:

Extreme Red.........460 millions of millions.
" Violet......730 " "

These numbers, compared with those of sonorous waves show the extraordinary difference in delicacy between the optic and auditory nerves. But whereas the range of the ear is somewhere about 12 octaves, that of the eye is less than one.

Dispersion.—We have just seen that, by Fresnel's interference experiment, waves of different length are separated (for in the last figure the position of the bright line, V, depends on the length of the waves which produce it). But the different colors are also separated by common refraction, as in Newton's celebrated experiment. This shows, of course, that in refracting media, waves of different colors move with different velocities; and, as the violet are more refracted than the red, it appears that the shorter waves move more slowly in glass or water than the longer ones. In free space, waves of all lengths travel with equal speed, else all stars ought to appear drawn out into spectra, in consequence of the earth's annual motion. Also, a star suddenly breaking out, or suddenly vanishing (a phenomenon several times observed), should flash out in the first instance red, and gradually become white, or it should gradually decay from white to violet, which is not, however, observed to be the case. These facts are, indeed, the most difficult to explain of any to which the undulatory theory has as yet been applied. Fresnel, indeed, appears to have been in possession of a solution of the difficulty, but the appendix to one of his papers, to which he more than once refers as containing this explanation, was not found among his MSS. Cauchy and others have, however, by very delicate investigations, shown that, *if the forces exerted by the molecules of a refracting body on the ether are exerted through distances comparable with the length of a wave*, the velocity of light will then depend on the wave-length. The velocity is, in fact, shown to be represented by a formula such as this:

$$A - \frac{B}{\lambda^2}$$

where A and B are constant quantities for a given medium, and λ is the length of a wave. The larger λ is, the less will be the second term of the formula, and therefore the velocity will be the greater. A very singular result follows from this same formula—viz., that the velocity will become more and more nearly equal to A as the wave length is greater. Hence, waves of low radiant heat, which are merely waves of light which are incapable of producing vision, must be crowded together toward a limit, not very far beyond the red end of the spectrum. *Polarization*—We now come to a set of phenomena which give us some further information as to the nature of luminiferous waves. When two beams of light, such as those in Fresnel's experiment, are polarized in planes perpendicular to each other before they meet, *they do not interfere*. This is in accordance with the assumption required for the explanation of the existence of polarization itself—viz., that the vibrations of the ether take place *transversely* to the direction of the ray. *Double Refraction*—Our assumptions, forced upon us by experimental results, are now so far complete that we may proceed, after Fresnel, to apply them to the explanation of double refraction. This explanation is extremely beautiful, and when published, was justly hailed as the greatest step in physical science which had been made since Newton deduced the facts of physical astronomy from the law of gravitation. As we have seen above, in treating of simple reflection and refraction, that the form and velocity in and with which a disturbance spreads from any point of a wave is all that is required for the determination of the course of a ray, we must endeavor to find the form in which a disturbance spreads in a double-refracting crystal; and this should lead us to a construction for each of the two rays. Huygens had already pointed out that one of the two rays produced by Iceland spar folows the ordinary law of refraction. Hence the disturbances which give rise to this ray are propagated in spherical waves in the crystal. He showed also that the other ray could be accounted for, if the disturbances to which it is due were propagated in the form of an oblate spheroid touching the sphere with the extremities of its axis, that axis being parallel to the crystallographic axis of the mineral. The following diagram (Fig. 5) when carefully examined will make this apparent:—P is the point where the ether is disturbed. Two waves spread from P in the form shown in the cut, the line ABP being the axis of rotation of the spheroid, and parallel to the axis of the crystal. Thus, let rays *a*A, etc. (Fig. 6), of which AB is the wave-front, fall upon the surface A*b* of such a crystal; and let AC be the direction of its axis. Draw, about A as a center, the sphere and spheroid into which the disturbance at A spreads in the crystal while light in air passes from B to *b*. Then if planes be drawn through the line *b* (perpendicular to the paper) so as to touch the sphere in B_1 and the spheroid in B_2, these planes will touch respectively all the intermediate spheres and spheroids produced by disturbances at points between A and *b*. Thus, bB_1 and bB_2 are the new wave-fronts and the ray *a*A, falling on the crystal, is divided into the two AB_1 and AB^2. Of these AB_1 is the ordinary ray, and being produced by spherical waves, has all the properties to be looked for in the case of a ray ordinarily refracted. It obviously moves forward perpendicularly to its front, as AB_1 is perpendicular to B_1b. But it is otherwise with AB_2, which is, in general, *not perpendicular to its front*, B_2b. Again, if AC, the axis of the crystal be not in the plane of incidence, the ray AB_2 is not in that plane; so that here we have *refraction out of the plane of incidence*. The exact accordance of this construction with observation was proved by the careful experiments of Wollaston. We have only to add, that the two rays AB_1 and AB_2 are, in all cases, completely polarized in planes at right angles to each other. The experiments of Brewster showed that in by far the greater number of minerals and artificial crystals, *both* rays are extraordinary—*i.e.*, neither of them can be accounted for by disturbances propagated spherically in the crystal. But no tentative process could lead to the form of the wave-surafce in this most general case. Here Fresnel's genius supplied the necessary construction. He assumes that the ether in a crystallized body is possessed of different rigidity, or different inertia, in different directions; a supposition in itself extremely probable, from the mechanical and other properties of crystals. In the general case there are shown to be three principal directions in a crystal, in any one of which, if the ether be displaced, the resulting elastic force is in the direction of the displacement. Each of these is, in all cases, perpendicular to the others. Any given displacement of the ether corresponds to partial calculable displacements parallel to each of these lines, and thus the elastic force consequent on any displacement whatever is known if we know those for the three rectangular directions. All the calculations are

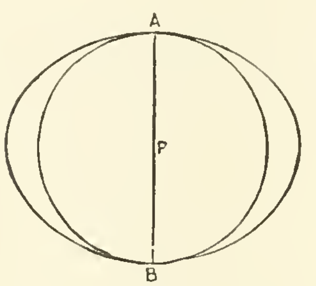


Fig. 5.

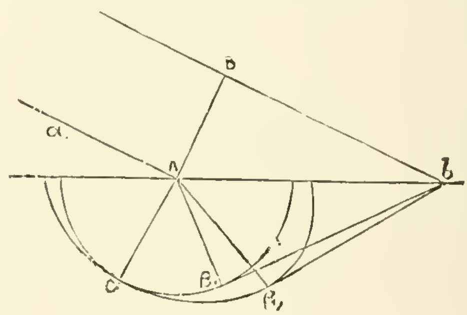


Fig. 6.

thus dependent on *three* numbers only, for each substance. It would unduly lengthen this article, and besides would lead us into discussions far too recondite for a work like this, to enter upon the question whether the vibrations in polarized light are *perpendicular to* or *in* the plane of polarization, a subject which has recently been well investigated by Stokes; or to consider the production of elliptically polarized light by reflection at the surface of metals, diamond, etc.; and various other most important points of the theory. We can only mention that Green, Cauchy, Stokes, and others, who have entered deeply into the mechanical question of luminiferous vibrations, have found themselves obliged to take into account the *normal* wave, which, as we have seen, Fresnel neglected. Fluorescence, spectrum analysis, and various other important recent additions to the theory, must be merely mentioned; as also the very remarkable observation of Maxwell, which appears to connect light and electricity, and was derived from a theory which assumes the ether to be the vehicle of electricity and magnetism as well as of light and heat, and by which it appears that the velocity of light is expressible in terms of the static and kinetic units of electricity.

LIGHT ARTILLERY BATTERY.—A mounted Battery of field-guns. In the United States army, for the purpose of diffusing instruction, the Lieutenants of the five artillery regiments are passed through the School of Light Artillery in their respective regiments, so that no Lieutenant will be in that School more than two years at any one tour. From this rule may be excepted Lieutenants in command of companies the Captains of which are indefinitely absent, Adjutants, Regimental Quartermasters, together with such others as from accidental causes may be unable to ride. If a vacancy happen in the grade of Captain of a Battery designated as a Light Battery, it will be filled by the order of the Secretary of War, on the recommendation of the Colonel, who usually names the Captain best qualified for the service. Every Battery of Artillery actually armed and equipped as a Battery of Horse-artillery or a Light Battery, and serving as such, is allowed, for annual practice, as many blank cartridges and friction-primers for instruction and drill as may be deemed necessary by the Battery Commander, and approved by the Post Commander. Such Batteries are also permitted to expend in target practice, annually, twenty-five projectiles for each gun of the command.

LIGHT-BALLS.—Preparations in pyrotechny, made in the same manner as fire-balls, except that there is no shell in them, as they are used for lighting up our own works.

They continue alight from 9 to 16 minutes, according to the caliber. Light-balls are of four different natures, viz: 10-inch, 8-inch, 5½-inch, and 4⅖-inch. Their form is oblong, and about 1½ caliber. The skeleton frame is made of wrought iron, and is partially covered with canvas, and filled with composition which burns with a brilliant light.

The proportion of composition is as follows:—

	lbs.	oz	drs.
Saltpeter, ground	6	4	0
Sulphur, ground	2	8	0
Rosin, pounded	1	14	0
Linseed oil, boiled	0	7	8

See *Fire-Balls* and *Fireworks*.

LIGHL-BARREL.—A common powder-barrel pierced with numerous holes, and filled with shavings that have been soaked in a composition of pitch and rosin; it serves to light up a breach, or a bottom of a ditch. See *Fireworks*.

LIGHT BOBS.—In the British service, the familiar term used for the light infantry.

LIGHT CAVALRY.—Regiments of mounted soldiers who, from their light equipment and active horses, are especially adapted for making long marches, performing outpost duties, skirmishing, etc. The experience of the wars of 1866 and 1870-71 has shown, clearly and convincingly, that the splendid charges, which in the days of Frederick and Napoleon frequently decided the fate of battles, have passed away, and that, in the future, it is before an action that the main *role* of the cavalry will be found to lie. Since the introduction of arms of precision, the duties of this branch may well be considered purely strategical, as cavalry can seldom be employed to take a decisive part in a battle. Upon this branch now devolves the task of preparing the way for an engagement, by *reconnoitering* the positions of the enemy, and giving, as to his movements, as much valuable information as possible. Light cavalry can therefore be used as a screen to mask the movements of the advancing or retreating army, and like a swarm of spies, to search the country of the enemy, gather information from all quarters, facilitate and often render unnecessary an armed attack, and, finally, bewilder, by harassing the foe. Employed as *éclaireurs* or feelers in every direction, they make a ring of mystery around their own army. The enemy does not know their whereabouts, while they carry back valuable information to their chiefs. The duties now thrown upon the light cavalry soldier demand much increased intelligence, and a knowledge of the operations of war. The value of good information is so important, and the evil of bad so great, that it would never be safe to trust anybody of ordinary trained men to fulfil these duties. Light cavalry form an important branch of the Intelligence Department, and it may be well said that 'They are the eyes and ears of an army." The hussar regiments form the light cavalry of the British army; but the lancers and the dragoons, although classed as medium cavalry, are often employed in the same duties.

LIGHT HORSE.—All mounted soldiers that are lightly armed and accoutered for active and desultory service: such as dragoons, hussars, mounted riflemen, etc. See *Light Cavalry*.

LIGHT-HOUSE BOARD.—A body organized in the United States, in accordance with an Act of Congress approved Aug. 31, 1852, and having the control and management of all lights, buoys, beacons, etc., on the coasts of the United States. It consists of eight persons, viz., two officers of high rank in the Navy, two officers of the Corps of Engineers, two civilians of high scientific attainments, an officer of the Navy, and an officer of the Corps of Engineers—the two latter serving as Secretaries. The Board as thus constituted is attached to the office of the Secretary of the Treasury, who is *Ex-officio* President of the same. A chairman, elected by the members from their own number, is chosen to preside in the absence of the President *Ex-officio*. The Board is required to meet four times a year, and the Secretary of the Treasury is empowered to call it together whenever, in his judgment, the exigencies of the service may require a meeting. It actually meets almost every week in the year. The coast and the waters of the country are divided into districts, each of which is served by an officer of the Army or the Navy in the capacity of Light-House Inspector, and other officers are employed from time to time, according to the exigencies of the service. The different subjects requiring attention are first referred to standing committees, whose duty it is to investigate and report to the Board what action, if any, is required. The two Secretaries perform all routine and general administrative duties under the orders and regulations of the Board.

LIGHT INFANTRY.—A body of armed men selected and trained for rapid evolutions. The service of Light Infantry often demands great individual address, intelligence, and quite well developed physical powers; a combination of qualities not easily found, and seldom, indeed, without careful, habitual training. Whereas, in Infantry of the Line, the qualities of the individual are of less importance, as results here depend almost solely upon the action of the mass.

The habitual order of battle of Light Infantry is the *dispersed order;* and whether acting offensively or defensively, it depends for its results upon the effect of its fire, resorting to the close order, and using the bayonet, only exceptionally. As each individual, although immediately supported by his own file-closer, and those on his right and left, is still often thrown upon his own resources, being obliged to take cover where he can most conveniently find it, he must be a good marksman, cool, deliberate, and circumspect; since it may become necessary to keep an enemy occupied hours, and even days together, pressing on him at one moment and yielding to him the next, or holding with tenacity, and disputing inch by inch some particular point, as it may suit the views of the General in command. In Infantry of the Line, as success depends upon the action of the mass, *ensemble*, judgement, coolness, and, determinaion should always characterize all its movements whether it delivers its fire in line, forms in column to attack with the bayonet, or throws itself into a square, to await the charge of the enemy's cavalry. The duties of Light Infantry are to open an engagement, and, after it is fairly under way, to keep it going; turning it to advantage if successful, otherwise breaking it off. In its relations to the Infantry of the Line it should cover the flanks of the latter: clear the way for its advance by rooting the enemy out of all covers, and then holding them if requisite. Upon it devolves all advanced-post, detachment, and advanced and rear-guard service.

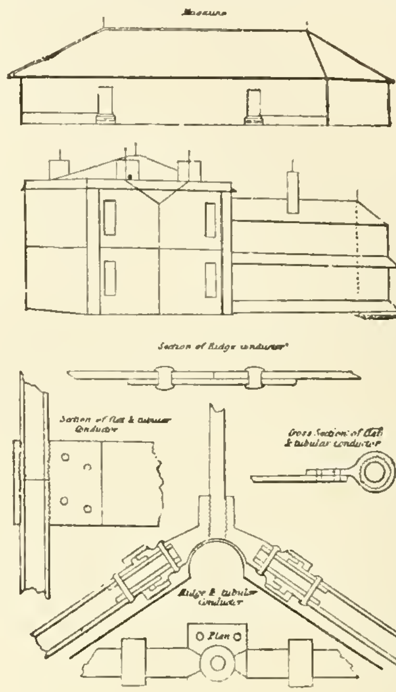
LIGHT INFANTRY COMPANY.—In the British service, a company of active, strong men carefully selected from the rest of the regiment. It always occupies its place on the left of the battalion until called for. When the call sounds, the Light Company orders arms and unfixes bayonets without word of command, and remains in readiness to move.

LIGHT MARCHING ORDER.—A term applied to troops lightly accoutered for detached service—usually paraded with arms, ammunition, canteen, and haversack.

LIGHTNING CONDUCTORS.—The following points and precautions should be carefully observed in the construction of powder-magazines and factories, in localities visited by lightning: experience shows that metal in a building, whether disposed of in the form of a conductor or otherwise, never *attracts* lightning. That, provided the surfaces of metals are not interrupted by bodies possessing a less conducting-power, a building entirely of metal will be the safest of all, and that such buildings require no further lightning-conductors than connection with the earth over the masonry foundations on which they are often laid. That, with regard to a building of brick or stone, the object must be to establish a sufficient number of lines of electrical conductors, extending from its most elevated and prominent points to the ground; and, further, bring the building into a condition similar to that of a metal building by means of other conductors generally attached to more prominent lines of the building itself, such as the ridges, angles, and eaves. There is no advantage, but the contrary, in endeavoring to insulate the conductors from the building.

The best material for conductors is copper, either in tubes 1½ to 2 inches diameter and .125 inch to .2 inch thick, or a wire rope. All metal surfaces, whether lead, copper, or iron, on ridges, roofs, gutters, or coverings to doors or windows, to be connected by plates of copper with the conducting system. Lead, on account of its low conducting power, cannot be altogether depended upon. One or more solid copper rods to project freely into the air, about 5 feet above the highest points of the building to which the main conductors are applied. The summit of the rod to be pointed; but gold, gilt or platinum tops are unnecessary. The termination of the conductors below to be led into damp or porous soil, when the building happens to stand upon it; but, when the soil is dry, two or three trenches to be cut, radiating from the foot of the conductor to a depth of 18 inches or two feet, and 30 feet in length, and either the conductor carried along the bottom of the trenches or old iron chain laid in them, carefully connected with the foot of the conductor. The trenches to be then filled up to one foot in depth with coal-ashes or other carbonaceous substance, and afterwards with earth or gravel.

If it be possible, in regulating the surface drainage to lead a flow of water, during the rain which gen-



erally accompanies thunder-storms, over the site of the trenches, it will be an additional precaution. Tanks are useless, except where the water flows freely into them from the surrounding soil, and even then they are superfluous as appendages to the conductors.

The conductors for brick or stone magazines with slate roofs should consist of a sheet-copper strip 4 inches wide, and .125 inches thick, covering the ridge, and securely fixed to it by wrought-copper nails. At each end of the ridge a solid copper rod .5 inch in diameter is securely fixed to the conductor on the ridge; and projects about 5 feet above the highest point of the building. Upper end of this rod is carefully pointed. Copper strips about 3 inches wide, or copper tubes nearly one inch in diameter, pass down the angles of the hip, and are firmly secured to the copper eaves-gutter. The descending water-pipes, made also of copper, and fastened to the face of the building by copper holdfasts, are connected at their lower end to the underground conductor by a piece of copper, 3 inches wide, wrapped around the lower end of the water-pipes and riveted to the underground conductor. The underground conduetor runs out from the building 4 feet, and then branches into two parts, each 8 feet long, 2 inches wide, and .125 inch thick. These conductors are about 2.5 feet from the surface of the ground at the lower end, and are covered with coal ashes and earth. The copper sheathings on the doors and windows are connected with the lower end of the water-pipes by flat copper strips, 2 inches wide, fixed to the water-table by copper nails driven into wooden plugs about 10 feet apart. When tubular conductors cannot be had of sufficient length in one piece, they are connected by a union joint, and strengthened by a small pipe or ferrule, about 4 inches long, inside the tube, and riveted to each end. Buildings which have the eaves-gutters and down-pipes made of tin or zinc should have a main conductor communicating directly with the ground; it should also be connected with the eaves-gutters, and the down-pipe should connect by a metallic communication with the ground, running out some distance from the building. In case of buildings situated on a dry or rocky soil, especial pains must always be taken to lay down old chains or other conductors in various directions, to at least a distance of 10 to 15 yards, and from 1 foot to 1.5 feet below the surface of the ground; and, if possible, lead a flow of rain over the surface of the ground about or near the conductor. Let the conductor terminate in a large surface of moist earth whenever it can be effected.

If copper be not used for conductors, zinc is the next best material of which they can be made. If iron be used, it should be in the shape of galvanized wrought-iron pipe, not less than 2 inches in diameter, firmly screwed together in joints of extra thickness.

Copper tube, of a thickness of from .125 to .2 inch is always to be preferred: it has more than five times the capacity for conducting electricity that iron has, and more than three times that of zinc. See *Powder Depots.*

LIGHTNING MAGAZINE-GUN.—The inventors of this rifle, the Colt's Patent Fire-arms Manufacturing Co., have adopted the left-handed method of handling, which enables the breech-action to be much simplified and lightened without detracting from its strength. The cartridge used is the same as that of the 44 caliber Colt revolver; it contains 40 grain of powder, and the bullet weighs 200 grains. The drawing shows the arm and its parts in position ready for firing.

To load and fire, bring the piece to the shoulder in the usual way; grasp the handle of the slide *A*, with the left hand and draw it to the rear. The first part of this movement raises the locking brace, *B*, from the abutment, *C*, acts upon the firing-pin-lever, *D*, withdraws the firing-pin, *E*, and releases the magazine-gate, *F*, causing it to hold back the cartridge in the magazine. Continuing the movement, the bolt, *G*, moves to the rear, ejects the cartridge-shell, cocks the hammer, *H*, and raises the carrier, *I*, so that when the movement is finished, the cartridge is in proper position to enter the chamber. The slide is then drawn forward. This movement carries the bolt forward, drives the cartridge into the chamber, throws down the carrier into position to receive another cartridge, and the rifle is ready for firing.

A feature peculiar to this rifle is, the lock is brought clear forward and the extractor is hooked over the cartridge-head *before* the magazine-gate will allow another cartridge to be fed to the carrier, thus preventing blocking of the breech-action. The firing-pin is held back positively until the cartridge has entered the chamber, when the bolt is locked so that premature explosion is impossible. The hammer is automatically locked and unlocked by the hook on the rear end of the magazine-gate. By this arrangement the rifle may be loaded and discharged by the reciprocating motion of the slide, keeping the trigger constantly pressed back during the motion by the forefinger of the right hand. The magazine can only be charged when the slide is drawn to the rear.

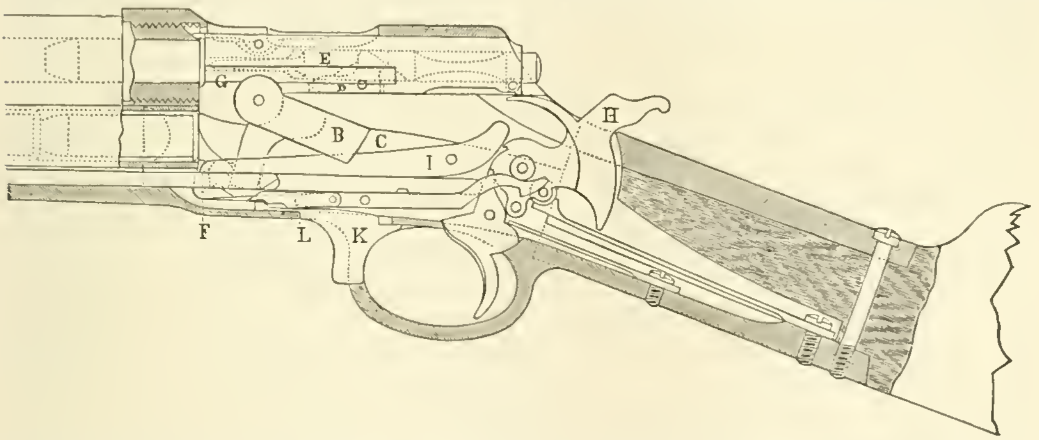
To take apart the rifle, take out the tang-screw. Draw off the butt-stock. Take out the magazine-screw at the front end and remove the magazine. Take out the two side screws, cock the piece, draw the slide about half way to the rear, and withdraw the trigger-plate. Slide the bolt clear back, insert a punch in the small hole on the left hand side, and push out the locking-brace pin, and slide out the lock. The other parts can be removed without special directions. To assemble the rifle, replace the parts in the reverse order from that given for taking the rifle apart See *Colt Magazine-rifle.*

LIGHTS.—In pyrotechny, lights are made by pressing lance or similar composition in shallow vessels, or in cases of large diameter. The burning surface being large, the light attains a great intensity.

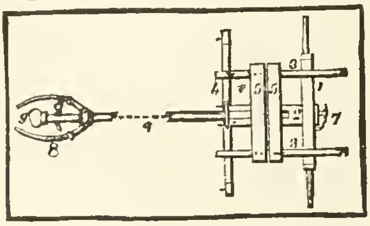
Shallow earthern, wooden, or metal vases or paper cases are used. The vase or case is filled with dry composition, slightly pressed in; or composition, moistened with gummed water may be used and pressed in the case more compactly. It is primed by powdering the surface first with a mixture of equal parts of the composition and mealed powder, and then with powder alone. Cover the top over with paper, pasted on the sides of the case. Through the center of the cover pass several strands of quick-match, spreading them over the suface and uniting them on the exterior in a single strand.

When the light is made with dry composition, the case must be placed in a vertical position. It may be placed horizontally if moistened composition be used and firmly packed.

Torch-lights for funeral ceremonies are made by impregnating large strands of cotton with a thin alcoholic pap, the whole arranged in vases like an oil-lamp, the pap replacing the oil. See *Fireworks.*



LIMBER.—To suit a gun-carriage to the easy and rapid transportation of its load, it must be converted into a *four*-wheel carriage, which is done by attaching it to another *two*-wheel carriage, called a *limber.* The field-limber is composed of an *axletree* (1), a *fork* (2), two *hounds* (3 3), a *splinter-bar* (4), two *foot-boards* (5 5), a *pole* (6), a *pintle-hook* and *key* (7), two *pole-yokes* (8), and a *pole-pad* (9). A side view of the limber is shown in the article CAISSON, with the manner of attaching the rear carriage to the pintle-hook. The limber axle-tree is made of iron, imbedded in a body of wood, as in the case of the gun-carriage. The fork constitutes the middle portion of the limber, and is the portion to which the pole is attached.



It is formed of a single piece of wood one end of which is mortised into the axle-body, and secured by the pintle-hook bolts, and the other is cut into the shape of a fork, to receive the tenon of the pole. The hounds are two wooden rails which are bolted to the axle-body and splinter-bar. They serve to support the ends of the limber-chest and foot-boards, and also for the purpose of transmitting the draught of the horses to the axle-tree. The chest is firmly secured by a stay-plate which is situated at the bottom of the cut in the fork, and two stay-pins, which pass through holes near the rear ends of the hounds. The splinter-bar is a piece of wood placed cross-wise with the pole, and is firmly secured to the fork and hounds. It has four hooks, to which the traces of the wheel horses are attached. The pole, or tongue, is employed to regulate the motion, and give direction to the carriage. The point of attachment of the rear carriage being near the axle-tree, and there being no sweep-bar, the weight of the pole is mostly supported by the collars of the rear horses; it should therefore be made of strong, light wood—ash is generally used for this purpose. As the pole is liable to be broken in ordinary service, the method of attaching it to the fork should always be such that all of the fragments can be promptly removed, and a new pole inserted. The foot-boards are secured to the fork and hounds in a proper position for the feet of the cannoneers to rest upon, while riding upon the limber-chest. The pintle-hook is a stout iron hook firmly fastened to the rear of the axle-tree, for the purpose of attaching the rear carriage. This mode of attachment is *simple*, *strong*, and *flexible*—qualities which are essential to rapid movements and great endurance. The point of the hook is perforated with a hole for the *pintle-key*, which prevents the carriages from separating while in motion. In the old system of field-carriages, the operation of limbering and of unlimbering was so difficult, that a rope, called a "prolonge," was used to connect the gun-carriage and limber in action. This implement is still retained, but the same necessity does not exist for using it. All field-carriages should admit of being turned in the shortest possible space. This depends upon the size of the front wheels, the distance between the front and rear axle-trees, the position of the pintle, and the thickness of the stock at the point where the front wheel strikes it. Notwithstanding that the front wheels are made higher in the present system of field-carriages than the Gribeauval system, which preceded it, the carriages of the former have greater facility of turning in consequence of the diminished thickness of the stock. See *Gun-carriages*.

LIMBER CHAIN.—A keep-chain which goes round the pintle and confines the trail to the limber, preventing its flying off the limber-hook.

LIMBER CHEST.—The ammunition or tool-chest belonging to the limber of an artillery carriage of any description. Those of the gun-carriage and caisson are fitted up as ammunition-chests, while those of the forge and battery wagon contain respectively tools and stores for blacksmiths, and for carriage-makers' and saddlers' use.

LIMBER HOOK.—The hook on the limber to which the trail of the gun is attached.

LIMBERING-UP HOOP.—A stirrup-handle on the trail of a gun by which the piece is moved in limbering and unlimbering.

LIMBER PITS.—Artificial cover provided in warfare for the limbers of guns. They are usually 12 feet long, $5\frac{1}{2}$ feet wide at bottom, 7 feet at top, 3 feet deep, and provided with ramps at each end. A pit of this size can be executed in two hours by eight men. Each pit should cover a limber and two horses.

LIMENARQUE.—An office of distinction, which existed in the Roman Empire. The persons invested with it were directed to watch the frontiers of the Empire, and they commanded the troops that were employed upon that service.

LIMITARY.—The guard or superintendent placed at the confines or boundaries of any Kingdom or State.

LIMITATION OF TIME OF PROSECUTION.—In the United States Army, no person is liable to be tried and punished by a General Court-Martial for any offense which appears to have been committed more than two years before the issuing of the order for such trial, unless, by reason of having absented himself, or of some other manifest impediment, he shall not have been amenable to justice within that period.

LIMITES ROMANI.—The name of a continuous series of fortifications, consisting of castles, walls, earthen ramparts, and the like, which the Romans erected along the Rhine and the Danube, to protect their possessions from the numerous attacks of the Germans.

LIMITS.—The importance of the notion of a *limit* in gunnery cannot be over-estimated, since many branches of mathematics, including the differential calculus and its adjuncts consist of nothing else than tracing the consequences which flow from this notion. The following are simple illustrations of the idea: The sum of the series $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} +$ etc., approaches nearer and nearer to 2 as the number of terms is increased; thus, the several sums are $1\frac{1}{2}$, $1\frac{3}{4}$, $1\frac{7}{8}$, $1\frac{15}{16}$, etc., each sum always differing from 2 by a fraction equal to the last of the terms which have been added; and since each denominator is double of the preceding one, the further the series is extended, the less the difference between its sum and 2 becomes; also this difference may be made smaller than any assignable quantity—say, $\frac{1}{100000}$—by merely extending the series till the last denominator becomes greater than 100,000 (for this, we need only take 18 terms; 3 terms more will give a difference less than $\frac{1}{1000000}$; and so on); again, the sum of the series can never be greater than 2, for the difference, though steadily diminishing, still subsists; under these circumstances, 2 is said to be the limit of the sum of the series. We see, then, that the criteria of a limit are, that the series, when extended, shall approach nearer and nearer to it in value and so that the difference can be made as small as we please. Again, the area of a circle is greater than that of an inscribed hexagon, and less than that of a circumscribed hexagon; but if these polygons be converted into figures of 12 sides, the area of the interior one will be increased, and that of the exterior one diminished, the area of the circle always continuing intermediate in position and in value; and as the number of sides is increased, each polygon approaches nearer and nearer to the circle in size; and since, when the sides are equal, this difference can be made as small as we please, the circle is said to be the limit of an equilateral polygon the number of whose sides is increased indefinitely; or, in another form of words commonly used. "The polygon approaches the circle as its limit, when its sides increase without limit," or again, "When the number of sides is infinite, the polygon becomes a circle." When we use the terms "infinite" and "zero" in mathematics, nothing more is meant than that the quantity to which the term is applied is *increasing without limit* or *diminishing indefinitely;* and, if this were kept in mind, there would be much less confusion in the ideas connected with these terms; from the same cause has arisen the discussion concerning the possibility of what are called vanishing fractions (*i. e.*, fractions, whose numerator and denominator become zero simultaneously) having *real* values; thus $\frac{x^2-1}{x-1} = \frac{0}{0}$ when $x = 1$; but by division we find that the fraction is equal to $x + 1$, which $= 2$, when $x = 1$. Now, this discussion could never have arisen had the question been interpreted rightly, as follows: $\frac{x^2-1}{x-1}$ approaches to 2 as its limit, when x continually approaches 1 as its limit, a proposition which can be proved true by substituting successively 3, 2, $1\frac{1}{2}$, $1\frac{1}{4}$, $1\frac{1}{10}$, $1\frac{1}{100}$, etc., when the corresponding values of the fraction are 4, 3, $2\frac{1}{2}$, $2\frac{1}{4}$, $2\frac{1}{10}$, $2\frac{1}{100}$, etc. The doctrine of limits is employed in the differential calculus. The best and most complete illustrations of it are found in Newton's *Principia*, and in the chapters on maxima and minima, curves, summation of series, and integration generally, in the ordinary works on the calculus.

LIMITS OF FIRE.—Within the limits of the zones of danger, positions are found for front, for reverse, and for enfilading fire. If the two faces, for example, of a work be prolonged to intersect the extreme limit of dangerous ground, the sector which they embrace is termed *the limits of direct* or *front fire;* since, from every position that can be taken up within this sector, a direct fire alone can be brought to bear upon the two faces. The two sectors which lie adjacent to this are termed *the limits of lateral*, or *reverse fire*, since they afford positions from which a reverse fire can be obtained against one of the faces, and a front fire upon the other. It is also only within these last limits that positions for enfilading the terre-pleins of the faces can be obtained. See *Defilement*.

LINCH-PIN.—A pin through the end of an axle-arm of an artillery carriage to keep the wheel on. A hook attached to the head of the pin and embracing the axle-arm prevents the pin from being jolted out. A ring against which the linch-pin rubs is called the *Linch-pin Washer*.

LINE.—1. In fencing, an imaginary line opposite to the fencer, wherein the shoulders, right arm, and the sword should always be found, and wherein are also to be placed the two feet at the distance of 18 inches apart. 2. In tactics, a body of men in either one or two ranks; generally a body of troops drawn up with an extended front. 3. An expression used in the British Army to distinguish ordinary Cavalry and Infantry from the Guards, Artillery, and Engineers. It obviously takes its origin from the fact that the troops in question constituted the usual "Line of Battle." 4. The Line Officers of the Navy and Army in the United States are divided into eleven grades, and their comparative rank on the active or retired list is as follows:

The Admiral of the Navy ranks with a General of the Army.

The Vice Admiral of the Navy ranks with a Lieutenant General of the Army.

10 Rear Admirals of the Navy rank with Major Generals of the Army.

25 Commodores of the Navy rank with Brigadier Generals of the Army.

50 Captains of the Navy rank with Colonels of the Army.

90 Commanders of the Navy rank with Lieutenant Colonels of the Army.

80 Lieutenant Commanders of the Navy rank with Majors of the Army.

280 Lieutenants of the Navy rank with Captains of the Army.

100 Masters of the Navy rank with First Lieutenants of the Army.

100 Ensigns of the Navy rank with Second Lieutenants of the Army.

Midshipmen of the Navy.

All Staff Officers are appointed by the President with the sanction of the Senate. He also appoints for vessels in actual service all Warrant Officers, such as boatswains, gunners, sail-makers, and carpenters, that may be required. All officers not entitled to hold warrants are called Petty Officers. All officers of the Army above the grade of Sergeant hold their authority by commissions, and are therefore termed Commissioned Officers, to distinguish them from Non-commissioned Officers.

President Fillmore in General Orders, No. 51, of 1851, has given the following satisfactory exposition of the use of the word *Line* in our Statute Book: The 122d Article of War provides that "If, upon marches, guards, or in quarters, different corps of the Army shall happen to join, or do duty together, the officer highest in rank of the Line of the Army, Marine Corps or Militia, by commission there, on duty, or in quarters, shall command the whole, and give orders for what is needful to the service, unless otherwise specially directed by the President of the United States, according to the nature of the case." The interpretation of this Act has long been a subject of controversy. The difficulty arises from the vague and uncertain meaning of the words "Line of the Army," which, neither in the English service, (from which most of our military terms are borrowed), nor in our own, have a well-defined and invariable meaning. By some they are understood to designate the Regular Army as distinguished from the Militia; by others, as meant to discriminate between officers by ordinary commissions and those by brevet; and, finally, by others, to designate all officers not belonging to the Staff. The question is certainly not without very great difficulty, and it is certainly surprising that Congress should not long since have settled, by some explanatory law, a question which has been so fruitful a source of controversy and embarassment in the service. The President has maturely considered the question, and finds himself compelled to differ from some for whose opinions he entertains a very high respect. His opinion is, that, although these words may sometimes be used in a different sense, (to be determined by the context and subject-matter,) in the 122d Article of War, they are used to designate those officers of the Army who do *not* belong to the Staff, in contradistinction to those who do, and that the article intended, in the case contemplated by it, to confer the command exclusively on the former. The reasons which have brought him to this conclusion are briefly these: 1st. It is a well-settled rule of interpretation that in the construction of *statutes*, words of doubtful or ambiguous meaning are to be understood in their usual acceptation. Now it must be admitted that, in common parlance, both in and out of the Army, the words "Line" and "Staff" are generally used as correlative terms. 2d. Another rule of construction is, that the same word ought not to be understood, when it can be avoided, in two different senses in different laws, on the same subject, and, especially, in different parts of the same law. Now in another article of this same law, the words "Line and Staff of the Army" are clearly and beyond question used as correlative and contradistinctive terms. The same remark applies equally well to almost every case in which the words "Line" and "Staff" occur in the numerous Acts of Congress. On the other hand, there is but one Act of Congress in which the words "Line of the Army" have been purposely employed to designate the Regular Army in contradistinction to the Militia, and none in which they have been manifestly used as contradistinctive of brevet. 3d. If Congress had meant by these words to discriminate between officers of the Regular Army and those of the Militia, or between officers by brevet and by ordinary commission, it is to be presumed that they would have employed those terms, respectively, which are unequivocal, and are usually employed to express those ideas. 4th. If we look at the policy of the law, we can discover no reasons of expediency which compel us to depart from the plain and ordinary import of the terms: on the contrary, we may suppose strong reasons why it may have been deemed proper, in the case referred to by the Article, to exclude officers of the Staff from command. In the first place, the command of troops might frequently interfere with their appropriate duties, and thereby occasion serious embarrassment to the service. In the next place, the officers of some of the Staff Corps are not qualified by their habits and education for the command of troops, and although others are so qualified, it arises from the fact that (by laws passed long subsequently to the Article in question) the officers of the Corps to which they belong, are required to be appointed from the Line of the Army. Lastly, officers of the Staff Corps seldom have troops of their own Corps serving under their command, and if the words "Officers of the Line" are understood to apply to them, the effect would often be to give them command over the officers and men of all the other Corps, when not a man of their own was present—an anomaly always to be most scrupulously avoided where it is is in any manner possible to do so. 5th. It is worthy of observation that Article 25, of the first "Rules and Articles," enacted by Congress for the government of the Army, corresponds with Article 122 of the present Rules and Articles, except that the words "of the Line of the Army" are not contained in it. It is evident, therefore, that these words were inserted intentionally with a view to a change in the law, and it is probable that some inconvenience had arisen from conferring command indiscriminately on officers of the Line or the Staff, and had suggested the necessity of this change. It is contended, however, that Sec. 10, of the Act of 1795, enumerates the Major General and Brigadier General as among the Staff Officers, and that this construction of the Article would exclude them from command, which would be an absurdity. No such consequence would, however, follow. The Article in question was obviously designed to meet the case (of not unfrequent occurrence) where officers of different Corps of the Army meet together with no officer among them who does not belong exclusively to a Corps. In such a case, *there being no common Superior*, in the absence of some express provision conferring the power, no officer, merely of a Corps, would have the right to command any Corps but his own; to obviate this difficulty, the Article in effect provides that, in such an event, the Officer *of the Line*, highest in rank, shall command the rest. But if there be a Major General or Brigadier General present, the case contemplated by the Article does not exist. No question can arise as to the right of command, because the General Officer, not belonging to any particular Corps, takes the command by virtue of the general rule which assigns the command to the officer highest in rank. See *Brevet*, *Command*, and *Rank*.

LINEAL RANK.—The rank of a Line-officer in his particular arm of the service. The *lineal promotion* of a Line-officer is his promotion according to seniority in the arm of service, as opposed to promotion in the regiment.

LINE OF BATTLE.—The formation of an army for battle. In all actions it is necessary to place troops in such a formation previous to making the assault, or in showing front to the adversary, as shall expose them as little as possible, and yet place them in the readiest mode to carry out the orders of the Commander. It has been the custom from a very ancient date, coming to us from the Romans, and an accepted principle by most nations, that an army, when drawn up for battle, should be formed in three distinct lines; the *first line*, to commence the battle; the *second*, to support it, and to fill up the gaps; the *third* which is in rear of all, as a reserve.

This triple formation, though modified, remains much the same at the present day; but instead of deployed lines or lines of heavy columns, the troops are placed in lines of half-column formation. This has been rendered necessary from the withering fire and long range of the present arms of precision, which necessitate the reduction of the front of battalions. It has also become necessary, whether taking the offensive or standing on the defensive, that shelter, either artificial (such as shelter-trenches) or natural, should be taken advantage of to screen the men as much as possible, and so not to expose them (in the case of an attacking party) more than can be helped before the moment of formation previous to the final rush in upon the enemy's position.

LINE OF CIRCUMVALLATION.—The front and the rear of camps around a besieged place are secured by lines of field works. The exterior line of works, termed the *Line of Circumvallation*, should form an unbroken line of intrenchments composed of the most simple elementary parts, as tenailles, redans, etc., with a slight profile; its chief object being to prevent succors of small detachments from slipping into the place. The interior line, termed the *Line of Countervallation*, is composed of detached works, which, if the garrison is strong, should be in defensive relations. The main points which should be occupied by these works are the principal avenues to the defenses, and the positions selected for the parks of the siege-train: to secure these points from the attempts of the garrison, and to render the entrance of large convoys into the defenses impracticable. The lines are so placed as to leave a space of about 200 yards between them and the front and rear of the camps.

When the great extent of ground that must be taken up by a besieging force, in the investment of any considerable position, which requires to be entirely surrounded to cut off all communication between it and the exterior, is taken into consideration, particularly now when rifled guns have acquired such long ranges, it will be seen that complete lines of circumvallation will be seldom practicable, and in most cases must be of too weak a character to serve as an intrenched defensive position for the besieging force to receive battle within them. Accordingly, in the later sieges in Europe, continuous lines of circumvallation have been seldom resorted to; the besiegers contenting themselves with occupying only the main points of their position by field works, and giving the intervening space such protection as could be afforded by strong patrols and posts This departure from former practice arose, in most cases, from the want of strength of the besieging force, and was frequently attended by the very events against which lines are chiefly effectual in guarding. As a field of battle against a succoring force of sufficient strength to cope with the besieging army, a position taken behind a line of circumvallation is but in rare exceptions eligible, a maxim that applies to all extended and weak lines; and in almost every case, where a serious effort has been made against such positions it has proved successful, and has entailed heavy loss on the besiegers. But, it must be repeated, as this is not the object of these lines, they are not open to this objection; and, as they have been found serviceable for the sole purpose to which they should be applied, they ought to be thrown up in all cases where the means of the besiegers will admit of it. See *Intrenched Camps*.

LINE OF COUNTERMARCH.—A sort of a trench which the besieged make, and push forward from the glacis, for the purpose of counteracting the enemy's works.

LINE OF COUNTERVALLATION.—The line of field works constructed in front of the camps, and on the side next to the besieged position, to defend the camps, parks, and trains against any attacks which might be made by the besieged. See *Line of Circumvallation.*

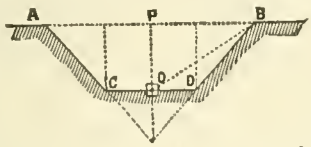
LINE OF DEFENSE.—A line representing the flight of a rifle-ball from the place where the soldiers stand, to scour the face of the bastion. The line of defense should never exceed the range of the rifle. It is either *fichant* or *rayant*. The first is when it is drawn from the angle; the last, when it is drawn from a point in a curtain, ranging the face of the bastion in fortification.

LINE OF DIRECTION.—In gunnery, the line formerly marked upon guns by a short point upon the muzzle, and a cavity on the base-ring, to direct the eye in pointing the gun.

LINE OF FIRE.—1. In gunnery, the production of the axis of the gun directed upon a point which is at a vertical distance above the object to be struck, corresponding to the time of flight required for the range, and at the end of which time the shot will be brought to the object by the force of gravity.

2. In fortification, this term admits of two distinct acceptations: *first*, when it is found necessary to give an idea of the manner in which a rampart or an intrenchment covers any space of ground by the discharge of ordnance or musketry, lines must be drawn to represent the distances traversed by the shot, etc.—these lines are called *lines of fire*, being representations of the actual ranges; *second*, all that extent of a rampart or intrenchment from which the projectile of ordnance or musketry are discharged.

LINE OF LEAST RESISTANCE.—The shortest distance from the center of the charge of a mine to the open air. Assuming the crater to be of the form of a truncated cone, as is usual, the radius O D, of the lower circle, being also assumed at one-half the radius P B, of the upper circle, then the radius P B, of the upper circle, is termed the *crater radius*, and the line O P, drawn from the center of the powder



perpendicular to the surface where the explosion takes place, the *line of least resistance*. The line O B, drawn from the same center to any point in the circumference of the upper circle, *the radius of explosion*. A mine with a line of least resistance not greater than nine feet, formed by sinking a shaft from the surface of the ground and placing the charge at the bottom of it, is termed a fougasse.—See *Crater.*

LINE OF MARCH.—The arrangement of troops for marching; also, the course or direction taken by an army or smaller command.

LINE OF METAL.—The profile cut from the upper surface of the piece by a vertical plane passing through the axis of the bore. When pointing a piece, the *line of metal* is accurately determined, and the piece is so maneuvered as to bring the line of metal into the plane of fire.

LINE OF METAL ELEVATION.—In gunnery, the visual line connecting the front and back sight when the latter is at its lowest point, *i. e.*, connecting the notch on the swell of the muzzle, or dispart sight, when the trunnions are perfectly horizontal.

LINE OF OPERATIONS.—All lines of communication leading towards an enemy's base do not offer equal advantages to an army acting on the offensive. Some lead more directly and offer more security than others in an advance on the enemy; some may offer greater advantages than others when our superiority lies either in infantry or in cavalry; some are more favorable as to subsisting an army, or afford ing it more convenient transportion, or in enabling us to turn the enemy's position; others again receive better support from the base of operations, etc. The talent of a Commanding General is chiefly shown in weighing the advantages and defects of each of these circumstances, and selecting from them the best. A line of operations is said to be *simple* when the army corps moving against the enemy are kept together, or at least are not so far separated as to be beyond mutual supporting distances. These corps consequently must all move on roads nearly parallel, and not too far apart, and without any impassable obstructions between them. A line of operations is said to be *double* when an army divided into two parts follows two sensibly parallel roads which are so far asunder that the two portions cannot be reunited upon the same day on the same field of battle.

Unless we are superior to the enemy on each line, both in numbers and the moral qualities of our troops, a double line of operations is purely disadvantageous to us; and particularly so if the two lines diverge as we advance; for the enemy, by throwing himself between the two fractions of our army, may beat each of them separately, and find himself in an attitude to intercept our communications. The more rapidly the double lines diverge, the greater will be danger and the certainty of success to the enemy.

Here we find a marked difference between what may be termed a strategical and a tactical operation. In the latter the greatest danger that an army can run is to be surrounded on the field of battle; whereas an army that throws itself, by a strategical movement, between several fractions of an enemy's army beyond supporting distance of each other, may, by superior activity, defeat them all in succession.

The only case in which—the armies on the two sides being sensibly of equal strength, and controlling reasons calling for it—a double line can be followed, in the face of a General of respectable abilities, is when the latter has also adopted double divergent lines, or lines very far asunder. But in this case our double line must be an *interior* one, or lie between those of the enemy, so that the two fractions may, in case of need, support each other if attacked; or be suddenly concentrated so as to attack one of the fractions on the enemy's exterior line, the other in this case being beyond supporting distance of the one attacked. This principle of interior lines, particularly when they converge as we advance, as a matter of fact, is only a modification of the one of a single line. It only amounts to keeping the fractions of our army in such distances from each other that they are nearer together than those of the enemy, and can be concentrated on any one of his before it can be reinforced by the others. Still, it must be observed, that it is always safer to maneuver on a single line than upon two, although they may be interior.

It is important not to confound double, or multiple lines, with the various lines of communication over which fractions of an army are necessarily marched, in order to concentrate on a particular point. In this case the movements of all concur to the same end; the army corps are momentarily separated only to march with greater convenience and rapidity; to reconnoiter the ground more thoroughly over which they move; and to live more comfortably. This momentary separation of our forces, to be again united at the moment of battle, when well executed, is the very acmé of good generalship. It is one of the best means of keeping the enemy for a long time uncertain of our real intentions as to the point of attack. To know when, in turn, to scatter our forces to embrace a greater extent of country, when circumstances permit or call for it, and then to concentrate them, in order to strike a decisive blow, is one of the most marked features in the qualities of a great Captain. No General of modern times has shown this trait in as high a degree as Napoleon.

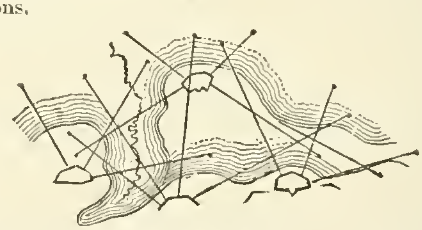
When, by the eventualities of a campaign, we find ourselves rather forced to abandon our primitive line of operations and take up some new one, the latter generally receives the appellation of an *accidental line of operations*. This term is not properly applicable to a line voluntarily taken up, to march upon a point which the enemy may have weakened by withdrawing from it troops, under the apprehension that he was threatened on some other. This change of line, so far from being an accident, is the legitimate fruit of profound combinations, and may be the cause of important successes. The primitive line was, to some extent, a feint; and the line apparently but secondary the true one; it cannot therefore be termed accidental; it will be thus simply the *new line of operations*

In like manner in a retrogade movement an army may abandon its natural line of retreat and take up another,leading off laterally from it, for the purpose of enticing the enemy into a district of country less favorable to him, and at the same time to throw him further off from his main object. The line of retreat in this special case will be sensibly parallel to our own frontier instead of being, as it is generally, perpendicular to it. This new line of retreat also cannot be classed under the head of accidental lines, since it is one voluntarily adopted, and presents advantages over the natural line of retreat. It has received the name of the *parallel retreat*, a term sufficiently expressive of the thing itself. To be successfully executed the retreating army should not be too inferior in force to the enemy, and should run no risk in being cut off from its own frontier by moving too far from it. The local features are particularly to be taken into consideration in such operations. If they are of a broken character, the movement will be the less perilous; if, on the contrary, the country is open, and without strong natural points of defence, the safest plan will be to regain our frontier by the shortest line.

When a choice between several lines of operation is offered, it will be best to adopt the one where the army can be most easily subsisted, and in which, according to the kind of troops of which it is composed, the army will be most secure from the enemy's enterprises If the army is superior to the enemy in cavalry, it will naturally prefer to move over an open district and country; if, on the contrary, its main strength lies in its infantry, it will prefer to skirt along the foot of a mountainous range, or to march through a broken country. A line of operations parallel and near to a river presents the advantage of having its wing nearest the water course perfectly secure from attack, whilst the river itself furnishes an excellent communication for bringing forward men and the supplies. The defensive position taken up by the enemy also has great weight in determining the direction of the line of of operations. If he occupies cantonments extending over a considerable line, the most natural line will be the one by which the army can throw itself into the center of the enemy's isolated corps, and thus separate them and beat them in detail. By attacking one wing of a position of this kind we should, in all likelihood, force back one corps after another upon the neighboring one, until in the end the whole would, in this way, be concentrated in their natural order of retreat. If, on the contrary, the enemy's corps are in proper supporting distance of each other, the natural point of attack is certainly one of his wings, provided that, in making the said movement, the line of operations of our own army is not left exposed; for the first of all necessities is never to place either our base or our line of operations in jeopardy. The choice to be made will also depend upon the characters and military talents of the enemy's Generals, the quality of the forces, their moral condition, etc., etc.; these are points which carry such great weight with able Commanders that they have often been known to have adopted plans the very reverse of what they would have done under contrary circumstances, according to their being in front of one or another General. Turenne,having for his opponent Condé, did not allow himself to do things which seemed to him as easy and a matter of course before the Archduke. On one occasion, in 1654, he lost some men while passing within the range of grape in front of the Spanish lines, which called forth remarks from some of the officers accompanying him. To these he replied: "The march we are making would be very imprudent before Condé's position; but it is very important that I should examine thoroughly this position; and I am so well acquainted with the Spanish service, that I feel assured that before the Archduke has been informed of it, has sent word to Condé, and called together his council, I shall have completed it and returned to camp." "See," said that Captain who more than the other was capable of pronouncing a judgment on such points, "here is something that pertains to the divine portion of the art." In truth, military genius manifests itself in just such subtle distinctions and delicate shades. See *Base of Operations*, and *Objective Point*.

LINE OF SIGHT.—In gunnery, the right line passing through the notch of the tangent-scale and tip of the trunnion-sight (at any elevation), and the object. See *Pointing*.

LINE OF WORKS.—When it is necessary to hold for a time a line of considerable extent by a force inferior to that which may be brought against it, the line should be fortified by intrenchments, consisting of a series of works laid out according to the approved principles. The kind of work for any particular position on the line will depend upon the nature of the locality it is to occupy and the manner in which it will combine with those adjacent in securing mutual support throughout. Such lines are frequently from fifteen to twenty, or even thirty miles in length, extending over every variety of country, and in their construction call for the highest skill in military engineering. They are constructed, usually, either for the protection of important towns, cities, and depots; or to make secure the base of operations and lines of communications of any army maneuvering in the field; or, by stretching across peninsular regions, to restrict the theater of operations of the enemy; or for surrounding and besieging a place; or for the purpose of holding the enemy in position with a part of an army while the remainder makes a flank or other strategic movement. The civil war of 1861-65 afforded numerous instances of each of these conditions.



The same general principles apply to lines as to other field-works; but, from their great extent, they usually receive only a slight relief, and the simplest angular figures are adopted for their plan. In laying them out, advantage should be taken of all the natural features presented by the position, so as to diminish the labor of erecting artificial ones. The flanks of a line or position are generally weak points. When possible, one or both should rest on natural points of support. A flank not so supported must be secured by strong works especially well garnished with artillery. A point that has not a clear field of fire is a weak point, and should be strongly intrenched, so that the enemy may not have advantage of hills, ravines, or other shelters in approaching the line. Care should be exercised in determining the kind of artillery for such positions. The field of fire being contracted, long range is not of so much importance as ability to search behind the enemy's shelter, or to throw a great mass of projectiles in a limited time. Mortars, howitzers, and machine-guns will be found serviceable. In establishing a line of works, the most important object should be to cover every portion of the front within fair range with direct or cross fire. To accomplish this, all prominent points along the line are fortified, each with a work having a trace most suited to the conformation of that particular site. The most important of these should be inclosed works upon the bastion-front principle, and of considerable size, capable of enduring an independent attack. Smaller inclosed works, such as redoubts and star forts, occupy the secondary points. Between the works thus located extend *rifle-trenches*, capable of sheltering infantry. The line is therefore composed of a series of works mutually supporting each other and covering every avenue of approach.

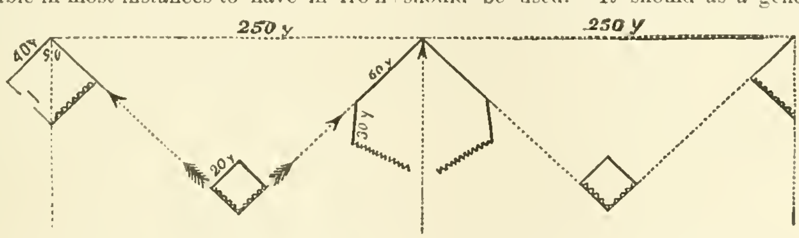
The artillery, of which there should be an abundance, will naturally be placed in the works occupying the most commanding and salient positions. These works should never be so far apart as to be out of mutual flanking range of the artillery with which they are armed. It is the duty of officers of artillery to co-operate with those of engineers in selecting the positions of the works that are to be armed with artillery, and to determine the kind and quantity to be placed in each. As infantry troops constitute the chief garrison of works of this nature, they will be required to construct them, leaving to the artillery the construction of magazines, embrasures, and the other accessories pertaining to their special arm. Generally these works are thrown up very hastily, and often when an immediate attack is apprehended; this, to a considerable extent, decides not only the nature of the works, but the parts of them that require the first attention. Subsequently, if time permits, they are strengthened, improved, and worked into better shape. As far as practicable, the line should be composed of inclosed works, for the reason that should the enemy concentrate and break through at any point, he will not be able to sweep the line to the right and left by taking it in flank and rear. To storm and capture each work in succession would be an operation too costly for him to undertake.

It is advisable in most instances to have in fro n of the line, within easy musket range, a line of small redans or lunettes at intervals of about 1,500 yards. Each of these should be capable of holding from one to two hundred infantry and four to six field-pieces. This line of outworks would form, as it were, a species of picket-line, keeping the enemy from closely observing and harassing the main line, and would constitute an advanced line of battle, against which the first shock of the enemy is partially thrown away, and he dare not attempt to neglect them; for an endeavor to penetrate through the intervals would expose his flanks to a close and deadly flank and cross fire. The redans being open towards the main line, could not be held if captured by the enemy. A somewhat similar line of works should be established in rear of the main line. They should, however, have their gorges stockaded or otherwise closed to prevent the enemy, should he succeed in forcing his way through the main line, from obtaining easy possession of them by the rear. Sites for them should be selected with a view of obtaining from them a searching fire of the front line in reverse. This line of works, although apparently inert in rear, must be kept fully armed and manned, ready to drive the enemy from any part of the main line that he may succeed in obtaining possession of. Prominent salients in the main line are especially inviting to the enemy; behind these a second line should be prepared, so placed, if possible, that should the enemy obtain the main line he will be within musketry range of the second, and be forced with wearied troops to undertake the capture of it. See *Field Fortification*.

LINES. The field-works known as lines are divided into several classes, according to the object for which they are constructed; or, according to some peculiar arrangement of their parts, or some other characteristic quality. They are most generally classified as *continued lines* and *lines with intervals*. There are no openings in a continued line, except those made for the use of the defense. Continued lines have been much used in past military operations, and will, in all probability, be used in the operations of the future. They may be usefully employed where a passive defense only is to be made, and where the position to be defended is limited in extent, and not exposed to flank attacks. They are not fitted for an active defense, and they have the serious disadvantage of being untenable, when any part of the line has been taken by the enemy. They require a large amount of labor to construct; and it is a very doubtful question, whether the advantages they give compensate for the time and labor employed in their construction.

Lines with intervals differ from the continued lines, by leaving intervals along the front of the position, which intervals present no obstructions to an enemy moving through them, excepting so far as they may be defended by the fire of the works, or may be obstructed by natural obstacles, or by artificial ones, placed along the front. The works forming the line may be placed so close to each other as to be in defensive relations; or they may be so far apart, as to admit only of their defending the intervals between them.

If an obstinate defense is to be made, a second line should be used. It should as a general rule be placed behind the first, and distant from it, about one-fourth, and certainly not greater than one-half, of the distance between the works in the first line. When artillery is used in the second line, a good position would be about six hundred yards distant from the first. This places the second line just out of range of aimed musketry fire, but in close range of artillery fire. A third line of field-works is sometimes built. The general arrangement of the works of this third line with the works of the first and second, conforms to the principles employed in arranging the work in the second line. A third line might be useful, in case of an active defense, since the works placed along this line can be utilized as screens for the reserves and for bodies of cavalry. A fourth line would evidently be of no practical service in the defence of a position. A force, unable to retain possession of outer lines, could not hold the fourth.



Plan of a Line with Intervals of Lunettes, or Square Redoubts flanked by Retired Redans.

The number of lines, whether a single one, or two, or three in number; the kinds of works to be used on each line; the distance apart of the works on each line; the distance apart of the lines; and the details of their construction, depend upon the natural features of the ground, the numbers and kinds of troops which are to occupy them, the range of the arm used in their defense, and the time disposable in which to construct them.

Certain advantages are claimed for lines with intervals. These advantages may be briefly stated to be as follows 1. The lines with intervals admit of either passive or active defense. They are peculiarly fitted for the latter. 2. Lines with intervals are more easily adapted to the natural features of the ground than continued lines. 3. For the same extent of front, they require fewer men to defend them, and the works require less labor to construct, than other kinds of lines. 4. They admit of a better use being made of raw and inexperienced troops. 5. A line with intervals may still be defended, even after a part of the line has been captured, or after the enemy has broken through the line.

The main defect inherent in lines of this class, is the sub-division of the defenders into several independent commands, by which unity of action of the whole command is impaired. This defect is reduced somewhat by a proper disposition of the works. A few capacious and strong works are better than a large number of small ones. Experience has shown that a body of one thousand men, in a single, well-constructed work will offer a more effective resistance to the attacks of an enemy than the same number would, when scattered among three, four, or more, smaller works. The difficulty which a General would meet, in obtaining experienced officers fit for these independent commands, and in having these officers to act in unison with each other, gives sufficient grounds for such a result to be expected under ordinary circumstances. See *Bastioned Line, Crémaillère Line, Multiple Lines, Redan Line, Rogniat Line, Serrated Line*, and *Tennaille Line*.

LINESMEN.—A term frequently applied in the British service to the infantrymen of the Regular Army.

LINES OF COMMUNICATION.—A term applied to all the practicable routes and roads connecting the different parts of an army occupying the theater of war. Therefore, as the army moves from its base, the *lines of operations* become *lines of communication*, and since these *lines of operations* are generally the longest and most important *lines of communication*, it is to them that the simple term *communications* generally refers. All the routes used by the trains employed in provisioning an army, form a part of the communications. The most important, safest, and most convenient of these routes, all other things being equal, will be the central one, or the one leading from the center of the army back to its base. This particular route is sometimes designated as the *line of supplies*.

LINES OF RETREAT.—The roads passed over by an army when advancing are ordinarily the roads taken when the army retires or is driven back. In the latter case they are known as Lines of Retreat, and are *Single, double diverging*, etc, according to their number and position. See *Retreat*.

LINES OF TORRES VEDRAS.—Famous lines of defense within which Wellington took refuge in 1810, when he found it impossible to defend the frontier of Portugal against the French armies; and from which, in the year following, he issued on that career of slow and hard-won victory, which ended in the expulsion of the French from the Peninsula. The *first*, or outermost of these lines, extending from Alhandra, on the Tagus, to the mouth of the Sizandro, on the sea-coast, and following the windings of the hills., was 29 miles long; the *second* (and by far the most formidable) from 6 to 10 miles behind the first, stretching from Quintella, on the Tagus, to the mouth of the St. Lorenza, a distance of 24 miles; the *third*, situated to the southwest of Lisbon, at the very mouth of the Tagus, was very short, being intended to cover a forced embarkation, if that had become necessary. The entire ground thus fortified was equal to 500 square miles.

LINES WITH INTERVALS.—When the front to be defended is covered by a number of field-works, scattered along this front, and placed near enough together to sweep the intervals with their fire, the whole arrangement forms a disposition called a Line with Intervals. Field-works placed so near to each other, that each one can bring its fire to bear upon the ground in front of those adjacent, are said to be in defensive relations with each other. See *Lines*.

LINGERER.—One who pretends to be indisposed, in order to avoid his tour of duty. Hence the expression malingerer, or a soldier who avoids duty in a disreputable manner.

LINKED REGIMENTS.—In localizing the forces of the British Army, it is laid down that in each of the sub-districts of the country two regiments shall be permanently selected (whether absent or present) to be so localized, and the mode of selection is of regiments having any connection with the county. These regiments are termed *linked*, and in the case of one of the regiments going or being on foreign service requiring men to make up its numbers, soldiers are drafted from the regiment remaining at home.

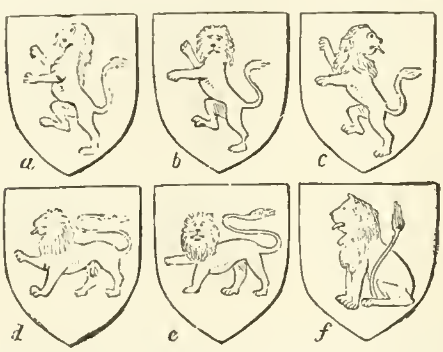
LINKED SHELLS.—Admiral the Hon. Arthur A. Cochrane has recently devised a novel method of marine attack and defense. Its very novelty may tend to prejudice against it those who are saturated with the conviction that nothing new which is also good can be devised in warfare; but the whole scheme is at once so simple, so ingenious, and so easily and cheaply tested, that it commends itself to impartial minds. He proposes to strew the line of approach of a hostile ironclad preparing to ram, or the wake of a ship when retreating, or the course of an enemy engaging on the broadside, with floating or partly submerged torpedoes, through which the pursuer dare not attempt to pass. These torpedoes could be thrown to some distance from the ship by means of mortars, which would fire very small charges of powder. Thus the 13-inch service mortar, at an elevation of 45 degrees, has a range of 850 yards with 3 pounds of powder, and with half a pound of powder a range of 180 yards when projecting a shell of about 180 pounds weight. The shells would have a charge of high-class explosive, say, of 35 pounds weight, surrounded by an envelope, whether of thin metal or other material, of sufficient capacity to buoy the bursting charge and of strength to resist the projecting charge of, say, 1½ pounds of powder. The shells would be connected by a floating line 100 feet or 200 feet in length, of small diameter, but of great strength; such coupled shells could be very readily fired from two mortars simultaneously by electricity; they could be placed quite close together; or the mortars, of which there would likely be six or eight on a large ship's deck, might be placed at a distance apart of 50 or 80 feet on the line of keel or otherwise, the rope still connecting the shells. The action of the air on the connecting line when the shells were fired would be to draw the shells together; but it is not anticipated that this would be a practical difficulty over the ranges expected, viz., from 200 to 1,200 yards as the mortars would be slightly deflected from each other. It is proposed to use such shells against ships on their near approach by firing them across and just ahead of the ship. It is clear that if the hostile ship still proceeded, she would, by fouling the rope, draw the shells alongside and be blown up, and as the shells would be concussive and fitted with time-fuses, they would doubtless not fail to act. Should the ship stop in time to avoid the shells, others could be thrown astern of or over her, so as to hamper her movements. Under any circumstances, the hostile ship could not ram her enemy, and by stopping would offer a good target for mortar shells to be thrown on her decks, and for artillery fire.

It is proposed to employ shells of several classes: "A" shells charged with explosives, capable of floating on water, cased in metal or other material, and united by a floating rope; to be fired across the bows of ships, or dropped across ships or ports in a tideway. "B" shells, charged with explosives, of slightly greater specific gravity than water; such to be regulated as to the depth they shall sink in water by means of an India-rubber tube or other material; such tube to be securely attached to the shell when it is fired, or by a line to the shell when it is necessary, filled with air and attached to the shell. In the case of land service, such a tube could be easily filled with explosive, and such tube could be attached to a second shell, for clearing parapets, trenches, etc., under special circumstances. "A" shells would be useful to clear hostile ships out of rivers, tideways, and to blow up buttresses of bridges floating-bridges, such as those lately used in the Danube, preventing ships entering the Dardanelles, etc. "B" shells, on being thrown near the ships and buoyed by a practically invisible tube, at a depth of say, 15 feet, would be very fatal on exploding. "B" shells could be thrown on the line of advance of a torpedo; and when entering a hostile port, defended by submerged torpedoes, they could be thrown in advance of ships entering, and regulated by means of the buoy line, to explode at any depth, or on the bottom, thus clearing the channel. The shells could be cased in metal and made in sections, or could be made of paper suitably prepared. Shells from mortars are now considered to be efficient in proportion to their falling weight. The shells suggested would be efficient in proportion, not to their weight, but to the charge of explosive carried. From the small weight of the mortars, very small charge and small recoil, they could be most readily fitted to any ship almost without strengthening fitments, and in the case of numerous river steamers would add but little to the draught of water. It will be seen that the success or failure of the whole scheme depends on the possibility of firing linked shells, so that their line of flight would be nearly parallel, and on the construction of the shells. Nothing but direct experiment can decide the first point; but it might be settled in a day for an outlay of a few pounds. The construction of the shells obviously presents some difficulties. Admiral Cochrane has proposed several designs for shells intended to overcome these difficulties. It may be fairly assumed that fire from mortars, whose shells would be, or might be, connected by a slight line, would be very inaccurate, particularly in high and cross winds. But if one is driven to make comparison of efficiency, the accuracy of artillary fire in ships in high cross winds may be seriously questioned, and the accuracy of action and aim of torpedoes fired from or at ships in motion may be very much more seriously questioned, particularly if fired at more than 500 yards distance. The bows and the sterns of ships are, as a rule, now the favored points for projecting the torpedoes, and compressed air, steam, steam pistons, and gunpowder, are being tried to endeavor to obtain a satisfactory means of projecting them into the water, after which they have to find some yet undiscovered process of making them go straight to the object to be struck, a result which, when there is any sea on, or the boat or vessel is in motion, will never be accomplished in any degree to be relied on. A comparison may be made between the effect of, say, a 100-ton gun, 30 feet long, burning 400 or 500 pounds of powder, and projecting a shot of three-quarters of a ton, against a 26-inch armor plate, and that of one of the shells proposed by Admiral Cochrane, falling when charged with 20 pounds or 30 pounds of gun cotton, on the deck or into the barbette battery of a 10,000 tons ironclad. Further, when the cost of the 100-ton gun, the powder and shot fitments, and complication of hydraulic gear required to work such a gun, are considered, as against a 13-inch mortar, weighing perhaps 12 hundred-weight, and requiring, so to say, no science to work it whatever, the advantage seems notably in favor of mortars as the principal arm. It may be observed that a sea-service 13-inch mortar weighs about 5 tons; its shell, loaded, about 200 pounds, carrying a bursting charge of some 10 pounds, and when fired at an angle of 45 degrees, with 3 pounds of powder, ranges 850 yards; but, as at present, Admiral Cochrane only suggests shells of a weight of, say, 100 pounds, and that to be projected to a distance of, say, 1,200 yards, and that as the mortars should be made of phosphor-bronze, 12 cwt. might, it is assumed, suffice for the weight of the mortar. The S. S. mortars have to face the firing of 200-pound shells up to a range of 4,000 or 5,000 yards. Mortar firing and sustained efforts to improve mortars have been but little considered. Rifled mortars are hardly known; and the suspended mortars—Roberts' patent, on turntables for sea service and used in the Baltic in 1854—have dropped out of sight, though they were stated to offer many advantages in principle, while faulty metal and construction were quoted against them.

LINOLEUM.—A peculiar preparation of linseed-oil, which is variously employed for military purposes. In 1849 Nicles and Rochelder independently discovered that chloride of sulphur will solidify oil, and render it usable in many new ways. In 1859 M. Perra communicated to the Académie des Sciences the details of a mode of effecting this by mixing and melting the ingredients, and pouring the mixture out in a thin layer. By varying the proportions the resulting substance assumes varying degrees of consistency. Thus, 100 linseed oil +25 chloride of sulphur produces a hard and tough substance; 100 oil +15 chloride a supple substance like India-rubber; and 100 oil + 5 chloride, a thick pasty mass. This third kind dissolves well in oil of turpentine. Mr. Walton afterwards found that, by the application of heat, linseed oil will become hard without the addition of chloride of sulphur. He conceives that it is not a mere drying, but a real oxidizing. Linseed-oil, first boiled, is applied as a layer to a surface of wood or glass, then dried; then another layer; and so on till the required thickness is produced. The sheet is then removed, and is found to be very much like India-rubber in elasticity; in fact, the production of a layer by this means is analogous to the smearing of clay-molds with caoutchouc juice to produce India-rubber, as practiced in South America. The drying is a little expedited by adding a small portion of oxide of lead. The solid oil is crushed, and worked thoroughly between heated rollers; and when treated either with shellac or with naphtha, it becomes applicable in various manufacturing forms. The term *Linoleum* properly applies to the hardened or the oxidized oil itself, but is cheifly used as a designation for one of the substances made from or with it, a kind of floor-cloth. When the oxidized oil is rolled into sheets it becomes a substitute for India-rubber or gutta-percha. When dissolved as a varnish or mastic and applied to cloth it is useful for water-proof textiles, felt-carpets, carriage-aprons, wagon and cart-sheets, nursing-aprons, water-beds, tank-linings, table-covers, etc., according to the mode of treatment. When used as a paint, it is useful for iron, for wood, and for ships' bottoms. When used as cement, it possesses some of the useful properties of marine glue. When vulcanized or rendered quite hard by heat it may be filed, planed, turned, carved, and polished like wood, and used for knife and fork handles, moldings, etc. When brought by certain treatment to the consistency of dough or putty, it may be pressed into embossed molds for ornamental articles. When used as a grinding-wheel, touched with emery, it becomes a good cutter. Lastly when mixed with ground cork, pressed on canvas by rollers, the canvas coated at the back with a layer of the same oil in the state of paint, and the upper or principal surface painted and printed, it becomes the *Linoleum* floor-cloth, for the production of which a factory has been established at Staines. Dunn's patented fabric for similar purposes has no oil in it; it is a mixture of cork-shavings, cotton, or wool fibers, and coutchouc, spread upon a cotton or canvas back, and embossed with patterns; it is a kind of kamptulicon.

LINSTOCK.—An iron-shod wooden-staff used in gunnery, for holding the lighted linstock in readiness to be applied to the touch-hole of the cannon. In old pictures, the linstock is seen planted in the ground to the right rear of each piece, with a match smoking at each of the ends of the fork in which it terminates.

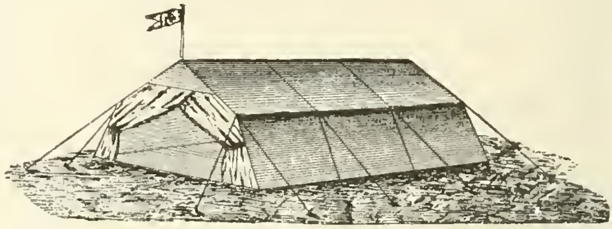
LION.—The lion holds an important place among the animals borne in coat-armor. As early as the 12th century, the king of beasts was assumed as an appropriate emblem by the Sovereigns of England, Scotland, Norway, Denmark, the native Princes of Wales, the Counts of Flanders and Holland, and various other European potentates. Lions occur in different positions. 1. The earliest attitude of the heraldic lion is *rampant (a)*, erect on his hind legs, and looking before him, the head being shown in profile, as he appears in the Arms of Scotland, and originally did in those of England. This was the normal position of a lion; but as the royal animal came to be more generally used by all who claimed to have any kindred with royalty, and to be granted to favorite followers by way of augmentation, some diversity of attitude was adopted for distinction's sake. 2. *Rampant gardant*



(*b*), erect on the hind legs, and affronté or full-faced. 3. *Rampant regardant* (*c*), erect on the hind legs, and looking backwards. 4. *Passant* (*d*), in a walking position, with the head seen in profile. 5. *Passant gardant* (*e*), walking, and with the head affronté. 6. *Passant regardant*, walking, and with head looking behind. 7. *Statant*, with all four legs on the ground. 8. *Saliant*, in the act of springing forward on his prey. 9. *Sejant (f)*, rising to prepare for action. 10. *Sejant affronté*, as seen in the crest of Scotland. 11. *Couchant*, lying down, but with his head held well erect, and his tail beneath him. 12. *Dormant*, asleep, with his head resting on his fore-paws. 13. *Coward* or *Coué*, with his tail hanging between his legs. The lion passant gardant is often blazoned as the *lion of England;* and at a time when terms of blazonry were comparatively few, it was confounded with the leopard, and hence the lion passant and rampant gardant came to be called respectively the *lion-leopardé*, and *leopard-lionné*. Two lions may be depicted *rampant combatant*—*i. e.*, face to face—or *rampant addossé*, placed back to back. Among leonine monsters, we have two-headed lions, bicorporate and tricorporate lions, lion-dragons and lion-poissons. There is also the Bohemian lion, with two tails, and the more celebrated winged lion of St. Mark, adopted by the Republic of Venice. The Island Republic bore, azure, a lion winged or sejant, holding between his fore-paws a book open argent, in which are the words, *Pax tibi Marce Evangelista meus.* Two or more lions borne on one shield are sometimes (though never when on a royal coat) blazoned *Lioncels*. See *Heraldry*.

LIP-STRAP.—A small strap with a buckle passing from one cheek of the bit through a ring in the center of the curb chain to the other cheek, for the purpose of preventing the horse from seizing the cheek of the bit in his mouth.

LIS.—A warlike machine used by the Ancients. It consisted of a piece of wood or a stake, about the size of the human body, which was made smaller at the top than at the bottom, and resembled a lily not yet blown. Several of these were tied together with ozier or willow twigs, and were used for the security of a camp. They were not unlike the palisades of the present day.



LISCHINE TENT.—A Russian hospital tent of peculiar construction, and well endorsed by military men. The frame is of iron, and is covered with thin pieces of board 10 feet long and 1 foot wide, overlapping each other like Venetian blinds. The ridge is of canvas. The iron frames are four in number. It has the advantage of being cheaper, more durable, warmer, and capable of better ventilation than the canvas tent. See *Tents*.

LISSBERGER FUSES.—The Lissberger percussion fuse, shown in Fig. 1, consists of a copper tapering body, A, with enlarged head, but closed at the rear by a brass screw-plug, which is hollow nearly its entire length. Fitting this screw-plug is a brass hollow cylinder filled with a friction composition; the

Fig. 1.

Fig. 2.

lower part of the cylinder is closed. A wire, whose lower end is serrated and twisted, passes through central holes in the screw-plug and the solid cylindrical plunger; it has its upper end looped to form a shoulder against the plunger. Between the plunger and the end of the screw-plug is a disk of leather.

The lower end of the screw-plug is closed by a small quantity of rifle-powder, and a disk of leather pressed in. The fuse-body has about the same taper rearward, and is inserted in the shell the same as the ordinary paper time-fuse; when inserted in a shell whose flight is suddenly arrested, the serrated wire is drawn forward by the plunger, igniting the friction composition, and setting fire to the charge.

The time-fuse is an ordinary paper fuse, A, shown in Fig. 2, which is ignited by means of an inertia igniter. The igniter, B, consists of four parts: A brass solid-headed shell, slightly tapering on the exterior, having holes in the head and side-openings for the escape of gas; through the head of the body, A, is introduced a hollow brass cylinder, whose lower end is cut and closed; within this cylinder is a lead plunger and a friction-pellet. At the instant of discharge, the friction-pellet is forced back and through the rough-closed end of the cylinder by the plunger and the time-fuse is thus ignited. See *Fuse.*

LIST.—1. A line inclosing or forming the extremity of a piece of ground, or field of combat; hence, in the plural, the ground or field enclosed for a race or combat. *To enter the Lists*, is to accept a challenge, or engage in a contest. 2. To engage in the public service by enrolling one's name, as soldiers; to inclose for combat. 3. A roll or a catalogue; as the *Army List*, the *Pay List*, etc.

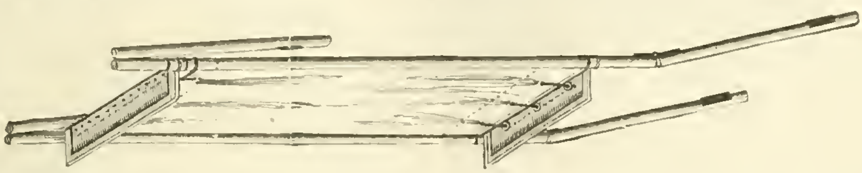
LISTENING GALLERIES.—The galleries of a fortification, leading outwards from the counter-scarp gallery. See *Gallery*.

LITHOFRACTEUR.—An explosive mixture having the following composition:

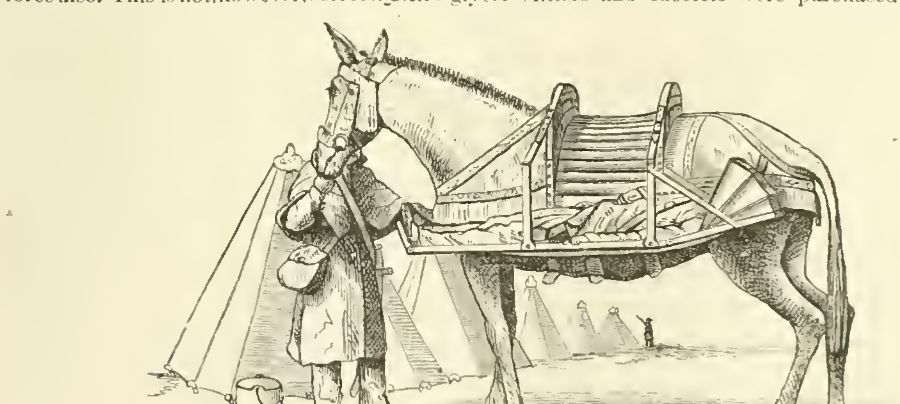
Nitro-glycerine	52.10	per cent.
Kieselguhr	30.00	"
Coal	12.00	"
Soda-saltpeter	4.00	"
Sulphur	2.00	"
	———	"
	100.00	"

Sometimes, instead of the sodium nitrate, the potassium of barium salt is used, and variations made in the quantity of nitro-glycerine contained in it. Like all the nitro-glycerine preparations, it has no necessarily definite composition, it being merely a mixture made according to the caprice of the manufacturers. This preparation is made by Krebs Bros. & Co. in Cologne, and has been used to some extent in Europe. It is claimed by the makers that the other substances (coal, saltpeter, and sulphur) mixed with the nitro-glycerine increase the quantity of gas delivered, and, therefore, the explosive force also. This is not, however, correct. Nitro-glycerine is so sudden in its explosion that nothing can be added to it from the slower burning of any of the other combustible ingredients, which are present in comparatively small amount and in bad proportions. Neither does the presence of these substances add any thing to the safety of the mixture. They tend to lower its firing-point, and render it more easily exploded. Its characteristics, as compared with dynamite, are: 1. Greater sensitiveness to temperature, exploding at 120°, while dynamite explodes at 190°; 2. Greater sensitiveness to moisture from the presence of the hygroscopic nitrate of soda; 3. The gases from the explosion always contain carbonic oxide from the carbon in the compound; 4. For equal volumes it has the lesser explosive power. See *Dynamite*, *Explosive Agents*, and *Nitro-glycerine*.

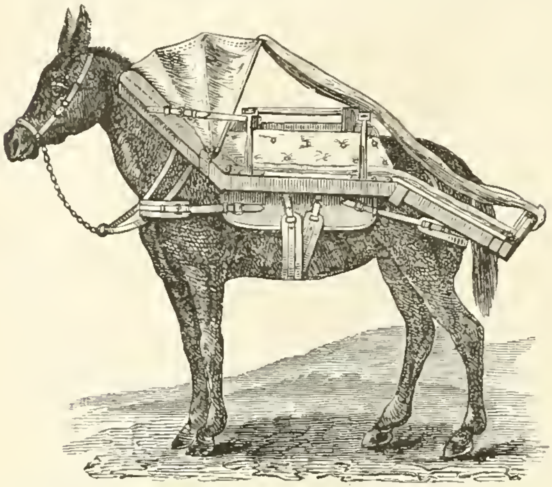
LITTER—A sort of a stretcher or hurdle-bed on which the wounded are carried off the field of battle. It is especially used for the badly wounded, who can only be carried lying down. In 1859 a Medical Board was convened to examine the subject of hospital transport. Besides various recommendations regarding the kind of vehicles suitable for the conveyance of patients and of supplies, the Board advised that *two-horse litters* should be constructed and issued to the frontier posts. This recommendation



was approved, and the specifications for the construction of such litters were incorporated in the Regulations for the Army. The form of litter recommended appears to have been derived from experiences in Florida and Mexico. The drawing shows the manner of its construction and its different parts. It weighs 88 pounds: the poles are $2\frac{3}{4}$ inches in diameter and 16 feet long; the sections are $4\frac{1}{2}$, 8 and $3\frac{1}{2}$ feet respectively from front to rear. Numerous improvised litters, constructed on the same general plan, have been extensively employed in Indian Campaigns and in travel over very rough country. During the late war in this country, a number of persons, actuated by motives of patriotism, humanity, or interest, devised and brought to the notice of the War Department forms of conveyance for the sick and wounded, in localities impracticable for wheeled vehicles. Several of these were apparently suggested by the descriptions of Delafield and McClellan of the horse-litters and cacolets they had observed in the Crimea. A number of sets of these litters and cacolets were purchased by the United

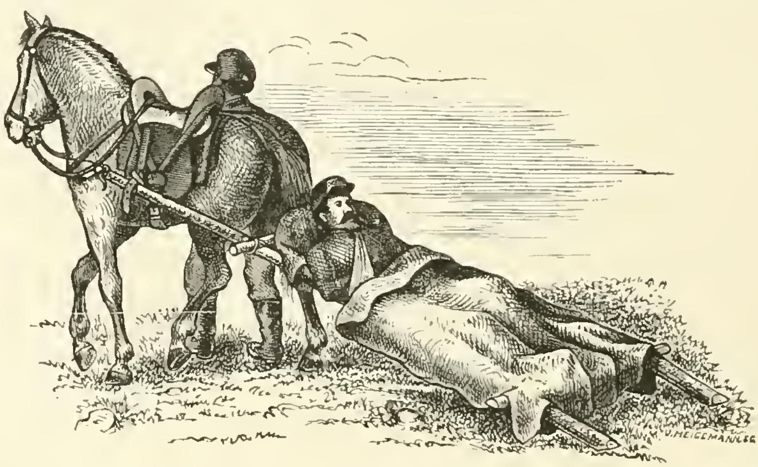


States Government, but were never used with success. The drawing shows the British Crimean mule-litter, also the very easy position of the wounded soldier when ready for transport, and the equipment. In the litters and cacolets now issued in the French Army there are improvements providing for making



the sections of the litter rigid, so that it can be used temporarily as a stretcher, for reduction in weight, and for greater compactness in packing. The mule-chairs and litters now issued by the British Royal Carriage Department are lighter and more conven-

A mode of transporting sick and wounded by litters that at one end rest on the ground, so that the patient is drawn, but only partially sustained, by the pack-animals, is mentioned by early travelers among the North American Indians. Parkman indicates that in the war with Pontiac, in 1763, the Colonists carried their wounded by this contrivance, and, in a later work, refers to the *travée* used by the Oregon Indians; and Lewis and Clark resorted to it in 1805, to carry a wounded hunter of their party. Latterly, this method of transport has received much attention from medical officers, as well adapted to the exigencies of frontier service. Assistant Surgeon McGillycuddy, United States Army, has made the accompanying drawing of such an appliance attached to a horse. A sacking bottom is lashed to two poles that are separated by traverses, and secured to the stirrup-leathers of a cavalry horse equipped with the regulation saddle. The soldier's pack makes a pillow, and a blanket is thrown over him. In this contrivance the utmost limit of simplicity has been attained. This form of litter is *drawn*, while the *two-horse* litter is *carried*, it being substantially a stretcher, either horses or mules being substituted for the men who act as stretcher-bearers. In the latter, one animal is harnessed between the poles before, and the second between the poles behind; the patient being



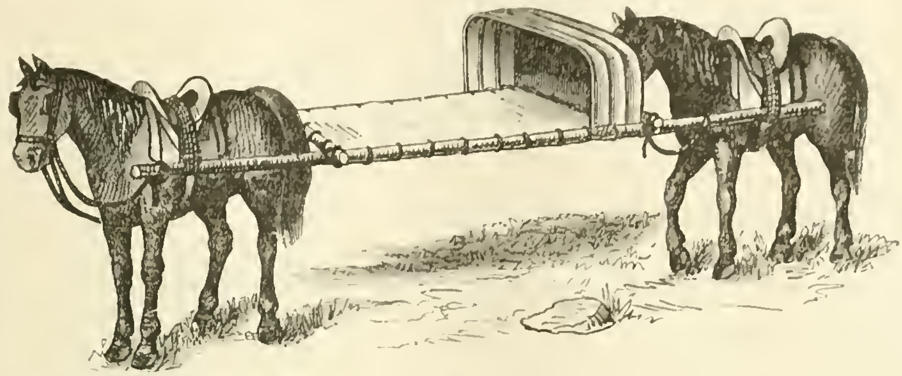
ient than those used in the Crimea. The drawing shows the British Army mule litter attached to its pack-saddle. It weighs 84 pounds, without bedding or pack-saddle. With the paillasses and pack-saddle, the weight is 167 pounds. The weight of a pair of English litters, used in the Crimea, was 138 pounds and 12 ounces, without the pack-saddle. So far as experience has gone, every form of litter and cacolet has been disapproved for one cause or another by the United States War Department. Although used in European services and in Algeria, with satisfaction and under favorable circumstances either on plains or on open rolling country, in our mountainous country, they are only a troublesome and barbarous encumbrance, cruel alike to the wounded and the pack-animals. This aversion to sick-transport by cacolets and double litters is doubtless due to defects in administration rather than to any demerits of the system, without efficient animals and packers it is vain to anticipate useful results from the best-contrived appliances. Used with the greatest advantage in Algeria, and in the Crimea, the French cacolets and litters were adopted by the British Army Medical Department with satisfactory results.

placed on a piece of canvas or other material, stretched between the poles in the intermediate space. Such a litter was extemporized by Assistant Surgeon A. Hartsuff, United States Army, as shown in the drawing.

This litter possesses the disadvantage of accident in case the two animals do not work well together; also, if the animals keep step, the litter begins to vibrate, from the regularity of the motion, and increases to such a degree as to almost throw the patient out. Again, the litter cutting off the sight of the ground from the rear animal, makes him particularly liable to stumble. All things considered, it would appear that the one-horse litter is far superior to this form, and the experience of all having had occasion to use both contrivances, confirms this opinion. The aparejo is the favorite pack-saddle for general purposes in America, and it is believed that ambulance-chairs and litters can be adjusted with facility to these saddles; what is essential is that there should be trained animals and skilled packers. Until these indispensable adjuncts are provided the contrivances found useful in European armies cannot be advantageously employed in our service, and medical officers will be compelled to resort in emergencies to the travée or to the two-horse litter. See *Ambulance*, *Cacolet*, *Stretcher* and *Travée*; also *Cleary*, *Doane*, *Greenleaf*, *McElderry*, and *Thistle Litters*.

and till the Reform Bill in 1832, they had the exclusive privilege of voting for Members of Parliament for the city.

LIVE SHELLS.—Shells loaded with their bursting charges ready for service.



LITTLE FORTIFICATION.—The name given to the first division of the first system of Vauban, when the exterior side of the fortification does not exceed 350 yards. It is used in the construction of citadels, small forts, crown-works, and horn-works. See *Fortification*.

LIVE HEAD.—The *head-stock* of a lathe, which contains the *live-spindle*; in contradistinction to the *dead-head* or *tail-stock*, which contains the *dead spindle*.

LIVERY.—A word applied in its origin to the custom which prevailed under the Merovingian and Carlovingian Kings, of delivering splendid habits to the members of their households on great festivals. In the days of chivalry, the wearing of livery was not, as now, confined to domestic servants. The Duke's son, as page to the Prince, wore the Prince's livery, the Earl's son bore the Duke's colors and badge, the son of the Esquire wore the livery of the Knight, and the son of the gentleman that of the Esquire. Cavaliers wore the livery of their mistresses. There was also a large class of armed retainers in livery attached to many of the more powerful nobles, who were engaged expressly to use the strong hand in their master's quarrels. By the colors and badge of the retainer was known the master under whom he served. The livery colors of a family are taken from their armorial bearings, being generally the tincture of the field and that of the principal charge, or the two tinctures of the field are taken instead, where it has two. They are taken from the first quarter in case of a quartered shield. These same colors are alternated in the wreath on which the crest stands The royal family of England have sometimes adopted colors varying quite widely from the tinctures of the arms. The Plantagnets, for instance, had scarlet and white colors, the House of York, murrey and blue; white and blue were adopted by the House of Lancaster; white and green by the Tudors; yellow and red by the Stuarts, and by William III.; and scarlet and blue by the House of Hanover. An indispensable part of the livery in former times was the badge. The Church of Rome has its liveries for Apostles, Confessors, Martyrs, Virgins, and Penitents. The Freemen of the 91 guilds or corporations which embrace the different trades of London, are called Liverymen, because entitled to wear the livery of their respective companies. In former times the Wardens of the companies were in use yearly to deliver to the Lord Mayor certain sums, 20 shillings of which was given to individuals who petitioned for the money, to enable them to procure sufficient cloth for a suit, and the companies prided themselves on the splendid appearance which their liveries made in the civic train. The Common Councilmen, Sheriffs, Aldermen, and some other superior officers of the city are elected by the Liverymen of London;

LIVING FORCE.—That force of a body in motion which determines the work of which it is capable. It is measured by the product of the mass and the square of the velocity. See *Force*, and *Work*.

LIZIERE.—The berme or narrow path round fortifications between the parapet and the ditch, to prevent the earth from falling in.

LLAMA.—This animal was in general use as a beast of burden on the Peruvian Andes at the time of the Spanish conquest, and was the only beast of burden used by the natives of America before the horse and ass were introduced by Europeans. It is still much used in this capacity on the Andes, the peculiar conformation of its feet enabling it to walk securely on slopes too rough and steep for any other animal. The working of many of the silver mines of the Andes could scarcely be carried on but for the assistance of llamas. The burden carried by the llama should not exceed 125 pounds. When too heavily loaded the animal lies down and refuses to move, nor will either coaxing or severity overcome its resolution. It is generally very patient and docile. Its rate of traveling is about 12 or 15 miles per day. See *Pack Animals*.

LOAD.—1. A word of command in the Manual of Arms, executed as follows: The Instructor commands—1. *Squad*, 2. LOAD. Execute the first motion of *about face*, the left knee slightly bent: at the same time drop the piece into the left hand at the lower band, elbow against the body, the small of the stock two inches below the right breast, the barrel sloping downward at an angle of about twenty-five degrees, the right hand at the small of the stock. (Two.) Look toward the chamber, open it, remove the cartridge-case if necessary, take a cartridge from the cartridge-box, and hold it near the chamber, between the thumb and first two fingers. (Three.) Place the cartridge in the bore, pressing it home with the thumb, close the chamber, cast the eyes to the front; carry the right hand to the small of the stock, and raise the muzzle to the height of the chin. 1. *Carry*, 2. ARMS. Resume the carry with the right hand, at the same time face to the front. (Two.) Drop the left hand by the side. With cartridges, the commands for loading, previous to the first are: 1. *With ball* (or *blank*) *cartridge*, 2. LOAD. 2. The term "load" is also applied to to the charge of a fire-arm. See *Loading* and *Manual of Arms*, *Fig.* 14.

LOADER.—An instrument used with smooth-bore siege howitzers to steady the shell in the passage down the bore. The fixed iron band which crosses the hollow hemisphere of the loader has a hole in it which embraces the fuse, and which on reaching the bottom of the bore can be easily disengaged.

LOADING.—In loading guns and howitzers, the powder is carefully put up in a cartridge-bag of woolen cloth, which is either attached to or carried separate from the projectile, depending on the weight of the projectile. In ramming a charge, only a sufficient force should be used to send it home, as the space which the powder occupies affects the initial velocity. In loading mortars, the powder is poured from the cartridge-bag into the chamber, and leveled with the hand; the shell is then carefully lowered upon it with the hooks. After a piece has been discharged the bore should be well sponged, to extinguish any burning fragments of the cartridge that may remain; and to prevent the current of air from fanning any burning fragments that may collect in the vent, it should be kept firmly closed with a thumb-stall in the operation of sponging. Experience shows that the use of a wet sponge is dangerous, as it contributes to form, from the fragments of the cartridge-bag, a substance which retains fire. It may be sometimes necessary to fire projectiles that are either very much smaller or larger than the bore. If it be desired to use a gun-shell, or solid shot, which is very much smaller than the bore, it should be very securely strapped to a stout sabot which fits the bore; if a mortar-shell, it is placed in the center of the bore by means of wedges, and the surrounding space is filled up with earth. Mortar-shells are fired from guns and howitzers, by digging a hole in the ground about 20 inches deep, and placing in it two pieces of stout plank inclined at an angle of 45°, for the support of the breech; the chase is supported on a moveable wedge, which rests on skids firmly secured with platform stakes; the charge of powder is then inserted in the bore, and the projectile is placed on the muzzle and secured by passing strings over it, and tying their ends to a rope, which encircles the neck of the chase. Pieces fired in this way should be elevated 40° or 45°; thus situated, the fuse of the 8-inch mortar-shell takes fire from very small charges; but the 10-inch fuse should be primed with strands of quick-match, which are allowed to hang over the sides of the shell.

LOADING-BAR.—A more convenient implement than the shell-hooks for carrying and loading the shell. It is simply a bar of round iron about two feet long, fashioned into a ring at one end for a handle, and having a screw cut on the other end, which screws into a shallow hole tapped in the shell at a short distance from the fuse-hole. When the shell is lowered into the bore and adjusted, the bar is unscrewed and removed.

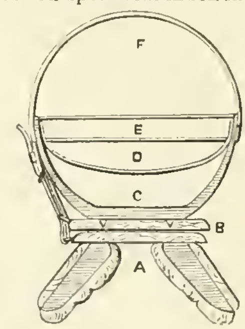
LOADING SIDE OF A GUN.—The side of the grooves of a gun, by which a projectile passes down the bore of a rifled gun from the muzzle. The studs of the shot press against this side when being loaded, but on being forced out by the explosion of the charge, they press against the other side, termed the *driving* side.

LOADING-TONGS.—Tongs for placing in the charges and shells of siege howitzers. They are formed of two arms, so hinged together that the bent ends of the short arms will enter the ears of the shell, and the grooved and widened ends of the long ones will clasp between them the cartridge. The implement is made of such a length that the cartridge can be thrust into the chamber by reaching in one hand, holding the tongs with the cartridge in position.

LOCALIZATION. The act of establishing troops, depots, magazines, etc., in any appointed place, dividing them into a number of small centers independent of each other. In case of mobilization of an army, each appointed town forms a place of rendezvous, where men on furlough and those belonging to the reserve meet to obtain their arms and equipment, and to be drilled until they are draughted into the regiments in the field, or join the army of reserve.

LOCAL RANK. The rank given to an officer in Her Majesty's service serving in a foreign land with other troops, whereby he is placed in his proper position, as regards equality of rank, with those officers whose first commissions are of the same date, but who have been more fortunate in promotion. For instance, a British officer located in India, with his regiment and with troops belonging to the Indian Army, may find himself junior in rank to an Indian officer, though his first commission is of the same date; to equalize their standing in the country, what is termed *local* rank is conferred by the Commander in-Chief in India.

LOCATI LITTER.—A single mule-litter designed by M. Locati, of Turin, for the passage of the narrowest defiles, avoiding as far as possible obstructions from tree-branches overhead or impediments on either side. It is looked upon with much favor in Europe.



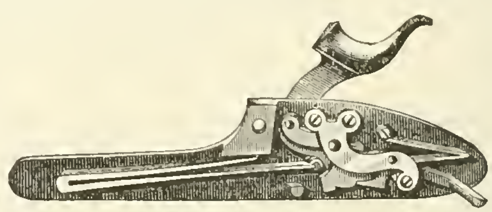
The drawing shows a cross-section of this litter, with its frame, braces, and cover, C. D. E. F., attached to its saddle, A. See *Litter*.

LOCHABER AXE.—An axe with a curved handle and very broad blade. It was the ancient weapon of the Highlanders, and was carried by the Old City Guard of Edinburgh.

LOCHAGE.—In Greek antiquity, the title of an officer who commanded a cohort.

LOCHOI.—The designation for a *file* in the elementary tactical formations of the Greeks. The composition of the grand phalanx was as follows: Tetraphalangarchia = 4 *Phalanxes* = 16 *Chiliarchiæ* = 64 *Syntagmata* = 256 *Tetrarchiæ* = 1024 *Lochoi* or files = 4 096 *Enomitiæ* of 4 men each. It is thus seen that, in the various formations, one division of the whole could be made by the powers of 2 or 4.

LOCK—1. In fencing, to seize, as the sword-arm of an antagonist, by turning the left arm around it, in order to disarm him. 2. That part of a fire-arm by which the powder is fired. Muskets, in their earliest use, were fired by the hand applying a slow match to the touch-hole. Towards the end of the



14th century, the first improvement appeared in the *matchlock*. This consisted of a crooked iron lever, in the end of which the match was fixed. By a pin-gear of a simple nature, pressure on the trigger brought the match accurately down on the powder pan, of which the lid had previously been thrown forward by the hand. This mode of firing involved the carrying of several yards of slow match, usually wound round the body and the piece; rain extinguished the match, and wind dispersed the powder in the pan, so that the match-lock, clumsy withal, was but an uncertain apparatus.

Superior to the match-lock was the *wheel-lock*, introduced at Nuremberg in 1517, in which fire was produced by friction between a piece of flint or iron pyrites and a toothed wheel. The mechanism which generated the sparks simultaneously uncovered the pan, so that the dangers from wind and rain were averted; but before firing, the apparatus required to be wound up like a clock, and therefore the charges could not be frequent.

The wheel-lock continued for a long period to be used in Germany, and partially in France. In the Spanish dominions, however, its place was supplied by the simpler contrivance called the snaphaunce, snapphahn, or the asnaphan lock, of nearly contemporaneous invention, which, acting by means of a spring outside of the lock-plate, produced fire through the concussion of a flint against the ribbed top of the powder-pan. Its positions of half and full-cock were obtained by the insertion of a pin to stay the operation of the mainspring. In the middle of the 17th century the *flint-lock* was invented, combining the action of the wheel-lock and the snaphaunce, while it was incontestably superior to either. After combating much prejudice, it was universally adopted in the armies of western Europe by the commencement of the 18th century. Muskets embracing it obtained the name of "fusils," a French adaptation of the Italian word *focile*, a flint. With successive improvements, the flint-lock continued in general use until the introduction of the *percussion-lock* almost in our own day; and among eastern and barbaric nations the flint-lock is still extant. Its great superiority over the snaphaunce consisted in the "tumbler" (of which presently) and also the "scear," appliances still retained in the percussion-lock, which enabled the positions of half and full cock to be taken up without the intervention of pins, always uncertain in their action.

The principle of the percussion-lock is the production of fire by the falling of a hammer upon some detonating powder, the explosion of which penetrates well into the charge in the barrel of the gun. The first practical application of this principle to fire-arms is due to the Rev. Mr. Forsyth, of Belhelvie, in Aberdeenshire. Various forms in which to ignite the detonating powder have been devised, but that generally accepted until within the last few years was the copper cap, fitting tightly on the nipple of the gun, charged with a detonating compound, and exploded by the hammer falling upon it. The mainspring communicates through the swivel with the tumbler, which concentrically with the hammer moves on the tumbler-nail. After the hammer has delivered its stroke, its further progress in the direction required by the spring is barred by the nipple. On pulling back the hammer to the position of half-cock the tumbler turns with it, and the pointed end of the scear (which moves on the scear-nail as center), influenced by the scear-spring falls into a notch in the tumbler. On forcing back the hammer to full-cock, however, the scear will move down to a shallower notch; and on the lever end of the scear being raised by the trigger, it brings down the hammer with a heavy blow on the cap. To keep the works firmly in their several places, a "bridle" is screwed over them which includes the pin through the tumbler in its width. Since the adoption of breech-loading arms, the action of the lock is so far varied that the hammer usually falls on a movable pin, which is impelled against a detonating charge placed in the body of the cartridge itself. A spiral spring around the pin brings it back to the position necessary for another blow. The advantage of this arrangement is that one operation of loading is substituted for the double process of loading and capping.

The conditions to be fulfilled in the construction of a military lock, are—1st. The production of fire, and its communication with the charge, should be certain, and under the perfect control of the soldier. 2d. The cap should be placed upon the cone with facility, and it should not be displaced in handling the piece. 3d. Fragments of the cap should not incommode persons near by, nor should the gas generated by the explosion of the cap corrode or injure the cone, barrel, or stock. 4th. There should be no danger of accidental explosions. The ordinary percussion lock as commonly constructed is composed of the *lock-plate*, to which the several parts are attached, and by which the lock is fastened to the stock; the *hammer*, which strikes upon the cap, and explodes the composition; the *mainspring*, which sets the hammer in motion; the *tumbler*, or axle, by which the power of the mainspring is communicated to the hammer; the *sear*, or lever, the point of which fits into the notches of the tumbler, and holds the hammer in the required position; the notches are designated as the *full-cock notch*, and *safety-notch*; the *sear-spring*, which presses the point of the sear well into the tumbler notch; the *bridle*, which is pierced with two holes for the inner pivots of the sear and tumbler; the *swivel*, which joins the mainspring and tumbler. The foregoing constitute the essential parts of an ordinary percussion-lock; in addition to these, the new service lock is supplied with Maynard's self-priming apparatus. The primer used in this apparatus, is a long strip of paper containing about 60 charges of percussion-powder, distributed at uniform intervals. The strip is wound up in the form of a coil, and inserted in a cavity cut into the exterior surface of the lock-plate, called the magazine. One end of the coil protrudes through an opening in the *magazine*, so that the center of the first charge of percussion-powder is directly over, but not in contact with, the top of the cone. When the lock is sprung, the primer is accurately cut off by a knife-edge located on the lower side of the face of the hammer, carried forward and promptly exploded on the top of the cone. A *feeding-finger*, connected with the tumbler, pushes out another primer, when the hammer is brought to the position of "full-cock." Other methods are used for self-priming, in some of which the primer is enclosed in the cartridge itself; but few are found, under all circumstances, to be as reliable as the common percussion lock. In the back-action lock, the mainspring is placed in rear of the tumbler, and the sear-spring, as a separate part, is dispensed with. The mortise, which forms a bed for this lock, seriously affects the strength of the stock at the handle; and, for this reason, the front-action lock is generally preferred for military arms. The drawing shows the Parker lock at full-cock. See *Springfield Rifle*.

LOCK CYLINDER.—A component part of most machine-guns. Behind the *carrier-block* the shaft carries another cylinder, called the *lock-cylinder*, in whose surface guide-grooves are formed, which are in line with the barrels, and in which slide long breech-plugs or locks, called *lock-tubes* or *plungers*, by which the cartridges are thrust into the barrels, and which close the barrels and resist the reaction of the charges when they are fired. This cylinder is called the *lock-cylinder*, because each plug or lock contains a spiral mainspring acting on a firing-pin or hammer, by which the charge is fired, so that the plug performs all the functions of a gun-lock, as well as of a breech-plug. See *Gatling Gun*.

LOCKET.—A name sometimes applied to the chape of a sword-scabbard; the metallic part put on the end to prevent the point of the sword from piercing through it.

LOCKING ANGLE.—The turning angle of carriages, or the angle formed between the gun-carriage and limber, when the wheel of the latter comes in contact with the trail.

LOCKING-CHAIN.—The work of holding back a carriage, on descending ground, devolves on the pole-horses. When the descent is very steep and the load large, they are relieved of a portion of this work by attaching a chain to one of the rear wheels, in such a manner as to prevent it from turning, and thereby changing the friction on the axle-arm to friction on the ground. In field-carriages, one end of the locking-chain is secured to the stock by an assembling-bolt, and the other is passed around the felloe, and secured to itself by a key. In siege-carriages, where the load is much heavier, a shoe is attached to the chain, upon which the wheel rides. This prevents the tire from being worn and the wheel from being strained; at the same time, the operation of locking and unlocking can be performed without stopping the carriages. The lock-chains on caissons are fastened to *lock-chain bridles* under the front ends of the side-rails, and are held up by *lock-chain hooks* fastened to the outside of the side-rails.

LOCKING PLATE.—A plate of metal fixed on each side of the trail of a wooden field carriage, at that point where the wheel of the limber, when it is turned round, comes in contact with the trail, called the locking angle. The plate being thus placed, the trail can receive no damage, as the plate acts as a fender.

LOCK-NAIL.—One of the pins by which the parts of a gun-lock are secured to the *lock-plate*. In the old form of lock, they are the *tumbler-pin, mainspring-screw, sear-pin, bridle-screw, hammer-nail*, and *hammer-spring screw*.

LOCK-NUT.—A nut placed in contact with the main nut, on the same shaft, to keep the main nut from turning. It is of frequent occurrence in the construction of artillery carriages, the elevating gears, etc. It is also called *jam-nut* or *check-nut*.

LOCK-PIECE.—A block of metal at the outer opening of the vent for the attachment of the lock. As friction-tubes are now used for firing cannon in the land service, this part is omitted.

LOCK PLATE.—The plate in a small-arm which covers the lock, and to which the mechanism is attached.

LOCKSPIT.—In field fortification, the small cut or trench made with a spade, about a foot wide, to mark out the first lines of a work.

LOCK-STEP.—A mode of marching by a body of men going one after another as closely as possible, in which the leg of each moves at the same time with, and closely follows, the corresponding leg of the person directly before him.

LOCOMOTIVE CRANE.—Cranes of this type consist of a rotary crane, usually of the pillar variety, mounted upon a suitable car or truck, and provided with an independent boiler and engine, the power of which is utilized for hoisting, lowering and rotating the load, and also for propelling the car upon its tracks. Locomotive cranes are of a great convenience in large works of all kinds where the buildings cover much ground and are connected by means of railroad tracks. By means of these tracks the crane can be transferred from one place to another, to suit the requirements of the work, and can be utilized also for transferring heavy loads from one building to another. They are useful also upon freight wharves, where, by means of a track laid near the edge of the wharf, they can be utilized for unloading vessels, and also for transferring heavy loads from one vessel to another. The construction of cranes of this type is varied according to the requirements of the work to be done. See *Cranes*.

LOCOMOTIVE TORPEDOES.—During the war between Great Britain and the United States in 1812-14, this name was applied to certain mysterious boats invented by Fulton and other Americans for the purpose of navigating beneath the surface of the water, and injuring the bottoms of hostile vessels. In those days of hand-to-hand naval war, all these designs (which, by the way, were failures) were looked upon as little less than diabolical. The progress of destructive weapons during half a century has removed this aversion. The modern torpedo is of two kinds—first, the locomotive torpedo, which is in various ways projected against the side of a hostile vessel; secondly, the fixed torpedo, a kind of stationary bomb-shell intended to explode under the bottom of the enemy's ship. To these fixed torpedos it is now more usual to give the appropriate name of submarine mines.

Of locomotive torpedoes there are three classes: (1.) The Whitehead 'fish torpedo,' which has a fish-shaped case, and is propelled in a straight line under water by means of a small screw-propeller driven by compressed air. It is discharged from a carriage on the deck of a man-of-war, and explodes on impact against the object aimed at. The secret of the construction has been sold by the inventor to the Austrian, Russian, and English Navies. (2.) The Harvey 'towing torpedo,' which is towed out at an angle from the side of the attacking ship, and maneuvered so as to come in contact with the bottom of the ship attacked. It is exploded either mechanically on contact, or by means of an electric fuse, the wire being inserted in the towing line. (3.) Boom, or outrigger torpedoes, which are carried on long booms in the bows of boats or steam-launches, and thus driven against the side of a hostile ship and exploded. Torpedo boats are becoming a special feature of European Navies: they are swift steamers not more than 60 feet long, lying low in the water, and steaming up to 19 knots an hour. The *Polyphemus*, added to the English Navy in 1881, is an armored ram, expressly and cunningly designed for torpedo warfare (carrying Whitehead torpedoes) and is a formidable vessel, 240 feet long. See *Torpedoes*.

LODGE ARMS.—An old word of command, which was used on guards and pickets for the men to place their arms in front of the guard-house or quarter-guard.

LODGED.—A term in Heraldry. A beast of chase, as a stag, is said to be lodged when lying down with its head erect; a beast of prey in the same position is said to be couchant.

LODGING-MONEY.—An allowance in the British Army, granted to officers and others, for whom suitable quarters cannot be provided in barracks. Married Sergeants and private soldiers who are married "with permission," are entitled to lodging-money at various rates up to 8s. a week, when separate rooms in barracks cannot be spared for the accommodation of each couple. The total charge for lodging-money in the Army Estimates amounts to about £100,000.

LODGMENT.—1. In gunnery, the hollow or cavity in the under part of the bore, where the shot rests when rammed home; it is formed in smooth-bore ordnance, after much firing, from the elastic force of the powder acting upon the upper surface of the projectile, and forcing it down, so as to occasion an elliptical indentation. 2. In fortification, an intrenchment hastily thrown up on a captured breach or outwork, in order to maintain the position against recapture. See *Siege*.

LOGARITHMS.—A series of numbers having a certain relation to the series of natural numbers, by means of which many arithmetical operations are made comparatively easy. The nature of the relation will be understood by considering two simple series such as the following, one proceeding from unity in geometrical progression, the other from 0 in arithmetical progression:

Geometrical series—1, 2, 4, 8, 16, 32, 64, 128, 256, 512, etc.
Arithmetical series—0, 1, 2, 3, 4, 5, 6, 7, 8, 9, etc.

Here the ratio of the geometrical series is 2, and any term in the arithmetical series expresses how often 2 has been multiplied into 1 to produce the corresponding term of the geometrical series; thus, in proceeding from 1 to 32, there have been 5 steps or multiplications by the ratio 2; in other words, the ratio of 32 to 1 is compounded five times of the ratio of 2 to 1. It was this conception of the relation that led to giving the name of *logarithms* to the arithmetical series, the word *logarithm* meaning "the number of the ratios." As to the use that may be made of such series, it will be observed that the sum of any two logarithms (as we shall now call the lower series) is the logarithm of their product; e.g., 9 ($=3+6$) is the logarithm of 512 ($=8\times 64$). Similarly, the difference of any two logarithms is the logarithm of the quotient of the numbers; a multple of any logarithm is the logarithm of the corresponding number raised to the power of the multiple; e.g., 8 (= 4 × 2) is the logarithm of 256 (= 16^2), and a submultiple of a logarithm is the logarithm of the corresponding root of its number. In this way: with complete tables of numbers and their corresponding logarithms, addition is made to take the place of multiplication, subtraction of division, multiplication of involution, and division of evolution. In order to make the series above given of practical use, it would be necessary to complete them by interpolating a set of means between the several terms, as will be explained below. We have chosen 2 as the fundamental ratio or base, as being most convenient for illustration; but any other number (integral or fractional) might be taken; and every different base or *radix*, gives a different system of logarithms. The system now in use has 10 for its base; in other words, 10 is the number whose logarithm is 1. The idea of making use of series in this way would seem, upon inquiry, to have been known to Archimedes and Euclid, without, however, resulting in any practical scheme; but by the end of the 16th century, trigonometrical operations had become so complicated that the wits of several mathematicians were at work to devise means of shortening them. The real invention of logarithms is now universally ascribed to John Napier, Baron of Merchistoun, who in 1614 printed his *Canon Mirabilis Logarithmorum*. His tables only give logarithms of sines, cosines, and the other functions of angles: they also labor under the three defects of being sometimes + and sometimes —, of decreasing as the corresponding natural numbers increase, and of having for their *radix* (the number of which the logarithm is 1) the number which is the sum of

$$1 + 1 + \frac{1}{1.2} + \frac{1}{1.2.3} +, \text{ etc.}$$

These defects were, however, soon remedied: John Speidell, in 1619, amended the tables in such a manner that the logarithms became all positive, and increased along with their corresponding natural numbers. He also, in the sixth edition of his Work (1624), constructed a table of Napier's logarithms for the integer numbers, 1, 2, 3, etc., up to and including 1000, with their differences and arithmetical complements, besides the numerous other improvements. Speidell's tables are now known as *hyperbolic logarithms*. But the greatest improvement was made in 1615 by Professor Henry Briggs, of London, who substituted for Napier's inconvenient "radix" the number 10, and succeeded before his death in calculating the logarithms of 30,000 natural numbers to the new radix. Brigg's exertions were doubly seconded; and before 1628 the logarithms of all the natural numbers up to 100,000 had been computed. Computers have since chiefly occupied themselves rather in repeatedly revising the tables already calculated than in extending them.

The following is the simplest method of constructing a table of logarithms on Brigg's system. The log of 10 = 1; the log. of 100 (which is twice compounded of 10) = 2·; the log. of 1000 = 3·, etc.; and the logarithms of all powers of 10 can be found in the same manner. The intermediate logarithms are found by continually computing geometric means between two numbers, one greater and the other less than the number required. Thus, to find the log. of 5, take the geometric mean between 1 and 10, or 3·162..., the corresponding arithmetic mean (the log. of one being 0, and that of 10 being 1·) being ·5; the geometric mean between 3·162... and 10, or 5·163..., corresponds to the arithmetic mean between ·5 and 1·, or ·75; in a similar manner the geometric mean between 3·162... and 5·623..., or 4·216..., has its logarithm = ½ (·75 + ·5), or ·625; this operation is continued till the result is obtained to the necessary degree of accuracy. In this example, the twenty-first result gives the geometric mean = 5·000,003, and the corresponding arithmetic mean = ·698,970, which is in ordinary calculations used as the logarithm of 5. Since division of numbers corresponds to subtraction of logarithms, and since $2 = \frac{10}{5}$, the log. of 2 = log. 10 − log. 5 = 1· − ·698970 = ·301030. The logarithms of all prime numbers are found in the same way as that of 5; those of composite numbers are obtained by the addition of the logarithms of their factors; thus, the log. of 6 = log. 2 + log. 3 = ·301030 + ·477121 = ·778151. This method, though simple in principle, involves an enormous amount of calculation; and the following method, which depends on the modern algebraic analysis, is much to be preferred. According to this method, logarithms are considered as indices or powers of the radix; thus, $10^0 = 1$, $10^{\cdot 301030} = 2$, $10^{\cdot 477121} = 3$, $10^2 = 100$, etc.; and the laws of logarithms then become the same as those of indices. Let r represent the radix y the natural number, x its logarithm: then $y = r^x$, or, putting $1 + a$ for r, $y = (1+a)^x$; and it is shown by the binomial and exponential theorems (see the ordinary works on algebra) that $y = 1 + Ax + \frac{A^2x^2}{1.2} + \frac{A^3x^3}{1.2.3} +$, etc., where $A = r - 1 - \frac{1}{2}(r-1)^2 + \frac{1}{3}(r-1)^3 -$, etc., the former equation expressing a number as the sum of different multiples of its logarithm and the radix.

If $\frac{1}{A}$ be now substituted for x, then, $y = r^{\frac{1}{A}} = 1 + \frac{1}{1.2} + \frac{1}{1.2.3} +$, etc. = 2·71828182.... which, as before mentioned, is Napier's radix, and is generally called e; then $r^{\frac{1}{A}} = e$, or $r = e^A$, or A is the logarithm of r to the base of radix e. Then, referring to the above-mentioned value of A, we have log. $_e r$ (*i.e.*, log. of r to the base of e) $= r - 1 - \frac{1}{2}(r-1)^2 + \frac{1}{3}(r-1)^3 -$, etc., or, as before, putting $1 + a$ for r,

$$\log._e(1+a) = a - \frac{a^2}{2} + \frac{a^3}{3} -, \text{ etc.};$$

a series from which log. $_e(1+a)$ cannot be found, unless a be fractional. However, if we put $-a$ for a, log.

$$_e(1-a) = -a - \frac{a^2}{2} - \frac{a^3}{3} -, \text{ etc.};$$

and subtracting this expression from the former, log. $_e(1+a)$ − log. $_e(1-a)$ or

$$\log._e\left(\frac{1+a}{1-a}\right) = 2\left(a + \frac{a^3}{3} + \frac{a^5}{5} +, \text{ etc.}\right),$$

and, for the sake of convenience, putting $\frac{u+1}{u}$ for $\frac{1+a}{1-a}$, in which case $a = \frac{1}{2u+1}$, we finally obtain

$$\log.\frac{u+1}{u} = 2\left(\frac{1}{2u+1} + \frac{1}{3(2u+1)^3} + \frac{1}{5(2u+1)^5} +, \text{ etc.}\right),$$

or

$$\log._e(u+1) = \log._e u + 2\left(\frac{1}{2u+1} + \frac{1}{3(2u+1)^3} + \frac{1}{5(2u+1)^5}\right) +, \text{ etc.}$$

If 1 be substituted for u in this formula, the Napierian logarithm of 2. is at once very readily obtained to any degree of accuracy required; if 2 be put for u, the Napierian logarithm of 3 can be calculated, etc. Now, as logarithms of any system have always the same ratio to one another as the corresponding logarithms of any other system, no matter what its base, if a number can be found which, when multiplied into the logarithm of a certain number to one base, gives the logarithm of the same number to another base, this multiplier will, when multiplied into *any* logarithm to the first base, produce the corresponding logarithm to the other base. The multiplier is called the modulus, and, for the conversion of Napierian into common or Brigg's logarithms, is equal to ·4342944...; so that *to find the common logarithm of any number, first find the Napierian logarithm, and multiply it by* ·4342944... As in Brigg's system the logarithm of 10 is 1, and that of 100 is 2, it follows that all numbers between 10 and 100 have, for their logarithms, unity + a proper fraction, in other words, the integer portion of the logarithms of all numbers of two figures is unity; similarly, the integer portion of the logarithms of all numbers between 100 and 1000 is 2, and, in general, the integer portion of the logarithm of any number expresses a number less by unity than the number of figures in that number. This integer is called the *characteristic*, the decimal portion being designated as the *mantissa*.

As the logarithm of $1 = 0$, the logarithms of quantities less than unity would naturally be negative; thus, the logarithm of $\frac{1}{2}$ would be—·30103, but, for convenience in working, the mantissa is kept always positive, and the negative sign thus only applies to the characteristic: the logarithm of $\frac{1}{2}$ or ·5 would thus be $\bar{1}\cdot69897$, the characteristic in this and similar cases expressing, when the fraction is reduced to a decimal, the number of places the first figure is removed from the decimal point; thus, the logarthm of ·0005 is $\bar{4}\cdot69897$. Logarithms are of frequent application in the solution of problems of gunnery, etc.

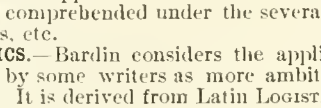
LOGEMENT.—Any place occupied by military men, for the time being, whether they are quartered upon the inhabitants of a town, or are distributed in barracks. When applied to soldiers that have taken the field, it is comprehended under the several heads of huts, tents, etc.

LOGISTICS.—Bardin considers the application of this word by some writers as more ambitious than accurate. It is derived from Latin LOGISTA, the Administrator or Intendant of the Roman armies. It is properly that branch of the military art embracing all details for moving and supplying armies. It includes the operations of the ordnance, quartermaster's, subsistence, medical, and pay departments. It also embraces the preparation and regulation of magazines, for opening a campaign, and all orders of march and other orders from the General-in-Chief relative to moving and supplying armies. Some writers have, however, extended its signification to also embrace STRATEGY.

LOG LINE.—The cordage used for lashing to gun-aprons, sponge and muzzle caps, etc. There is also a log-line made in India which is used for choking rockets; for handles for case-shot, etc.

LOG PAPER.—A thin drawing paper used in the manufacture of paper fuses, etc.

LOG REVETMENT.—A revetment made of trunks of small trees or saplings laid horizontally one on the other, and supported by posts sets into the banquette. At frequent intervals tie beams are dovetailed between the logs, and, extending six or eight feet into



the parapet, are secured to horizontal anchoring logs. For intrenchments hastily thrown up, this is the most usual form, rails or timber of any kind being used. See *Revetment*.

LOMBARDS.—A German people of the Suevic family, not very numerous, but of distinguished valor, who played an important part in the early history of Europe. The name is derived from *Longobardi*, or *Langobardi*, a Latinized form in use since the 12th century, and was formerly supposed to have been given with reference to the long beards of this people; but is now derived rather from a word *parta*, or *barte*, which signifies a battle-axe. About the 4th century they seem to have begun to leave their original seats (on the Lower Elbe, where the Romans seem to have come first in contact with them about the beginning of the Christian era), and to have fought their way southward and eastward, till they came into close contact with the Eastern Roman Empire on the Danube, adopted an Arian form of Christianity, and having been for some time tributary to the Heruli, raised themselves upon the ruins of their power, and of that of the Gepidæ, shortly after the middle of the 6th century, to the position of Masters of Pannonia, and became one of the most wealthy and powerful nations in that part of the world. Under their King Alboin, they invaded and conquered the north and center of Italy (568—569). The more complete triumph of the Lombards was promoted by the accession of strength which they received from other tribes following them over the Alps—Bulgarians, Sarmatians, Pannonians, Norici, Alemanni, Suevi, Gepidæ, and Saxons—for the numbers of the Lombards themselves were never very great. 2. Cannon of peculiar form in former use, and originally employed by the Lombards. See *Bombard*.

LONG-BOW.—A bow of the height of the archer, formerly used in England for war and sport. The term is now synonymous with *bow*, and used in contradistinction to *Cross-bow*. See *Bow*.

LONGE.—The training ground for the instruction of a young horse, to render him quiet, tractable, and supple; to give him free and proper use of his limbs, to form his paces, and to prepare him in all respects for the cavalry service.

LONGEVITY PAY.—An extra rate of pay for long service. It has recently been decided by the Supreme Court that service as Cadets must be taken into account in computing Longevity Pay. The service performed as enlisted men of Regulars or Volunteers is also to be counted.

Under secton 1284, Revised Statutes, a soldier who completes a term of five years' continuous service, and re-enlists within thirty days thereafter, is entitled to an additional allowance of $2 per month; and for each successive and continuous re-enlistment under the same conditions he is entitled to a further addition of $1 per month. See *Pay*.

LONG ROLL.—When the troops should form suddenly to meet the enemy, the signal "*to arms*," is sounded or the "*long roll*" is beaten. The troops after assembling on their company parades, form rapidly in front of their camps. In the cavalry, if the troops are to form mounted, the signal "*to horse*" is sounded.

LONG-ROLLER.—A round piece of wood, 6 inches in diameter, and $3\frac{1}{2}$ feet long, having a groove cut round it in the middle, for the reception of the gun when placed upon it. It is used to move a gun in the direction of its axis, on skids, on a hard smooth surface, such as a platform, etc. Two of them are used at once, and the gun moving upon them, gains twice the distance passed over by the roller.

LOOKING-GLASS SIGNALING.—A method of signaling invented and extensively used by the North American Indians, both on the Plains and in the regions west of the Rocky Mountains. The reflection of the sun is flashed from a small piece of a mirror held in the hand, and in this manner a Chief is frequently enabled to direct the movements of his warriors with the greatest ease and certainly from a distant point overlooking the field. This method of signaling, modified by the resources of science, has been lately introduced into the English service, and used both in India and Southern Africa. A great advantage of this method over the ordinary signal system is that the apparatus is more portable, but it can be succesfully used only in regions where the atmosphere is clear of clouds through considerable periods of time. Anybody who has any idea of the ordinary method of telegraphing by electricity with the ear alphabet, will understand how spaces of time may be employed to indicate letters and words by means of the eye. There are two methods: the reflector may be obscured except when the screen is temporarily removed to produce a flash or letter; or the reflector may be kept exposed except when it is obscured to produce a letter. The first method is said to be the easier for the beginner, but the second less fatiguing to the eye. The distance through which this mode of communication may be carried on varies with the size of the mirrors and the clearness of the atmosphere. From the Himalayas a 5-inch mirror has communicated distinct signals 60 miles. The instrument could be used with good success on the Andes. When the signaling station forms an angle greater than a right angle between the sun and the receiving station, two mirrors are used to prevent too great a loss of rays by oblique reflection. The mirrors are mounted on tripods, and are held by a socket, or a universal joint. Besides its use as a signaling instrument, the heliograph has served to define distant points in a survey, and for this purpose was employed in the triangulation of India. It was also used by the late Astronomer-Royal of England at the Cape of Good Hope in verifying the arc of the meridian. See *Heliography*.

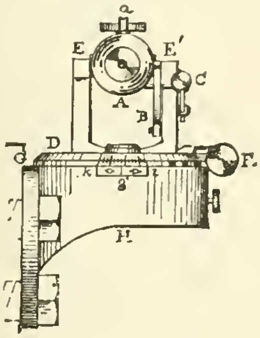
LOOPHOLED GALLERIES.—Vaulted passages or casemates, usually placed behind the counterscarp revetment, and behind the gorges of detached works, having holes pierced through the walls, to enable the defenders to bring a musketry fire from unseen positions, upon the assailants in the ditch. Loopholes, however, are not confined to galleries. In modern fortifications, the revetments, both scarp and counterscarp, are very generally pierced for a musketry fire.

LOOP HOLES.—In fortification, loop-holes are small apertures in the walls, through which sharp-shooters may fire. The loop-hole should widen towards the outside, that the shooter may have a sweep with his rifle; and it is of importance, on that account, so to fashion the sides that a bullet may not penetrate, unless fired straight into the center. For this purpose, the stones are generally laid stepwise, although other forms are frequently resorted to. Walls are readily made available for purposes of defense by loopholing them, the mode of doing it varying with their height and situation. It is a general rule that loopholes must be so placed that an enemy, if he succeeds in rushing up, shall not be able to make use of them. To prevent this they should be 8 or 9 feet above the ground on the outside; but on the inside the banquette from which the defenders are to fire should not be more than about 4 feet 6 inches below them. A portion of the wall not less than 18 inches high should be left above the loop-holes to screen the men's heads when firing. These points are attainable in several ways; if the walls are high, the loopholes may be made near the top, and a temporary stage or earthen banquette might be placed inside; if the wall is not over 6 feet high, the loop-holes may be made at 4 feet 6 inches above the inside level, and a ditch made outside. The quickest way of making a loop-hole is to break the wall down from the top for about 2 feet, and then to fill it up at the top with a stone or sand bag. If the wall should be low, a piece of timber supported on a couple of stones would be a ready expedient. If exposed to the fire of artillery, a wall will not afford good cover, but it may be improved by sinking a trench in rear and throwing the earth against the wall, or by digging a ditch in front and throwing the earth over the wall.

LOOSEN.—To open ranks or files from close order. To loosen is, in fact, to lose that firm continuity of line or perpendicular adherence, which constitutes the true basis of military operations. The lock-step was introduced for the purpose of counteracting the mischievous effects of loose marching, but it produced a greater inconvenience, and has therefore been laid aside. The equal pace and marked time correct both.

LOOTEES. An East Indian term for a body of irregular horsemen, who plunder and lay waste the country, and harass the enemy in their march. The word is derived from *loot*, plunder or pillage, and is frequently written *Looties* and *Looty Wallars*.

LORAIN SIGHT.—Owing to the great range at which rifled guns are used, and of the accuracy of fire demanded of them, it is important that they should be provided with aiming apparatus more perfect than the coarse and clumsy sights heretofore supposed to be sufficient for artillery purposes. The Lorain sight, of which the following is a brief description, combines the properties most desirable in a sight for heavy rifled guns. This instrument is essentially a transit with a vertical and horizontal limb, the former to give the required elevation or depression, and the latter to give proper allowance for drift. The telescope (A) has a top, a front and rear open sight (*a*), used to bring the object aimed at within the field of view. The vertical limb (B) is graduated to degrees. The least count of the vernier is six minutes. The tangent screw (C) elevates or depresses the telescope. The horizontal limb (D) has a scale of 20° on each side of the zero, which is graduated to degrees. The standards (E E') are supported by the horizontal limb. The tangent screw (F) moves the horizontal limb to right or left. The base of the



instrument (G) has on it the vernier (*g*) of horizontal limb, the least count of which is six minutes. When in use, this instrument sits in a seat (H) which is screwed on to the right trunnion of the gun. This seat is so placed that the plane of its top is parallel to the horizontal plane through the axis of the bore. When the vertical limb is at zero, the axis of the telescope will be parallel to the axis of the bore, if the zero of the horizontal limb coincides with the mark (*i*) on the seat. The mark (*i*) is on a movable piece (*k*) and attached to the seat, and its position is easily determined. The elevations given with this sight and with a quadrant do not agree, the latter being measured from the horizontal and the former from the line from sight to object. In firing from above an object, the telescopic sight requires more elevation than the quadrant. If from below an object, it requires less elevation than the quadrant. When the piece is to be fired, the instrument is lifted out of its seat. One instrument suffices for three or four guns, it being carried from piece to piece as they are prepared for firing. For short range and rapid firing, the pieces should, in addition, have the ordinary sighting arrangements. The proper place for the sight is on the left trunnion; but as, with carriages now constructed, it would be interfered with by the crane, it is placed on the right trunnion.

LORARII.—Among the Romans, officers whose business it was, with whips and scourges, to compel the gladiators to engage. The Lorarii also punished slaves who disobeyed their masters.

LORD.—A title given in Great Britain to persons noble by birth or by creation. Peers of the Realm are so styled, including such Archbishops or Bishops as are members of the House of Lords, who are Lords Spiritual. By courtesy, the title Lord is given to the eldest sons of Dukes, Marquises, and Earls, prefixed to an inferior title of the Peerage, and to the younger sons of Dukes and Marquises, prefixed to their Christain name and surname. The following persons bear the title Lord in virtue of their employments: the Lord-Lieutenant of Ireland and Lords-Lieutenant of Counties, Lord Privy Seal, Lords of the Treasury and of the Admiralty, the Lord High Admiral, Lord Great Chamberlain, and Lord Chamberlain, Lord High Constable, Lord High Almoner, Lord High Steward, Lord Steward of the Household, Lords in Waiting, Lords of the Bedchamber, Lords Justices, the Lord Chief Baron of Exchequer, the Lord Chief Justice, the Lord Lyon, the Lord Mayor of London, York, and Dublin, and the Lords Provost of Edinburgh and Glasgow. The Committee of the Scottish Parliament by whom the laws to be proposed were prepared, were called Lords of the Articles. The favored beneficiaries, who, after the Scottish Reformation, obtained in Temporal Lordship the benefices formerly held by Bishops and Abbots, were called Lords of Erection. Persons to whom rights of regality were granted in Scotland, were termed Lords of Regality. The representative of the Sovereign in the General Assembly of the Church of Scotland is called the Lord High Commissioner. The Judges of the Courts of Session and Justiciary in Scotland have the title "Lord" prefixed to their surname, or some territorial designation assumed by them; and throughout the three kingdoms Judges are addressed "My Lord," when presiding in Court.

LORD LIEUTENANT.—In Great Britain, the Lord Lieutenant of a county is a permanent Provincial Governor appointed by the Sovereign by patent under the Great Seal. The office, in England, arose from the occasional Commissions of Array issued by the Crown in times of danger or disturbance, requiring experienced persons to muster the inhabitants of the counties to which the Commissioners were sent, and set them in military order. The right of the Crown to issue such Commissions was denied by the Long Parliament, this question proving the immediate cause of the breach between Charles I. and his subjects. Their legality was established at the restoration by a Declaratory Act. The Lord Lieutenant is now the permanent local Representative of the Crown, who, on the occasion of an invasion or rebellion, has power to raise the militia, form regiments, troops, and companies, and give Commissions to officers. The history of the office seems to have been somewhat similar in Scotland. The "Lieutenant" is commanded to "raise the County" whenever it may be necessary to bring the rebellious and unruly possessors of castles and fortalices into subjection; and though his powers were executive rather than judicial, he seems sometimes to have had authority to exercise the functions of the Sheriff, or overrule his decisions. The Lord Lieutenant of a county is at the head of the Magistracy, the Militia, and the Yeomanry; he nominates officers of militia and volunteers, and is the Chief Executive Anthority, forming the settled channel of communication between the Government and the Magistracy for the preservation of public tranquility. Under him are permanent Deputy-Lieutenants appointed by him.

LORD LIEUTENANT OF IRELAND—The Viceroy or Deputy of the Sovereign to whom the Government of Ireland is committed. The office has existed from a remote period, the appointment having been made under different designations. His powers were in early times very extensive, almost regal. For the last half century following the Revolution the Lord Lieutenant resided little in Ireland, visiting it only once in two years to hold the session of Parliament. Some Lords Lieutenant never went to Ireland at all, and occasionally, instead of a Viceroy, Lords Justices were appointed. The Lord-Lieutenant is appointed under the Great Seal of the United Kingdom, and bears the Sword of State as the symbol of his vice-regal office. He has the assistance of a Privy-Council of 58 members, appointed by the Sovereign, and of Officers of State. He is commissioned to keep the peace and the laws and customs of Ireland, and to see that justice is impartially administered. He has the control of the police, and may issue orders to the General commanding the troops for the support of the Civil Authority, the protection of the public, the defense of the Kingdom, and the suppression of Insurrection. He may confer knighthood, and, previous to its disestablishment, had the disposal of church preferment, as well as all the other patronage of the country. The granting of money, and lands, and pensions, of all titles of honor except simple knighthood, the appointment of Privy-Councilors, Judges, Law Officers, and Governors of Forts, and the appointment to military commissions, as a common thing, are reserved to the Sovereign, acting, however, on the Lord Lieutenant's advice and recommendation. No complaint of injustice or oppression in Ireland is entertained by the Sovereign until first made to the Lord Lieutenant, who is in no case required to execute the royal instructions in a matter of which he may disapprove until he can communicate with the Sovereign and receive further orders. Yet, notwithstanding the dignity and responsibility of his office, the Lord Lieutenant acts in every matter of importance under the direct control of the Cabinet of Great Britain. The views and opinions of the Cabinet on all the more important questions connected with his government are communicated to him by the Home Secretary, who is held responsible for the Government of Ireland, and with whom it is the duty of the Lord Lieutenant to be in close correspondence; on matters of revenue he must be in constant communication with the Treasury. On his occasional or temporary absence from Ireland, Lord-Justices are appointed, who are usually the Lord-Primate, the Lord Chancellor, and the Commander of the Forces. His salary is £20,000, with a residence in Dublin Castle, as well as one in Phœnix Park. His tenure of office depends on that of the Ministry, of which he is a member. A Roman Catholic is ineligible for the Lieutenancy of Ireland.

LORICA—A curiass, or coat of mail worn by the Roman soldiers, made of various materials. The ordinary kind consisted of a skin, or a piece of strong linen covered with small plates of iron, which resembled, both in their shape and in their manner of overlapping each other, the scales of a serpent or fish. Sometimes cuirasses or hauberks, composed entirely of iron rings linked together, were worn by the Roman *Hastati*. A less flexible but more impervious defense was the cuirass made of hard leather or of metal, and consisting of two parts (the one covering the breast and abdomen, and the other the back), united by hinges and leather thongs.

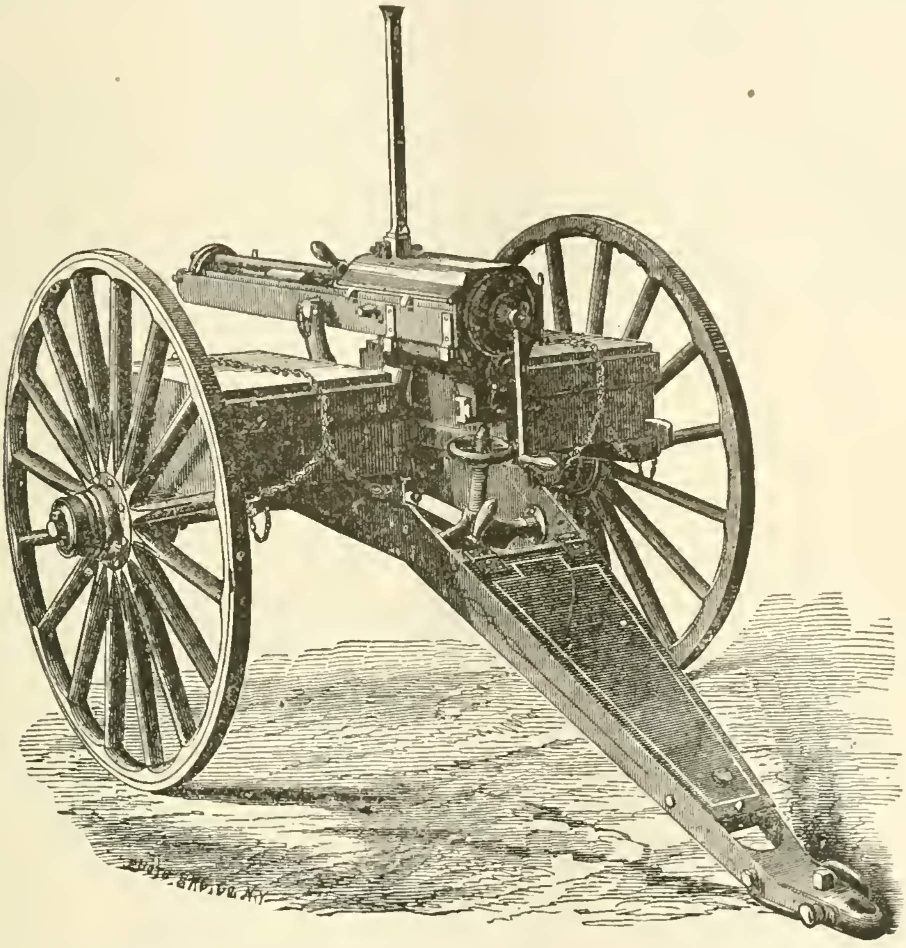
LORIMER.—A maker of bits, spurs, stirrup irons, all metal mountings for saddles and bridles, and generally of all articles of horse-furniture. In London, the lorimers, who had previously formed part of another guild, were incorporated by letters patent in 1712; in the Scottish burghs they have been comprehended as a branch of the corporation of hammermen. Cutlers, locksmiths, and brass-founders have been considered as in the exercise of branches of the lorimer art, and therefore bound to enter with the corporation. The Court of Sessions in 1830 held it to be a gross violation of the exclusive privileges of the lorimer craft to manufacture bits, stirrup-irons, and other metallic articles of horse-furniture, with a view to silver-plating them before selling.

LOSSES.—1. Killed, wounded, and captured persons, or captured property. 2. In the British Army there is a regular provision made for indemnification for losses by fire; by shipwreck; in action with the enemy; by capture at sea; by destruction or capture of a public store-house; by the destruction of articles or horses, to prevent their falling into the hands of the enemy, or to prevent the spreading of an infectious disorder. In the United States it would seem just that Congress should establish some general rules regulating such matters. The principle of settling all such claims by special legislation cannot but bear hardly on a number of individuals, and also probably in the end imposes greater burdens upon the treasury.

LOUP DES ANCIENS.—An iron instrument, made in the shape of a tenaille, by means of which the ancients grappled the battering-rams, and broke them in the middle.

mounted with four barrels arranged in a circle. After firing from one barrel until it may become heated, it is moved aside by a simple movement, and another brought into action, and so on. The first barrel becomes cooled before it is again brought into use, so that a continuous fire can be maintained for any length of time. The barrels being hung upon trunnions may be disconnected from the machine or tilted upwards, allowing them to be readily inspected or cleaned, also facilitating the extraction of any obstruction.

The working parts are exceedingly simple and strong, requiring but a few seconds for their removal or replacement, and can be manipulated by any man of ordinary capacity. The firing is from the center of the machine, and therefore is not diverted from its aim by the recoil. The lock has two extract-



LOUIS.—The name of a Military Order in France, instituted by Louis XIV., in 1693. Their collars were of a flame color, and passed from left to right. The King was always Grand Master. Commonly written *Knights of St. Louis.*

LOVER'S WAR.—In French history a name given to a civil war in the year 1580, during the reign of Henry IV. It was so called because it arose from the jealousies and rivalries of the leaders, who were invited to meet at the Palace of the Queen-Mother.

LOW-BLAST FURNACE.—A metallurgic furnace in which the air of the blast is delivered at moderate pressure.

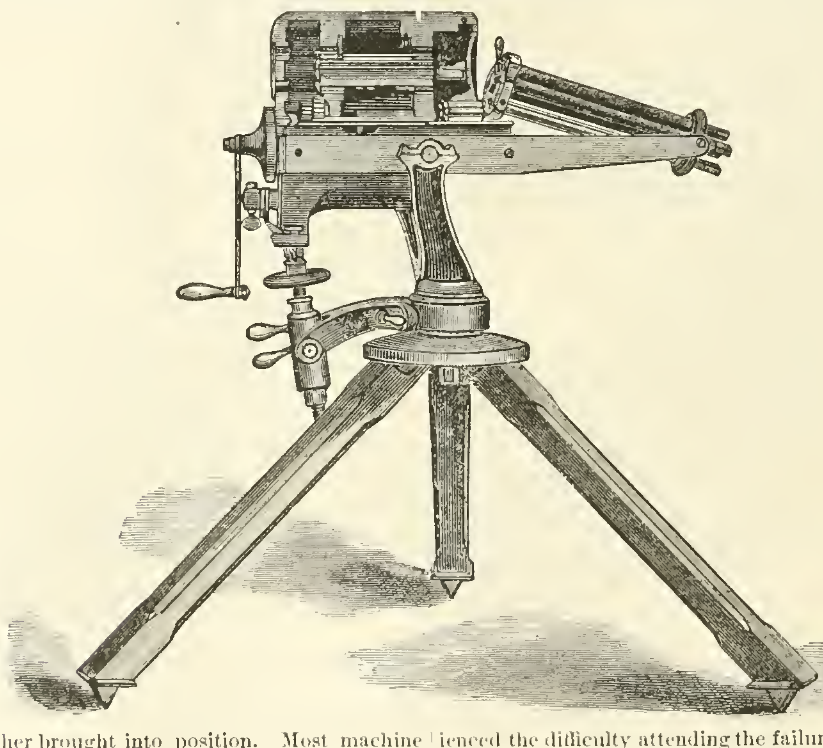
LOWELL BATTERY-GUN. This gun is of the Mitrailleur order. It may be mounted with one or any number of barrels, but the firing is confined to one at a time, and requires but one lock. It is generally

ors, which are not dependent upon springs, but operating positively, insure the extraction of the empty shells under all circumstances. The cartridges are fed into a hopper from which they are taken by two carrier-rolls and deposited one by one between the plunger and opening in the barrel. The plunger then forces them into the chamber of the barrel, fires them and extracts the empty shell, leaving it in the position which it occupied before firing. The next motion of the carrier-rolls throws out the shell and brings another loaded cartridge into position to be forced into the barrel. It is impossible for the empty shell to be carried around a second time, by which the gun might be clogged.

The drawing shows the gun mounted upon its improved gun-carriage. The mechanism of this carriage is so arranged that the gun can be leveled, adjusted or trained to be effective in any position, either at elevation or depression. When operating upon rough or uneven ground and when frequent changes of position are necessary, this arrangement is of much value, as it enables the gunner to bring the gun into any desired position in a very short time. Attached to the carriage are two skeleton cages or crates, where four thousand cartridges can be deposited and carried with the gun, and at the same time be within easy reach of the operator and fed directly to the magazine, requiring no transfer of the ammunition after it is packed at the place of manufacture. Three men can work the gun steadily and continuously when the carriage is used.

The following points should be noticed in connection with this gun: The firing being from the center of the machine, the barrel is not diverted from its aim by the recoil, whereas in most machine-guns the firing-barrel is located some distance from the center of the machine, and the barrel is consequently soon diverted by the continued recoil. The firing being confined to one barrel at a time, other cool and clean barrels are kept in reserve, so that a continuous fire may be maintained. It is well known that the barrels of a rapid firing machine gun become overheated after a few hundred shots, and thereby become practically inoperative until cooled. As the firing is confined to one barrel at a time the gun is not rendered inoperative by the bursting of a cartridge shell or other obstruction in the chamber, as the obstructed barrel may be instantly moved aside, occupying but little space, and requiring but a few seconds for its removal and replacement. it can all be taken from the gun and packed in a close box: by which it can be kept in condition for use at all times. In making long marches over dusty roads the mechanism of some guns is liable to be clogged by dust and found inoperative when called into action. The Lowell Battery Gun requires no feed case or any preparation or transfer of the ammunition whatever, but the cartridges are fed directly from the packages as they are prepared at the factory into a trough which conveys them one by one to the carrier rolls. By this arrangement two men can keep up a continuous fire for any length of time. It is well-known that when feed cases are required for working machine-guns, a large force is required to fill and apply them. Frequent jams also occur in transferring the cartridges from the feed-cases; to the hopper, and the feed cases being necessarily of delicate construction they are liable to injury.

The plunger of this gun is provided with two strong extractors, operating positively and not depending on springs. These extractors are arranged to grasp the cartridge shell at opposite sides and remain locked until the shell is fully withdrawn. Extractors operated by springs are liable to slip over the flange of the shell when it sticks in the chamber of the barrel, preventing the further operation of the gun until removed. The ejection of the empty shells does not depend upon gravity, but is absolutely forced out by the positive movement of the carrier rolls. This feature will be appreciated by those who have exper-

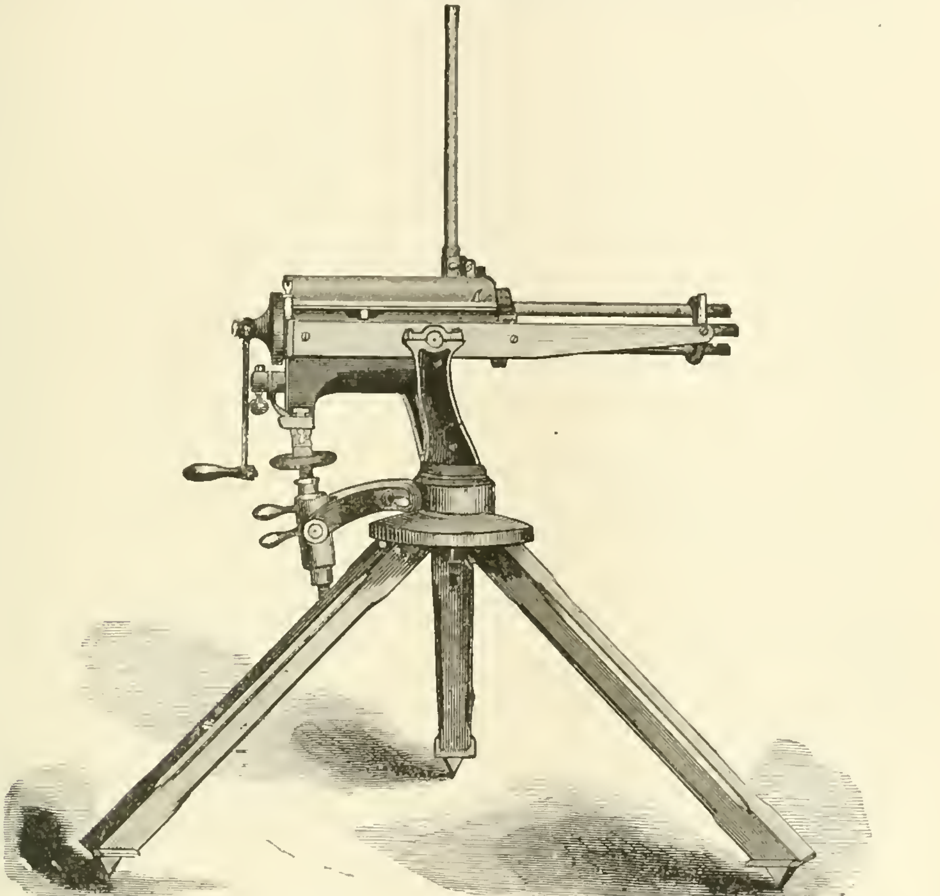


ienced the difficulty attending the failure of the ejection of a shell. The barrels are firmly fixed in the breech plate and require no adjustment after the firing has begun, But few tools are required to dissect the machinery, all of which and a spare plunger are packed with the gun, requiring no spare article or tool box to be carried with it. The lateral, oscillating or traverse motion is very simple, and can be operated by the gunner while firing, and be made to cover any desired space at any distance and returned to a fixed position without cessation of firing. This gun can be worked and fired by two men steadily and continuously 400 shots per minute; and, by the

and another brought into position. Most machine guns become more or less disabled when one barrel is obstructed by the non-extraction of the empty shell, and in some cases entirely so until the obstruction is removed. The barrel and working parts may be removed and replaced in a few seconds, allowing them to be readily inspected and cleaned or removed for protection or other purposes.

In most machine guns, the barrels are made fast to the frame work, rendering inspection and cleaning quite difficult, and, the working parts being encased, considerable time, and services of an expert are required to extract any obstruction. The mechanism assistance of a third man to feed, it can be worked at the rate of 600 per minute, taking the cartridges from the boxes as they come from the factory. By the addition of a second plunger the number of shots per minute can be doubled. The lock is constructed upon a new principal, is very simple, and not liable to be injured or disabled by wear.

The drawing shows the gun mounted on a tripod and ready for firing. Russia, after thorough investigation by its naval officers, bought twenty Lowell Battery Guns. The United States Navy has adopted it. California has purchased three for its State prisons. Ohio has one, and other States are in negotiation for them for use by militia companies stationed in cities.



A comparison of this gun with rival guns detracts nothing from the Lowell. While the Gatling gun has ten locks and ten barrels, all revolving at each shot, the Lowell Battery gun has but one lock and uses but one barrel at a time. The disabling of one lock or barrel of the Gatling renders it useless until repaired by a skillful mechanic. A disarrangement of the Lowell can be remedied by the renewal of a lock or change of the barrel, which can be done in five seconds by any person of ordinary capacity. See *Machine Gun* and *Battery Guns*.

LOW STEEL.—This variety of steel is often known as "mild steel," "soft steel," "homogeneous metal," and "homogeneous iron," and is made by fusing wrought-iron with carbon in a crucible, after which it is cast into an ingot and worked under a hammer. As it contains less carbon than high steel, it has a greater specific gravity. It can be welded without difficulty, although overheating injures it. It more nearly resembles wrought-iron in all its properties, although it has much greater hardness and ultimate tenacity, and a lower range of ductility depending on its proportion of carbon. It has less extensibility within the elastic limit than high steel, but greater beyond it; or, in other words, greater ductility. Its great advantage over wrought-iron for general purposes is that it can be melted at a practicable heat and run into large masses, possessing soundness and tenacity. Its advantages for cannon are greater elasticity, tenacity, and hardness. Its tenacity when suitable for cannon is about 90,000 lbs., or three times as much as cast gun-iron, and 50 per cent. more than the best wrought-iron. The difficulty in the use of steel for large, homogeneous guns is the great size of the hammers required to work the blocks into which it is cast. See *Steel*.

LOYALIST.—A person who adheres to his Sovereign, or to the constituted authority; especially one who maintains his allegiance to his Prince or Government, and defends his cause in times of revolt.

LOZENGE.—In Heraldry, a charge generally enumerated among the sub-ordinaries, in the shape of a rhombus placed with the acute angles at top and bottom. The horizontal diameter must be at least equal to the sides, otherwise it is not a lozenge, but a fusil. The term *lozengy* is applied to a field divided by digaonal lines crossing one another at regular intervals so as to form a diamond pattern, the compartments being of alternate tinctures. See *Heraldry*.

LUBRICATION.—The application of a substance to a surface for the purpose of making it smooth. This substance, which is called a lubricant, may be either a liquid, a semi-liquid, or a solid. Plumbago, or black-lead, is in most common use as a solid lubricant, but powdered soap-stone, or talc, is used for many purposes, as, for instance, by shoemakers upon the inside of the heels of boots and shoes to facilitate the pulling on. When it is desired to have a rope or cord slip over a bearing, as a pin, or a pulley which refuses to turn, it is usual to smear it with lard. Grease is the common lubricant, but for machinery, or the bearing of axles generally, other substances may be added which will materially reduce the friction. Mineral oils, particularly the thicker portions of petroleum, have valuable lubricating properties, and may be used either alone or added to lard, tallow, or animal oils, according to the size, weight and velocity of the revolving shaft. Oils are used for high speed; pasty lubricants for large and heavy bearings. There are a great variety of lubricants used for the axles of artillery carriages, many of them patented. Perhaps the most favorite lubricant fo rlight, fine road carriages, which are furnished with tight boxes, is castor oil. When the box is not tight,a mixture of lard and rye flour is used to advantage.

It has the property of lasting, when mixed in the proportion of about 4 parts of grease to one of flour. Black-lead may be used in combination with lard and flour, or it may alone be mixed with lard or oil. Some vehicles are made with wooden axles, and for these common pine tar is an economical, lasting, preservative, and efficient lubricant. Its application may be alternated with lard, or a mixture of lard and tallow, or lard, tallow and flour; but it is well to have some tar always present. Wherever great delicacy of motion is required, as in watches and other time-pieces, the lubricant must be very fluid. The lubrication may be performed by manual application, or mechanical devices may be employed. There are many kinds of lubricators. They are in the form of reservoirs, which discharge their contents, the lubricants, as fast as they are consumed by the revolving shaft or piece of moving machinery. A simple and often a very efficient lubricator is an inverted oil-can suspended over the bearing or place which requires lubrication. When a pasty lubricant is used, it may be applied on a sponge or brush, if the situation favor such application. The ingenuity of the operator is often advantageously exercised as well as that of the inventor.

LUGS.—The ears of the ordinary bomb-shell, to which the hooks are applied when lifting it.

LUNETTE.—1. An iron ring at the end of the trail of a field-piece, which is placed over the pintle-hook of the limber in limbering up the gun. The term is also applied to the hole through an iron plate on the under side of the stock of a siege-piece, into which the pintle of the limber passes when the piece is limbered. 2. A field work consisting of two faces forming a salient angle, or one projecting towards the enemy, and two flanks, parallel, or nearly so, to the capital or imaginary line bisecting the salient angle. In shape, it is like the gable end of a house. It is intended for the defense of avenues, farm-houses, bridges, and the curtains of field-works. The term is specially applied to a small work beyond the ditch of the ravelin, to supply its deficiency of saliency, and formed at the re-entering angle made by the ravelin and bastion. The lunette has one face perpendicular to the ravelin, andthe other is nearly perpendicular to the bastion. The term *lunettons* is applied to a smaller sort of lunettes. See *Field Works*.

LUNETTES D'ARCON.—In order to bring the lunettes further off the place and diminish the defect of their gorge, General D'Arcon has constructed lunettes which bear his name, and which are supposed to be capable of defending themselves. This work has the same dimensions as an ordinary lunette, except that the salient angle may be made as open as deemed necessary. The gorge is closed by a loop-holed wall 18 feet high, and a round tower 15 feet in diameter separated from a terreplein by a ditch 12 feet wide.

LUNGE.—An extended thrust in fencing and bayonet exercise. The lunges are used the same as the thrusts, and differ from them only in advancing the left foot, so that the left leg, from the foot to the knee, shall be vertical. In both the thrust and the lunge, the body must be covered on the side of the adversary's piece. See *Bayonet Excercise* and *Thrust*.

LUNT.—The match-cord formerly used for firing cannon.

LUSTRATION.—In antiquity, purification by sacrifices and various ceremonies. The Greeks and Romans purified the people, cities, fields, armies, etc., defiled by crime or impurity. This was done in several ways,,viz.: by fire, water, sulphur, and air, the last by fanning or agitating the air around the thing purified. When Servius Tullius had numbered the Roman people, he purified them as they were assembled in the Campus Martius; and afterwards a lustration of the whole people was performed every fifth year before the Censors went out of office. On that occasion the people assembled in the Campus Martius, when the sacrifices termed *Suovetaurilia*, consisting of a sow, sheep, and ox, after being carried thrice around the people, were offered up, and a great quantity of perfumes was burned. This ceremony was called *Lustrum*. It was instituted by Servius Tillius, 566 B.C., and performed for the last time in the reign of Vespasian. The term *Lustrum* was given also to the period of five years between the lustra. The army was purified before a battle by causing the soldiers to defile before the two quivering halves of a victim, while the Priest was engaged in offering certain prayers. The establishment of a new Colony was preceded by a lustration with sacrifices. Rome itself, and in fact all the towns within its dominion, always underwent a lustration after being visited by some great calamity. The lustration of fields were performed after sowing was finished, and before reaping began. The lustrations of flocks, designed to keep them from disease, was performed every year at the festival of the Palilia, when the shepherd sprinkled them with pure water, thrice surrounding the fold with savin, laurel, and brimstone set on fire, and afterwards offering incense and sacrifices to Pales, the tutelary goddess of shepherds. Private houses were purified with water, a fumigation of laurel, juniper, olive-tree, and the like, a pig being offered as a victim. Infants were purified, girls on the third, boys on the ninth, day after birth, then named and placed under the protection of the god of the family. The lustration of a funeral pile was by having the spectators march round it before a fire was kindled. Whatever was used at a lustration was cast into a river, or some other inaccessible place, as to tread upon it was considered ominous of some great disaster.

LUTE.—A term employed in the laboratory to denote a substance used for effectually closing the joint of apparatus, so as to prevent the escape of vapor or gases,or for coating glass vessels so as to render them more capable of sustainging a high temperature, or for repairing fractures. For ordinary purposes, lutes made of common plastic clay or pipe-clay with an admixture of linseed-meal or almond-powder, or,for common stills,linseed-meal and water made into a paste, are quite sufficient; for more delicate experiments, *fat lute*, covered over with moistened bladder, is used. Lutes for coating glass vessels are generally composed of Stourbridge clay or Windsor loam, mixed with water; but the most simple method is to brush the glass retort over with a paste of pipe-clay and water, dry it quickly and repeat the operation till a sufficient thickness of coating is obtained. Other lutes in frequent use are *Willis's lute* (a paste composed of a solution of borax in boiling water with slaked lime), various mixtures of borax and clay, of lime and white of egg, *iron cement*, moistened bladder, paper prepared with wax and turpentine, and caoutchouc. The use of the last named lute has on account of its flexibility and consequent non-liability to accident, been rapidly extending.

LUZERNER.—A name given to the *pole-hammer* in Germany and Switzerland, it being a favorite arm of the people of Lucerne.

LYCANIENS.—A term applied by the French to the Hungarian light infantry.

LYING OUT OF QUARTERS.—In the United States army, any officer or soldier who lies out of his quarters, garrison, or camp, without leave from his Superior Officer, is punished as a Court-Martial may direct.

LYLE EMERY GRAPPLE SHOT.—This projectile was devised by Lieutenant D. A. Lyle, United States Army, and Mr. C. E. Emery, draughtsman at the National Armory. It is intended for use in connection with the 2½-inch Lyle gun for life-saving purposes. It is an elongated, solid, cast-iron, smooth-bore projectile, with a wrought-iron base and shank. In form the shot is cylindro-ogival. The radius of the ogival head is equal to the diameter of the projectile. An axial cavity, 1.25 inchs (3.175 centimeters) deep is bored in the rear end of the shot, upon whose interior cylindrical surface is cut a female screw-thread to engage the screw on the wrought-iron base. The base has a cylindrical axial cavity drilled through it, with a rounded groove on one side to accommodate the stop and stop-spring. The front end of this cavity is enlarged by counter-boring, to allow the necessary longitudinal play of the shank-head in opening and closing the flukes. The screw on this end fits accurately that in the body of the shot. At the rear end of the base are formed five sectoral slots, equidistant circumferentially. These slots receive the heads of the flukes, which are fastened to the base at these points by rivets. Circular grooves are milled out between the slots to allow the insertion of the rivets. The shank is of forged wrought iron. The front end of this bolt has a screw-thread, upon which, after insertion in the axial cavity of the base, a nut is placed. This end of the bolt is riveted after screwing on the nut. A rectangular groove on one side of the shank receives the stop and spring. Five lugs, placed equidistantly around the shank near the forward end, serve as points of attachment for the links that extend the flukes. The rear end of the shank contains an eye-hole for attaching the line in firing. Each link is composed of two flat pieces of Troy steel, with holes at each end to receive the rivets that connect them with the shank and fluke. The flukes, five in number, are also made of Troy steel. Each fluke has a rounded notch near its upper or forward end to accommodate the corresponding lug on the shank when closed. All edges or angles are carefully rounded. The details of form and construction permit the use of the projectile in the 2½-inch gun already in the service, and prevent the entanglement of the line as much as possible in firing. The projectile is inserted in the gun point first, with the flukes closed, as shown in the drawing, and the line tied in the eye-hole of the shank. In this position the base of the shot is toward the muzzle of the gun; the flukes partially enter the bore while the shank extends beyond the muzzle. In firing, the projectile describes the first part of its trajectory base foremost; the strain upon the shank being toward the rear, the flukes are kept closed; but, as soon as the projectile reverses, the tension on the line draws out the shank to the limit of its *play* in the base, spreading the flukes to their full extent. When the head of the shank reaches the bottom of the counter-bore in the base of the shot, the stop is thrown out by the action of the stop-spring, and a square shoulder catches on the base and prevents the closing of the flukes. The latter may be opened and closed readily by hand. To close the flukes press the thumb upon the stop until the shoulder is disengaged, and then push in the shank gently till its head strikes the front end of the counter-bore.

When vessels are stranded the crews sometimes fasten a line or rope to a cask, spar, buoy, or raft, and heave it overboard, hoping that the wind and waves will throw it on the shore to be seized by persons there, thus establishing communication between the wreck and beach. It frequently occurs, however, that there is an inshore current that carries the floating object along parallel to the coast, in which case the object desired fails to be attained. This projectile was devised for the purpose of firing over the line thus paid out from the stranded vessel, so as to pass above that line at some desired point between the cask or buoy and the vessel, and then by hauling in the attached shot-line, the flukes grapple the ship's line, and enable the life-saving crew on shore to land the buoy and secure the line from the vessel. There are other uses to which it may be put that will readily suggest themselves to those familiar with the service.

The following are the principal dimensions of the shot:

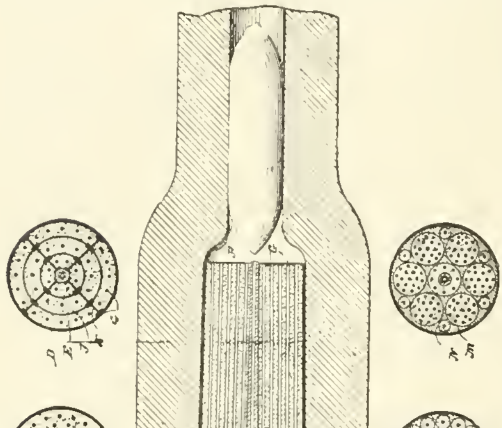
	Inches.	Cent.
Total length of body and base	13.50	34.289
Length of ogival head	2.17	5.5118
Radius of head	2.50	6.350
Length of cylindrical part	9.83	24.967
Diameter of cylindrical part	2.50	6.350
Axial cavity—Length	1.25	3.175
Base—Total length	2.75	6.985
Shank—Total length	13.25	33.654
Total length of shot and shank flukes closed	23.50	59.689
Total length of shot and shank, flukes extended	24.60	62·483
Distance of center of gravity from base	5.00	12.700

The weight of the shot is 18.218 + lbs. = 8.264 kilos. See *Anchor-rocket*, *Chandler Anchor-shot*, and *Life-saving Rockets*.

LYON KING-OF-ARMS.—The title borne since the first half of the 15th century by the chief heraldic officer for Scotland. He is the Presiding Judge in the Lyon Court, and appoints the Heralds, Pursuivants, and Messengers-at-Arms. Unlike the English Kings-of-Arms, he has always exercised jurisdiction independently of the Constable and Marshal, holding office directly from the Sovereign by Commission under the Great Seal. In Scotland he takes precedence "of all Knights and Gentlemen not being officers of state, or Senators of the College of Justice." In England he ranks after Garter, and before the Provincial King-of-Arms. Since the revival of the Order of the Thistle, he has been King-of-Arms of that Order. So sacred has his person been held that, in 1515, Lord Drummond was declared guilty of treason, attainted, and imprisoned in Blackness Castle, for striking Lyon. Prior to the Revolution, Lyon was solemnly crowned at Holyrood on entering on office by the Sovereign or his Commissioner, his crown being of the form of the royal crown of Scotland, but enameled instead of being set with jewels. The crown is now only worn at coronations; and that actually supplied on occasion of the last four appointments has been similar to the crowns of the English King-of-Arms. Lyon's badge or medal, suspended by a triple row of gold chains, or on common occasions by a broad green ribbon, exhibits the Arms of Scotland, and on the reverse, St. Andrew on his cross; and his baton is of gold enameled green, powdered with the badges of the Kingdom and with gold ferrules at each end. Besides the velvet tabard of a King-of-Arms, he has an embroidered crimson velvet robe; and as King-of-Arms of the Thistle, a blue satin mantle, lined with white, with at St. Andrew's cross on he left shoulder.

LYMAN CARTRIDGE.—The object of Mr. Lyman is to supply a cartridge which shall burn with a constantly increasing fire-surface so that nearly uniform pressure shall be exerted upon the projectile until the powder is about all consumed. When the cartridge is suited to the length of the barrel, the strain will be distributed equally throughout the principal part of the barrel, whatever may be its length. It consists in forming powder into a solid cake within the cartridge shell, which cake, if for small-arms, is pierced by a central perforation from end to end, and is protected from the fire by the shell on its outer surface and rear end, so that only the small surface of the perforation and the front end of the cake can be exposed to the igniting flame. After this small surface is ignited the burning proceeds in a radial direction toward the surface of the cake, thereby continuously enlarging the burning surface in a constantly increasing ratio and increasing the development and heat of the gases, and exerting a nearly uniform pressure upon the projectile throughout the principal part of the length of the barrel.

The character of this powder cake is very important: it should be solid and compact, none of it granular; it should have a uniform density so that it will be burned evenly on all sides. To make it, powder meal which is reduced very fine may be moistened until it becomes somewhat plastic or of a consistency adapting it to to be molded and compressed into a solid mass, and while in this soft or plastic condition it is properly compressed in the cartridge shell. When dried the rapidity with which the powder burns depends upon the porosity of the cake, and this depends upon the amount of water contained in it when being compressed as well as upon the pressure.



The drawings show a longitudinal section of the breech of the gun containing a cartridge in position for firing, also cross sections of modified forms of the cartridge. In the chamber of the gun B is the breech-block which holds the cartridge in place, C is a wedge for securing the breech-block, which part may be of any suitable construction, D is the cartridge shell or case, and E is the powder cake packed in the shell which protects its outer cylindrical and rear end surfaces from the action of the fire, G represents holes running through the powder cake and through the head F of the cartridge, H is a firing tube passing centrally through the powder cake, and is designed to direct the igniting flame to the front end of the cake. This tube projects rearwardly from the cartridge head, and bears against the breech-block, leaving a space I between them. The cartridge head is also located somewhat within the shell, so that the shell may bear upon the breech-block, as shown. To fire the cartridge a flame is forced through the firing tube and ignites the front end of the powder cake and flashes back down the perforations in the powder cake, igniting the surfaces of all the holes at the same instant.

The particular object of the chamber I behind the cartridge head is to permit the perforations through the powder cake to communicate with one another to insure their being instantly and simultaneously ignited throughout their whole extent. If these holes were closed at their rear ends some of them might possibly become more or less filled with air and gases upon the first of ignition which would prevent their entire surfaces from being instantly ignited and thereby prevent the intended uniformity of the radial burning and increase of the burning surface along the whole length of the hole; but when these channels open into a common space as shown they cannot become so filled or obstructed and their entire surfaces are instantly ignited and the progress of the radial burning is practically the same in all parts of the powder cake. The distance of the perforations in the powder cake from each other determines the time of the burning of the cartridge and this distance should be proportionate to the length of the gun. The holes should meet some time before the projectile reaches the end of the bore. When the walls of the powder cake are burned through, the burning and caving of their remaining fragments may raise the pressure slightly; but the space into which the burning gases expand has now become so large and the rapid onward movement of the shot increases it so rapidly that such increase in pressure is not material.

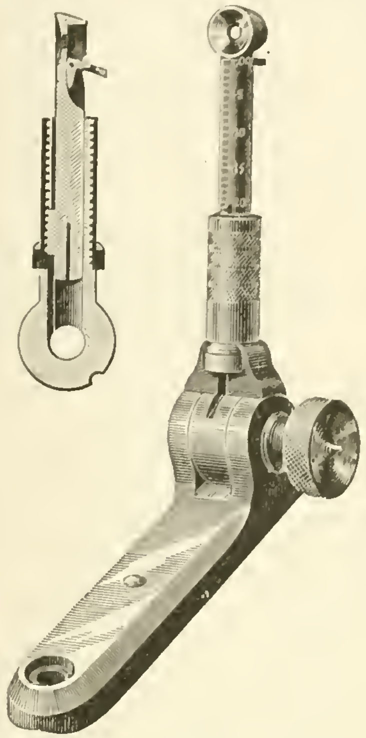
Trials of the cartridge in a $\frac{3}{8}$ inch rifle show initial velocities of 2080, 2247, and 2312, f. s., although these experiments are the first, and naturally do not show its capabilities when everything is perfect. The shot thrown at these velocities was *seven* calibers long, and with a twist of $4\frac{1}{2}$ inches. The cartridge as adapted for cannon has the following specifications: 1. A cartridge consisting of a shell charged with a solid cake of powder or other material having longitudinal holes running through from end to end, and protected by said shell from the action of the fire upon its outer surface. 2. A cartridge consisting of a shell charged with solid cakes of powder or other explosive material packed in the shell and extending from end to end of the shell, and each provided with one or more holes piercing them longitudinally, and being protected from the action of the fire upon their outer surfaces. 3. A cartridge consisting of a shell charged with a solid cake of powder, which is protected from the action of the fire upon its outer surface by said shell, and at its rear end by the head of the shell, said cake and the head of the shell being pierced by longitudinal holes. 4. A cartridge consisting of a shell charged with a solid cake of powder pierced from end to end by holes extending also through the head of the cartridge, the cartridge being provided with a projection extending rearwardly and adapted to bear against the gun, and thereby form an open space back of the head of the cartridge. 5. A cartridge consisting of a shell charged with a solid cake of powder pierced from end to end with holes extending also through the cartridge head, and provided with a firing tube arranged to direct the igniting-flame to the front end of the powder-cake.

LYMAN HASKELL MULTI CHARGE CANNON.—The theory of this curiosity of ordnance is the gradual accumulation of velocity or power by a succession of charges of powder exploded behind the projectile as it passes along the bore of the gun. The inertia of the shot is first overcome by a moderate charge of coarse-grained, slow-burning powder, and then repeated charges of quick-burning powder are applied in succession until a greatly increased velocity is attained. General Newton, United States Army, says the penetrative power of this gun is not inferior to that of the Armstrong 81-ton and 100-ton guns. He thinks the 10-inch accelerating gun would be as efficient as the 81-ton gun, and nearly as much so as the 100-ton gun, and that the 12-inch accelerating gun would be more powerful than the 100-ton gun. No doubts are entertained by experts that the gas check can be made perfectly efficient, and it is believed that early experiments will show that these guns, at comparatively moderate cost are at least as efficient as the best in Europe. See *Haskell Multi-charge Cannon.*

LYMAN SIGHT.—The optical principle involved in this most excellent sight is entirely new in its application. When aiming it has the appearance of a ring or hoop, which shows the front sight and the object aimed at, without intercepting any part of the view. The drawing shows the manner of its construction. The aperture of the sight, being very near the eyes, is greatly magnified as compared with the notch in the common open sight. This feature gives many the impression that an aperture which looks so large cannot allow of accurate aim; whereas, the larger this small aperture looks, the more accurate the aim. Furthermore, the distance from the Lyman sight to the front sight is nearly twice as much as from the ordinary open sight to the front sight which, in itself, doubles the accuracy.

The rim of the sight can be instantly changed to give it a large aperture with a narrow rim, or a small aperture with a wider rim. For all quick shooting the large aperture should be used. The sight cannot shut out the view of the front sight, nor the object to be aimed at; while with any other rear sight the chief difficulty in aiming is to bring the sights and objects quickly into line without interfering with the view of the front sight or the object. It possesses the following additional advantages, viz., it allows an instantaneous aim to be taken—the object being sighted as quickly as if only the front sight were used; it readily permits one to shoot moving objects, with both the eyes in use; it is also very accurate, simple, and strong. Any kind of front sight may be used with it, and it may be put on any rifle in the same way that a peep sight is attached, and adjusted for shooting any distance up to 1,000 yards.

To apply the sight to any rifle, screw the base firmly on the tang of the piece. See that the *spring* notch



in the sight-joint is filed so that the sight stands perpendicular when in use. Remove the middle sight, *i. e.*, the rear open sight from the gun. A blank piece can be put in the slot on the barrel, if desired. It is recommended to use the Beach *front sight*, in conjunction with the sight, and for most shooting, use the large aperture of the rear sight; and for very quick shooting, aim with both eyes open.

M

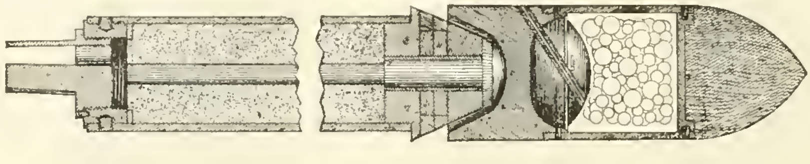
MACADAMIZED.—A term applied to roads covered with broken stone. The principles of the Macadam system of road-making are as follows: For the foundation of a road, it is not necessary to lay a substratum of large stones, pavement, etc., as it is a matter of indifference whether the substratum be hard or soft; and if any preference is due, it is to the latter. The metal for roads must consist of *broken stones* (granite, flint, or whinstone is by far the best); these must in no case exceed 6 oz. each in weight, and stones of from 1 to 2 oz. are to be preferred. The large stones in the road are to be loosened, and removed to the side, where they are to be broken into pieces of the regulation weight; and the road is then to be smoothed with a rake, so that the earth may settle down into the holes from which the large stones were removed. The broken metal is then to carefully spread over it; and as this operation is of great importance to the future quality of the road, the metal is not to be *laid* on in shovelfuls to the requisite depth, but to be *scattered* in shovelful after shovelful, till a depth of from 6 to 10 inches, according to the quality of the road, has been obtained. The road is to have a fall from the middle to the sides of about 1 in 60, and ditches are to be dug on the field side of the fences to a depth of a few inches below the level of the road. This system, which at one time threatened to supercede every other, is calculated to form a hard and impermeable crust on the surface, thus protecting the soft earth below from the action of water, and so preventing it from working up through the metal in the form of mud. Strange to say, it has succeeded admirably in cases where a road had to be constructed over a bog or morass, but in some other circumstances, it has been found deficient.

MACANA.—The war-club of the South American Indians.

MACCONNELL CARTRIDGE-BOX.—This box, invented by Captain C. C. MacConnell of the U.S. Army.

is square-shaped, made of leather lined with tin, and has compartments to hold 40 cartridges. There is an opening at the bottom, working by means of a spring, and by which one cartridge can be taken out at a time. The cartridges are placed in the box on top by raising the flap. The box is worn on the waist-belt.

MACDONALD'S HALE ROCKET.—The case of this improved rocket is of steel of great strength, at the end of which is soldered a collar, to the center of which is screwed a wrought-iron tube; this tube unites the head to the body of the rocket and allows the gas to escape through the upper vents. The head has a cavity, communicating with the exterior by five openings directed toward the rear. These vents or openings, as in the Hale rocket, have semi-cylindrical flanges; the gas escaping acts against



the concave face of the flanges and imparts a motion of rotation to the rocket. The lower end of the case is closed by a disc, also pierced with five vents corresponding to those in the head, and furnished with similar flanges. This construction applies the motion of rotation to the head as well as to the rear part of the rocket, and remedies the considerable deviation of the Hale rocket due to the motion of rotation being applied to the base only; as its center of gravity is quite considerably in front, the head describes very large and irregular spirals. The rocket composition consists of 70 parts of niter, 16 parts of sulphur, and 23 parts of charcoal. It is pressed into the tube with a pressure of 90 tons. As it is bored throughout its whole length by the channel, the surface of inflammation is much more considerable than in the Hale rocket, and its velocity much greater. The head has at its front part, in front of the cavity, a shell with a bursting charge, which is ignited by means of a fuse, either percussion or time. The rocket thus perfected has given results very superior to those obtained by war-rockets of other systems. Five 12-pounder rockets thrown under an angle of 8° 15′ had a mean range of 1,870 meters, with a lateral deviation of 2.74 meters only, while Hale rockets of the same caliber, under the same angle of elevation, had a range of only 1,200 meters with a lateral deviation of 34 meters. See *Rockets*.

MACE.—A strong, short wooden staff, with a spiked metal ball for a head. It was a favorite weapon with knights, with the cavalry immediately succeeding them, and at all times with fighting priests, whom a canon of the church forbade to wield the sword. No armor could resist a well-delivered blow from the mace. The mace is now borne before magistrates as an ensign of authority. The variety known as *Morgenstern*, or *Morning-star*, had generally a long handle, and its head bristled with wooden or iron points or spikes.

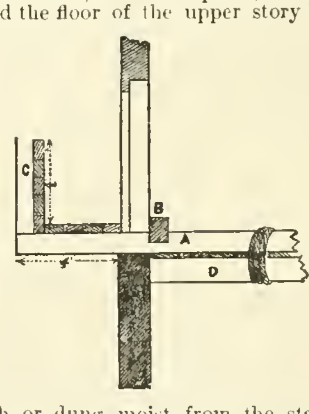
MACEDONIAN PIKE.—A spear or lance of great length used in warfare by the Greeks. It is commonly called *Sarissa*.

MACHETE.—A large, heavy knife resembling a broadsword, often 2 or three feet in length, used by the inhabitants of Spanish America as a hatchet, to cut their way through thickets, and for various other purposes.

MACHICOLATION.—The act of hurling missiles, or pouring various burning or melted substances upon assailants through *Machicolations*.

MACHICOLATIONS.—The apertures between the corbels supporting a projecting parapet. The machicolations are for the purpose of allowing projectiles to be hurled at an enemy when he approaches near the wall, as in scaling, undermining, etc. Such defenses are very common in castellated architecture, especially over gateways, towers, etc. For the purpose of attaining, by musketry, the foot of a scarp wall without flank defenses, resort must be had to a machicoulated arrangement at the top of the scarp. The usual mode adopted for this purpose, is to form a parapet wall which rests upon a solid horizontal band of stone, near the top of the scarp, which is supported on corbels or projecting blocks, firmly built into the wall. The back of the parapet wall is placed a few inches in advance of the scarp, leaving room for the slanting loop-holes pierced in the horizontal band through which the fire is to be delivered on the foot of the scarp. The top of the parapet wall is also arranged to admit of firing on more distant points. Where, from the irregularity of the site, the ordinary machicoulis cannot be made efficient, resort may be had to small polygonal chambers of stone, open at top, and having the sides and bottom pierced with loop-holes and machicoulis. These constructions may be made just of sufficient size to hold a single sentinel. They are placed at the angles of the works where they will not be exposed to artillery, and are supported on a corbel work projecting from the top of the scarp wall.

MACHICOULIS GALLERY.—To place a house in a defensive attitude, the doors and windows of the lowest story should be firmly barricaded, and loop-holes be made as in the case of a wall. A tambour should be placed before the doors, both for their protection and to procure flanking arrangements if required. The windows of the upper stories should be partly barricaded, to cover the troops within, and loop-holes should be arranged as in the lower stories. The roof, if not fire-proof, should be torn down, and the floor of the upper story be covered



with earth or dung, moist from the stable, to the depth of about two feet. If it is intended to defend the upper stories, should the enemy succeed in forcing the lower, the stairs should be torn down, and slight ladders be used in their stead; holes should be made through the floor to fire on the enemy in the lower story, or to throw heavy articles, or boiling water, etc., on him. If there are balconies to the windows of the upper stories, or an upper gallery, they can readily be placed in a defensive state by placing thick boards as a shelter on the outside, and cutting suitable holes through the floor to defend the doors and windows of the lower story. If there should be no conveniences of this nature, a temporary structure, termed a Ma-

Trial No. 1. For Accuracy. Range 500 meters; 2 targets, 20 meters apart.

Name of Gun on Trial.	No. of barrels.	Caliber in inches.	No. sighting shots.	No. shots fired.	No. hits on both targets.	Remarks.
Hotchkiss	5	1.45	4	10	10	Gun sighted after each shot.
Nordenfeldt	4	1.00	12	24	8	Firing fast.
Gardner	1	.45	40	60	*	" "
Pratt & Whitney	2	.45	22	80	*	" "
Gardner	2	.45	2	20	17	Gain at 20 shots. Cartridge nipped in feed-slide.
				80	19	Firing fast.
Nordenfeldt	10	.433	40	100	90	" very slow.
Montigney	30	.433	24	100	......	" fast.
Gatling	10	.45	5	100	141	" at rate of 800 per minute.
Gatling	6	.42	5	100	61	" fast.

* No. hits not known.

Trial No. 2. 100 shots. Range 1,000 meters; 2 rows of targets, 20 meters apart.

Name of Gun on Trial.	No. of barrels.	Caliber.	Sighting shots.	Shots fired.	Hits on both targets.	Remarks.
Hotchkiss	5	1.45	2	10	7	Gun sighted after each shot.
Nordenfeldt	4	1.00	4	24	7	" " volley (4 shots).
Gardner	1	.45	2	100	42	Firing at rate of 200 per minute
Pratt & Whitney	2	.45	8	100	60	" " " "
Gardner	2	.45	10	100	51	" " " "
Nordenfeldt	10	.433	30	100	59	" slow.
Montigney	30	.433	16	100	40	" fast.
Gatling	10	.45	15	100	106	" time $3\frac{1}{2}$ seconds.
Gatling	6	.42	15	100	48	" fast.

Trial No. 3. For Accuracy. Range 1,800 meters; 100 shots; two rows of targets.

Name of Gun.	Number of barrels.	Sighting shots.	Shots fired.	Hits on both targets.	Remarks.
Gardner	1	12	100	1	Firing Slow.
Pratt & Whitney	2	24	100	0	" "
Gardner	2	20	100	15	" "
Nordenfeldt	10	50	100	0	" "
Gatling	10	15	100	18	" time $3\frac{3}{4}$ seconds.
Gatling	6	21	100	20	" slow.

Trial No. 4, one mile. Time 30 seconds. Range, 800 meters; two rows of targets.

Name of Gun.	Time loads.	Sighting shots.	Shots fired.	Nelson Park target.	Remarks.
Hotchkiss	30	1	485	888	
Nordenfeldt	30	12	52	20	
Gardner	30	4	84	44	
Pratt & Whitney	30	4	170	27	Most of shots went over. It being late this
Gardner	30	2	160	120	trial was made in a hurry. It was the first
Nordenfeldt	30	20	251	121	trial made with the Gatling. A large party
Gatling	30	13	413	29	were present, who wanted to see the gun,
Gatling	30	8	195	82	or it would not have been fired.

Pratt and Whitney gun fired 3,266 shots in $9\frac{1}{4}$ minutes, with four changes at the crank; two barreled Gardner, 1,446 in $4\frac{1}{4}$ minutes; 100 shots fired at 70° elevation in $3\frac{1}{4}$ seconds by the Gatling.

chicoulis Gallery, may be formed by placing stout pieces of scantling through holes made in the wall, on a level with the floor; these pieces being confined to the floor on the inside, either by nailing them to it or by tying them with rope to the joists; they should project from three to four feet beyond the wall on the exterior, and vertical pieces of smaller scantling, about four feet long, should be nailed to them, on which boards are nailed to cover the troops from the enemy's fire; these boards should be at least three inches thick. The flooring of the gallery is laid on the horizontal pieces, and holes are made through it to fire on the enemy, or to throw grenades, stones, etc., on him. Any similar arrangement which will shelter a man, in the act of firing from a window on the foot of the wall, or in throwing over stones, etc., will serve the same purpose as a Machicoulis gallery. A table might easily be arranged to answer the end in view. The drawing shows a section of a Machicoulis. D is a flooring joist: A is a horizontal support; B is a cross timber; and C is an upright in front. See *Tambour.*

MACHINE-GUN.—A gun designed to deliver against animate objects a strong, rapid, continuous and accurate fire of small projectiles at all ranges suited to infantry; to be served by the fewest possible number of men, and also to give a fire that may, in many cases, be as effective as the discharge of canister from artillery. The conditions to be fulfilled in the construction of such guns are: simplicity and strength of mechanism; lightness; freedom from sensible recoil; endurance; and interchangeability of ammunition with that used by the troops generally. A variety of machine guns, having merits, will be found noticed under Battery Guns. Prominent among the American battery or machine guns are the *Gatling*, the *Lowell*, the *Gardner*, and the *Hotchkiss Revolving Cannon.*

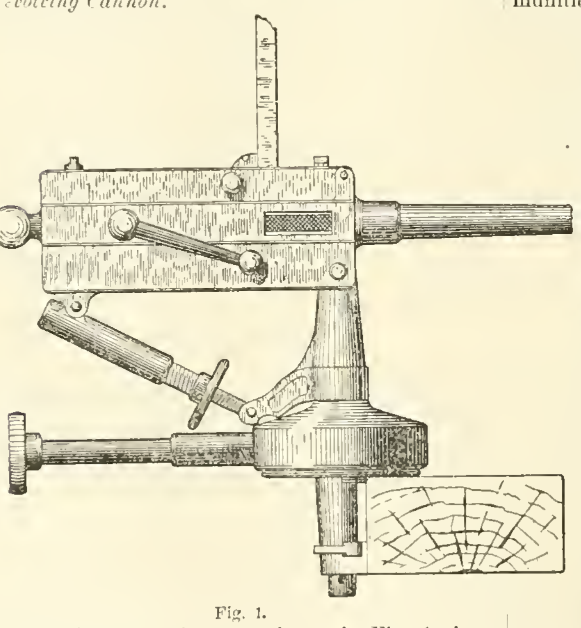


Fig. 1.

The Gardner machine-gun, shown in Fig. 1., is an exceedingly simple machine, with a capacity for rapid fire probably as great as is consistent with the economical expenditure of ammunition, and its extreme lightness of construction makes it very easy to handle. Several forms of cartridge-holders and feed-cases to feed cartridges to the Gardner gun have been devised by Mr. Parkhurst. In one of these the cartridges are held by the bullet end in a block, leaving the flanges exposed. The feed tube or guide of the gun receives all the flanges in a block. The block is then pulled off. The Lowell machine-gun, manufactured at Lowell, Mass., fires a single barrel. but is provided with two, three, or more barrels which can be rapidly turned into position for firing as one or another becomes heated. The cartridges are held in feeding-tubes above the gun, and pass down the tubes into the carrier-rolls. These are two cogged wheels placed side by side behind the barrel and on axes parallel with the barrel, the cogs abutting instead of intermeshing, and the space between the cogs being just large enough to receive a cartridge. A plunger carries the cartridge forward from this receptacle while the wheels are at rest, fires, and then withdraws the shell, when a further rotation of the cog-wheels ejects the spent shell and brings another into line with the barrel. The gun is made with an automatic traversing mechanism which may be thrown into or out of gear, so that the direction of fire may change slowly or rapidly over a sector of considerable extent in front of the gun, or the fire may be confined to a single line of direction. The rapidity of fire for the 45 caliber is about 300 shots per minute.

The carriage, usually employed in the United States, for the machine-gun is at wo-wheeled vehicle, drawn by two horses placed abreast; the off horse works in shafts situated so as to occupy the proper position; the carriage is guided by this horse, and he supports the portion of the weight that is not borne by the axletree. The near horse is ridden by the driver. When firing, the horses being detached, the shafts serve as a trail. The gun is mounted over the center of the axletree on an iron *bed* formed of two plates, one of which moves over the other about a vertical axis, to give the desired horizontal training to the gun. On each side of the gun is a box opening to the rear; the enterior is divided into spaces, each of which carries a feed-case. These boxes serve also as seats for the gunners. Boxes of additional ammunition and tools and spare parts are carried in a compartment beneath the gun bed in rear of the axletree. Fig. 2. on the opposite page, shows the form of light gun-carriage used with the Lowell Battery-gun when making long marches over very rough country. It is a suitable pattern for all machine-guns, and is, of very simple construction.

The trials of machine-guns at Turin, Italy, commencing October 10, 1883, and tabulated on page 241, will serve to show the wonderful powers of these weapons.

MACKAY GUN.—A wrought iron gun distinguished from the Whitworth and Lancaster guns by the following characteristics: The Whitworth has a hexagonal bore in a tube of homogeneous iron, strengthened with hoops forced on by hydraulic pressure; the Lancaster is without grooves, but the bore is oval; the Mackay has numerous grooves, but the projectile does not, as in other guns, fit into them, its rotation being imparted by the rush of gases through the spiral grooves around it. In every case the groove or oval takes one turn, or portion of a turn, within the gun.

MACKAY PROJECTILE.—The distinguishing feature of this projectile consists in the application and use of several diagonal grooves formed in the interior surface of the gun at a great angle, which are to act as windage grooves so that the powder and gas passing down such grooves, encircling the projectile, shall have a longer distance to travel than the projectile, and also cause the projectile to revolve round its longest axis at a high rotation as it passes down the gun. The projectiles are not allowed to enter or fit these grooves as in rifles, but simply to pass down the smooth surface in which the grooves are formed.

MACKENZIE CUPOLA FURNACE.—This pattern of furnace is extensively used in working cannon metals, and in the fabrication of projectiles. The body of the cupola, which is oval in shape, consists of a lining of fire-brick inclosed in a wrought-iron caisson, contracted at the top to form the stack, and resting on a cast-iron bottom plate, which is supported on iron pillars. The peculiarity of this cupola, as compared with others of the many varieties in use, exists only in the shape of the tuyere, or in the method employed for introducing the blast, a continuous air-chamber inclosed between the caisson and a wrought-iron apron, which projects inward, and is braced by a cast-iron ring, which can easily be replaced when worn out. The tuyere itself is the slot beneath, through which the air, admitted to the chamber from the blast-pipes, passes into the cupola. The bottom is a cast-iron drop-door made in two hinged parts, and supported, when closed, by a prop. This bottom is covered with a layer of sand, arranged with a gentle slope towards the spout; the latter, through which the melted iron runs to the ladle, is of iron coated with loam, and painted with coke-wash. *The charging-door* is situated at the rear of the furnace, and the stock is generally lifted to it on an elevator. To charge the furnace most expeditiously shavings are placed in the bottom, then light wood, and cord-wood sawed into lengths of from ten to eighteen inches, a part of it being stood on end around the sides to protect them, and the whole bed being built up level. In this last respect care is used through all the subsequent stages of the charging. On the top of the wood is placed the "stock," which, for a No. 8 furnace, consists of about 2,100 pounds of (Lehigh) lump coal. The fire is then lighted, and when the flames are seen to be working well through the mass about five tons of iron are

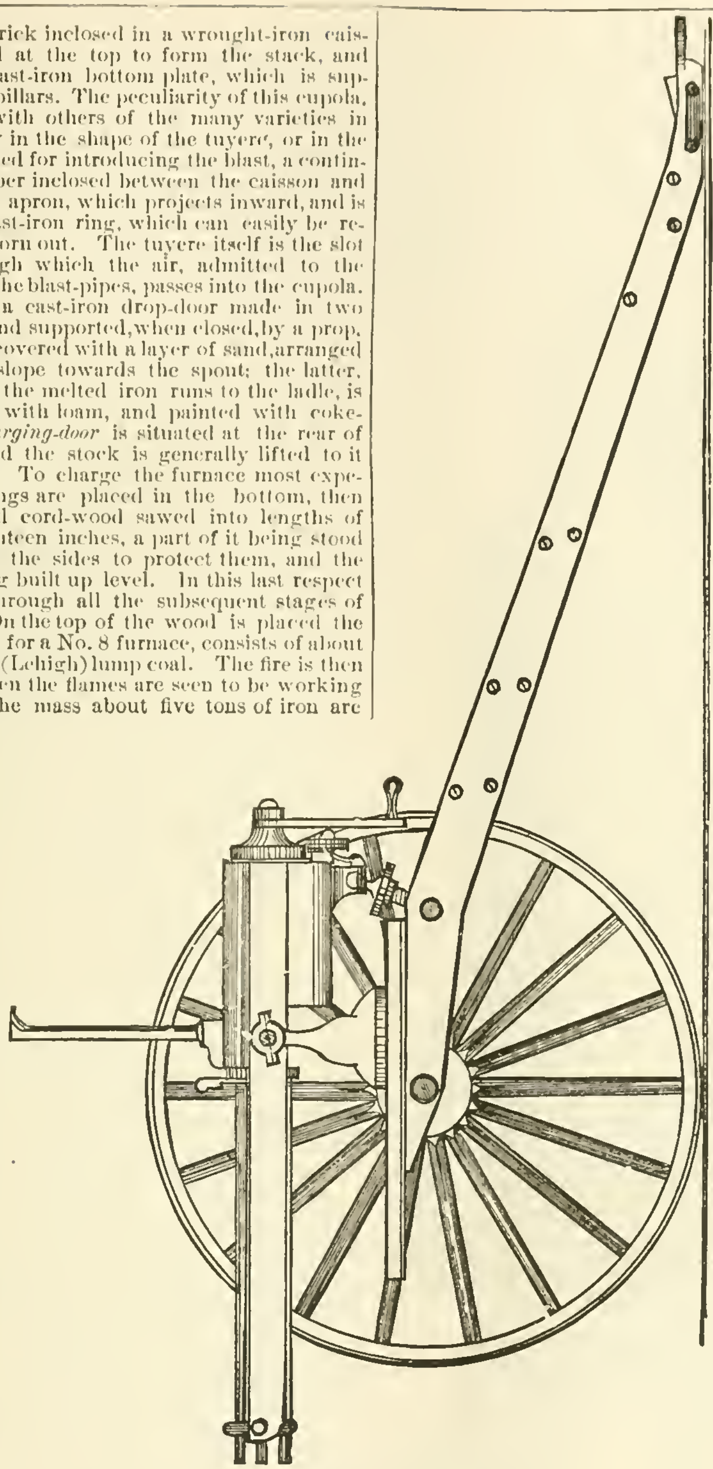
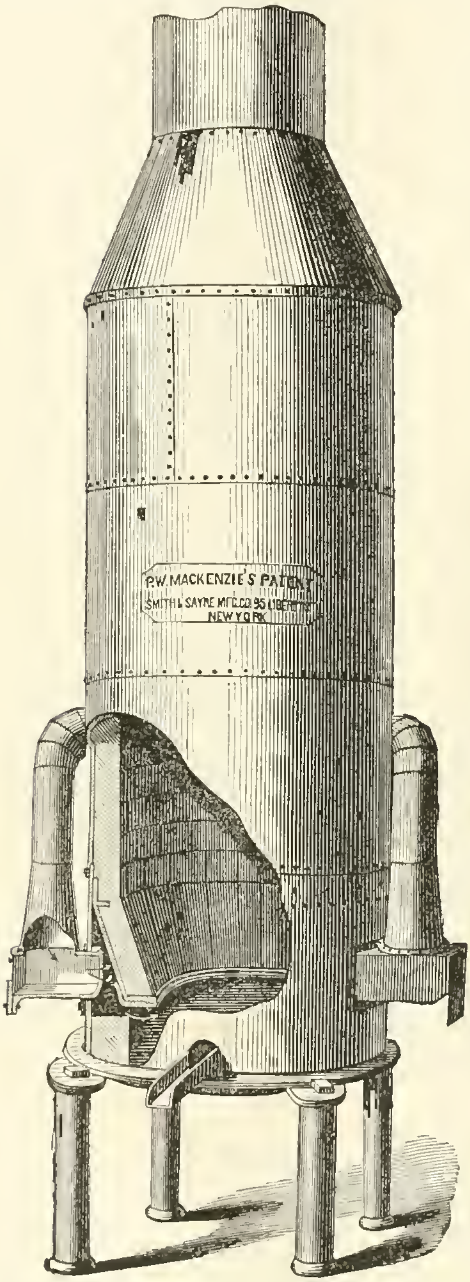


Fig. 2.

placed evenly on top; then about 900 pounds of egg or grate coal, followed by five tons of iron. This "building up" of the charge can be continued as long as the material can be handled through the charging-door, the ordinary capacity of such a furnace as described being about fifteen tons. In charging the iron, it is usual to first put in pieces of plate and light scrap iron to protect the lump coal from being broken as the heavier portions of the charge are added. As soon as the cupola is "charged" the blast is put on, and in about twenty minutes the iron is "down," and ready to be drawn off. Warned of this by the melted metal "blowing" through the "tap-hole," the melter closes it securely with a "*bod*" made of sand mixed with clay-wash; he has prepared in advance also a number of other "bods," which he uses for the same purpose whenever it may be necessary while drawing the metal. The "bod" is lightly attached to the end of an iron or wooden rod, and being shoved into the tapping-hole, sticks to it and closes it up. To "tap" the cupola, the melter shoves into the "bod" an iron bar with a square point, and enlarges the hole by turning the bar around. The ladles into which the metal is run are lined with a mixture of molding sand and clay-wash, or with loam, and thoroughly dried before being used. When all the metal is drawn off, the cupola is "dumped" by removing the prop and allowing the doors to fall. The "dump" is then extinguished, and the pieces of iron and fuel picked and sifted out. After each day's casting, the furnace has to be repaired by picking



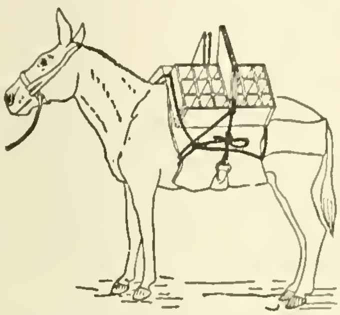
out the slag which has formed within, and by daubing with a mixture of clay and fire-sand the parts of the lining where the fire-brick has been burned out. About once in six months the entire fire-brick lining has to be replaced. See *Cupola Furnace*, *Foundry*, and *Iron*.

MACLED ARMOR.—Armor of the Middle Ages, composed of small lozenge-shaped plates of metal, sewed on a foundation of cloth or leather, and sometimes overlapping each other half way.

MACOMBER GUN.—A gun, the peculiarity of which consists in its stated extraordinary strength. The chamber for holding the powder and the breech of the gun are formed of discs of wrought iron, composed of three different qualities of the iron, the softest forming the center and the hardest the outer circumference of the disc, which are thoroughly welded together, leaving a hole in the center. After a sufficient number of these are prepared to form the gun, they are roughly engine-turned to bring them to a uniform thickness. These discs are then submitted to a process of "setting" by steel punches (each disc separately), by powerful blows of a steam-hammer, beginning lightly, and increasing gradually until the soft and hard metal have been forced (in a cold state) from center to circumference to the point of enlargement of the latter which *commencement* of the enlargement is *proof* that every portion of the disc *will* bear its equal proportion of a future strain or concussion which it may be subjected to and which, in the use of gunpowder, cannot exceed the test thus supplied. After the discs are set, they are welded one at a time upon a mandrel; by the process known to smiths as "jump welding." Subsequently, the mandrel upon which the discs were forged will be entirely taken out by the process of boring the gun, leaving only the metal which has been subjected to the steam-hammer and punch. The breech of the gun is surrounded with steel rings, which are forced over it, in a cold state, by a powerful hydraulic press. The gas-check is Mr. Macomber's own invention. He uses Dyer and Sons' friction-primers, and makes use of the strongest powder and of a fine grain; but he states that he would have no objection to use gun-cotton. The weight of the gun is 12 cwt., caliber $1\frac{3}{4}$ inch, weight of shot 3 lbs., initial velocity about 2000 feet per second. The inventor states that at an elevation of 38° the shot attains the very remarkable range of $9\frac{1}{4}$ miles.

MACROMETER.—An instrument by means of which the ranges of distant objects can be determined with rapidity and accuracy. It consists of two mirrors, disposed somewhat similarly to the mirrors of a marine sextant, the observations being taken much in the same way. One of the mirrors is movable, and is fixed to an arm on which the several distances, from 20 to 2,000 yards, are marked. The arm moves over a peculiar curve placed on a part of the instrument called the "fan," and indicating the distances answering to any given inclination of the mirror. The arm, moreover, is fitted with a slide so as to be capable of being set to any length of base, and this base may either be measured by a chain or may be paced, the slide being set to the line marked "yards" or "paces," as the case may be. The result is always given in yards. When it is required to make an observation, two men take up a position so as to form a triangle with the object, the distance of which it is desired to ascertain. One of the two observers, by means of an optical square, places himself so as to be at right angles with the distant object and the second observer, by whom the macrometer is used. From experiments made with this instrument, the distance of moving objects has been ascertained with very great accuracy, and in the case of stationary objects the error has been found to be less than 1 per cent. The notation of the instrument admits of the units being taken to represent chains and links; thus 835 would be 8 chains and 35 links.

MADIGAN AMMUNITION-BOX.—These boxes, also adapted for use as a medicine or mess chests, are packed in pairs on either an aparejo or ordinary pack-saddle. They meet all the requirements of active service and by means of them, troops in line of battle or skirmishing may be quickly supplied, and are not obliged to lose valuable moments of time, while unpacking, unscrewing covers, etc. The drawing shows the boxes packed on an aparejo, and the manner of using them. Their construction is such that *all* or *any part* of the contents may be removed, whenever desired for immediate use, without unloading, slacking the lash-rope, or even halting the animal carrying them. These are certainly important advantages in case of a surprise or sudden attack upon the pack-train, or the unexpected discovery of the enemy; or, if used for medical or subsistence stores, and in case of sudden illness, or the



necessity of eating a meal under the various circumstances forbidding a halt. Many instances will doubtless recur to every officer or soldier of experience in field service, where disasters have resulted from not having been able to quickly replenish the supply of ammunition.

The devices by which this box is made available for sudden emergencies, are essentially three in number, viz: FIRST, and most important:—The angle castings or corner-bands in the center of each side of the top of the box, each of which has a diagonal circular opening, or socket, for the lash rope. SECOND:—The center partition, $1\frac{3}{8}$ inches thick, on the top of which is screwed a center strip, $2\frac{1}{2}$ inches in width, with two lids hinged thereto, opening from the ends. THIRD:—The sub-division of the interior of the box, by adjustable partitions, into compartments, adapted in number and arrangement, to the nature of the contents, and shape and size of the packages. These compartments prevent the shaking or damaging of the packages by the motion of the animal, which would occur with an ordinary box after being partially emptied: and permit the load to be kept practically balanced by taking out of each box, alternately all or part of the contents of one or more compartments--thus obviating any necessity for unloading, or touching a rope during the march other than the usual adjustment of the lash rope. By filling only a portion of the compartments, when the packages are unusually heavy, or when the animal is not in good condition, the weight of the load may be adapted to the circumstances of the case, without danger of rattling, shaking, or breaking the packages; for hard bread or other stores of light weight, the boxes may be made larger, if desired: or if *necessary*, four boxes of the usual size *can* be packed on one animal.

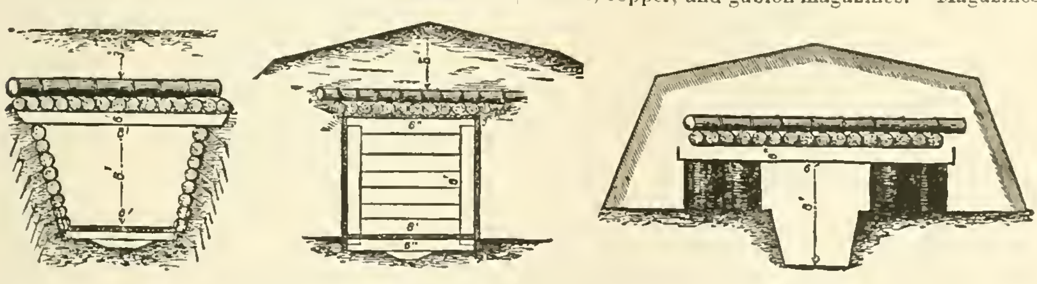
No special fittings or attachments to the ordinary aparejo or pack-saddle, are required; the boxes are complete in themselves and in case of emergency may be packed with very little in the way of outfit — a few old sacks filled with hay or straw, a couple of cinches and a piece of rope will answer. The ammunition boxes in present use in the United States are very unsuitable for packing; two being too light for a proper load, while three are awkward to handle, very difficult to lash so as to be kept in place on an aparejo or pack-saddle, and are liable to chafe and strain the animal's back.

MADRIERS.—Long planks of broad wood, used for supporting the earth in mining, carrying on a sap, making coffers, caponiers, galleries, and for various other purposes at a siege; also to cover the mouth of petards after they are loaded, and are fixed with the petards to the gates or other places designed to be forced open. When the planks are not strong enough they are doubled with plates of iron.

MADRINA.—The animal preceding a troop of mules, usually an old mare, in South America, to the neck of which a little bell is attached, the sound of which the mules follow with the greatest docility.

If several large troops are turned into one field to graze, in the morning the muleteer has only to lead the madrinas a little apart, and tinkle their bells, and although there may be 200 or 300 mules together, each immediately knows its own bell, and separates itself from the rest. The affection of these animals for their madrina saves infinite trouble. It is nearly impossible to lose an old mule; for, if detained several hours by force, she will, by the power of smell, like a dog, track out her companions, or rather the madrina; for, according to the muleteer, she is the chief object of affection. The feeling, however, is not of an individual nature; for any animal with a bell will serve as a madrina.

MAGAZINE.—In a literal sense, any place where stores are kept; but as a military expression, a magazine always means a *powder-magazine*, although arms may at times be kept in it. A magazine may be a depot where vast quantities of gunpowder are held in reserve, an entrepot for the supply of several advanced works, a battery magazine for the wants of a fortress during a siege, or merely an expense magazine for the daily requirements of the special battery in which it may be situated. The last is usually temporary, and hollowed out in the back of the rampart; but the other forms require most careful structure. They must be bomb-proof, and therefore necessitate very thick walls; they must be quite free from damp; and they should admit sufficient daylight to render the use of lanterns within generally unnecessary. The drawing shows cross sections of fascine, copper, and gabion magazines. Magazines



are commonly built of brick, the solid masonry being arched over within, and a thickness of earth sometimes added above the brick-work to insure impermeability to shells. The entrance is protected by shot-proof traverses, lest an opening should be forced by ricochet shots. Within, the magazine is divided into bins or compartments, and one of these should always be kept empty in order that the barrels of powder may frequently be moved from one place to another, a process necessary to keep it in good condition. The battery magazine commonl contains 500 rounds for the guns dependent on it. Depot magazines should, when possible, be limited to 1000 barrels of powder.

In 1870–71, the German Army Corps had supply trains generally attached to the divisions of each corps; these distributed food to the troops—they carried 4 days' rations for men. Then they had a certain number of supply wagons, containing food for men and horses for six days; these kept in rear of the corps, and could communicate with the magazines. When traveling by rail, the troops were fed at certain stations, or took in their food at these stations. The whole management of supply appears to have been admirably carried out, and, when so performed, it considerably facilitates operations. The subject of the formation and position of magazines is one of such vast importance that military men will do well to study the history of past campaigns, when they will observe—to take only one example—how Napoleon, in the Wars of the Republic, was careful to accumulate vast magazines and to keep his communications open, notwithstanding that his troops helped themselves pretty freely off the country they invaded; nevertheless, no General ever realized more than he did the necessity of having accumulated supplies ready to fall back upon, and to keep his communication to the rear carefully guarded. See *Lightning Conductors*, *Powder Depots*, and *Powder Magazines*.

MAGAZINE-GUN.—A breech-loading small-arm, having a magazine capable of holding a number of cartridges which may be fired in quick succession—the empty shell being ejected and another cartridge conveyed to the chamber from the magazine by working the mechanism of the piece. There are several types. 1. Those in which the magazine is a tube below the barrel, as in the Winchester, the Ward-Burton, etc. 2. Those in which the magazine is in the stock, as in the Spencer, Meigs, and others. 3. Those in which the magazine is a separate piece attachable to the gun when required, as in the Lee, Elliot, and Gatling gun. The following is a general classification of magazine-arms, founded on the method by which cartridges are fed from the magazine:

sity of providing troops with arms that will give every possible superiority of fire in battle. Rapidity of discharge is certainly an essential element under all circumstances. Should equal detachments be opposed, there can be no doubt but that the one able to fire ten effective shots per minute, each man, more than the other, would have a great advantage. Rapidity of fire alone can compensate for an inferiority in number of men engaged. In magazine or repeating arms, the cartridges are fed automatically into the chamber of the barrel, by the manipulation of the breech mechanism. It is only necessary to close the breech when the arm is ready to fire. This obviates the necessity of handling and charging each cartridge, besides preventing the considerable loss of ammunition, occasioned by soldiers dropping cartridges while transferring from the cartridge-box to the arm, which, in the excitement of battle and rapid firing, are seldom recovered or saved. The principal objection offered to magazine guns, is that their use causes a wasteful and unnecessary expenditure of ammunition. The same argument was largely used, when only a few years ago, the merits of breech versus muzzle-loaders, were being discussed, *and is as weak now as then.* With officers and non-commissioned officers thoroughly impressed with the necessity of an economical and judicious use of ammunition, the question becomes one only of discipline and drill.

No valid reason can be given why, other essentials being equal, the same men should not aim as well, firing rapidly, as slowly sighting requires the same time whatever may be the time used in loading; and if increasing the time expended between the firing of one shot and sighting for the next, increases the effectiveness of the man, it follows, that to shoot accurately, a certain amount of time must be wasted in operations other than aiming the weapon—a theory that could hardly be sustained.

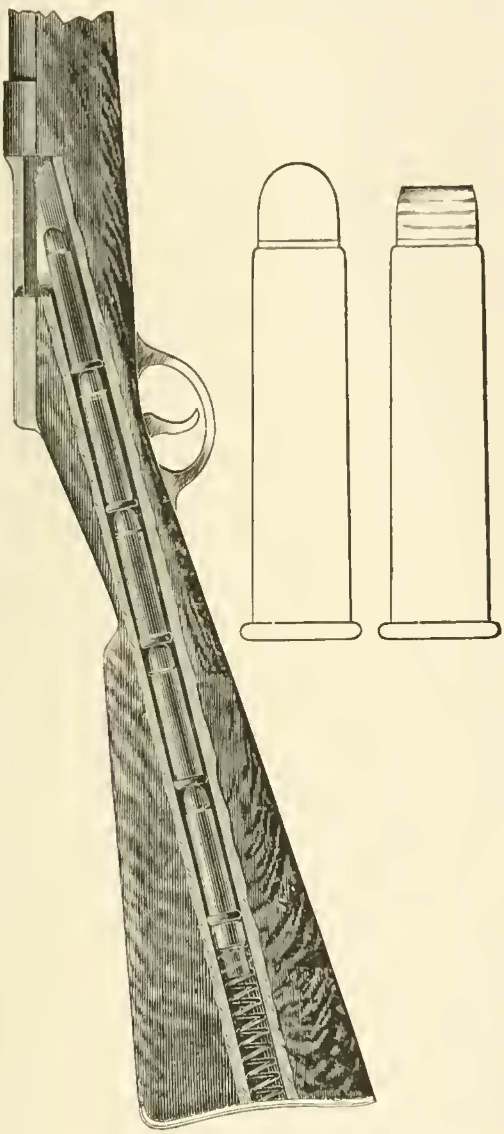
The drawings show the positions at "order arms," of cartridges contained in tubular magazine-guns, constructed with magazines under the barrel and in the butt-stock. All the cartridges are forced toward the breech mechanism by a spiral spring (as partly

Magazine-arms supply chamber with cartridges from:

- 1st, butt stock
  - 1st, by a spring.
    - 1st, direct
    - 2d, indirect...
      - 1st, by rotating barrel about axis parallel to it into line with magazine.
      - 2d, to position opposite receiver
  - 2d, by a ratchet, which is—
    - 1st, automatic
    - 2d, operated by hand.
  - 3d, by a spiral cam (screw-motion).
- 2d, tip stock.. by a spring— on a carrier which is—
  - 1st, sliding, at right angles to axis of bore
  - 2d, rotating—
    - 1st, to position oblique to axis of bore.
    - 2d, to position parallel with axis.
  - 3d, sliding and rotating—
- 3d, magazine on top of barrel — by a spring— to position parallel to axis of bore and above receiver— and by gravity into line with axis of bore.
- 4th, magazine below bolt — by a spring (vertically)— to position opposite center of chamber.
- 5th, revolving chambers

The question of the comparative merits of magazine guns and single breech-loaders, for military purposes, has been so exhaustively discussed by the military authorities of the world, that there would seem to be no longer any doubt regarding the neces-

shown in A), which spring must be of sufficient strength to support the weight of the column of cartridges, and force them into the receiver of the arm as fast as required, and of necessity it must have very considerable stiffness or strength. The weight of a column of five ordinary service cartridges would be about seven ounces, at least four-fifths of which weight would in a tubular magazine, rest fairly upon the point of the bullet of the last cartridge and which bullet comes directly in contact with the primer itself of the cartridge in advance of it. All ordnance officers and ammunition manufacturers realize the difficulty experienced in preparing fulminate of mercury (used for primers), that will, in practical use, always have a uniform degree of sensitiveness. It can be made so sensitive that the slightest scratch will ignite it, and many fulminate mixers have lost their lives by a moment's inattention or relaxation of caution while compounding it. While it is generally possible to produce fulminate of nearly equal quality, still different batches do vary: and whether it be from difference in this quality, or from the different position or placement of the fulminate in the primer as regards the cartridge-anvil, or otherwise, still it is certainly true that cartridges are to be found in use that will explode with one half the concussion ordinarily required. It is a fact that cartridges have exploded by dropping a few inches from the machine in which they are loaded into the receptacle below. It is readily seen, then, that the use of such a spiral spring makes premature explosion not only *possible*, but *very probable*, and there is no way to prevent it, except by discarding it, as in the Lee or Chaffee-Reece guns. During the War of the Rebellion, guns using the spiral spring have been known to explode when the cavalry were on a march. Of course such arms were discarded; but the same thing may happen to any arm of recent invention which is so constructed as to require a spiral spring in feeding the cartridge into the chamber.



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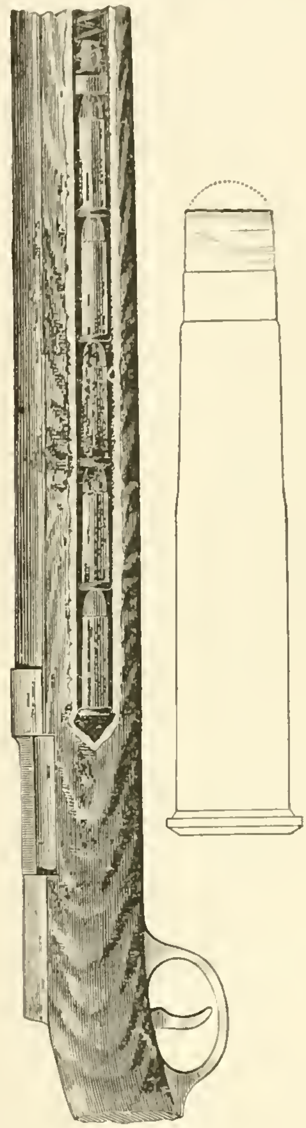


B

Where the cartridges are fed from the butt-stock by a spiral spring the bullet is liable to strike the counter-bore of the barrel, making a notch in the bullet and rendering it useless for accurate work. When the cartridges are brought up by a carrier on an angle the same thing will happen—the counter-bore of the barrel either stops the bullet or cuts off a piece sufficiently large to make it impossible that its flight be accurate and make a good target, because of its irregular shape made by such contact. It is well understood that a good shot, when using any of the magazine-guns in which the cartridges are fed up by a spiral spring, uses it as a single-loader;

and the reason is, that the bullet is generally so mutilated by striking the counter-bore, that its flight is not to be depended upon for accuracy.

MAGISTRAL GALLERY.—A name frequently applied to the gallery immediately behind the counterscarp wall, in contradistinction to the *Enveloping Gallery*, which is parallel to the counterscarp gallery, and at some thirty or forty yards in advance of it. See *Gallery*.

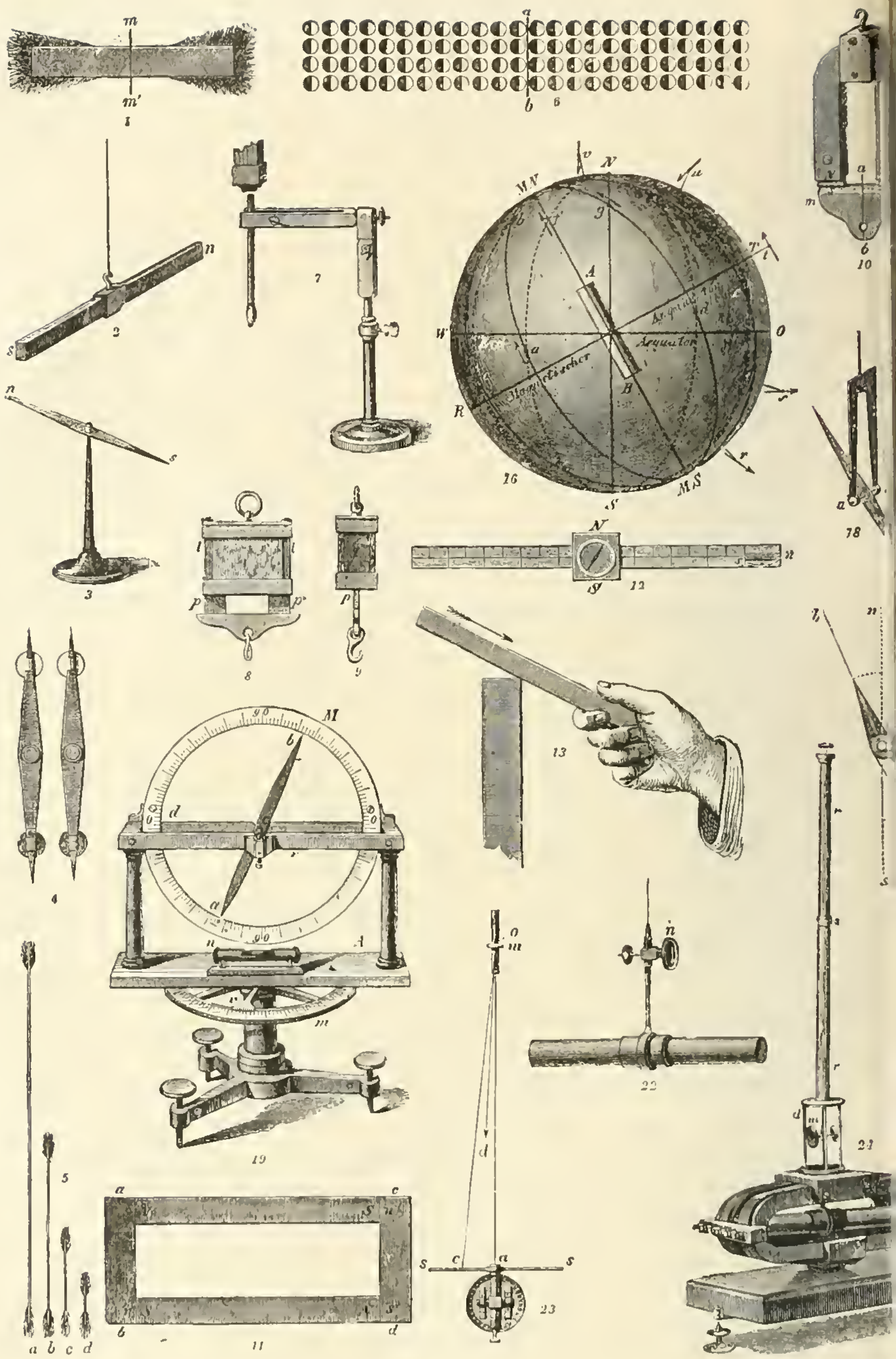
MAGISTRAL LINE.—The trace or outline of a work as the plan of its guiding or *magistral* line. In field fortifications, this line is the interior crest line. In permanent fortifications, it is usually the line of the top of the escarp of each work.

MAGNA CHARTA.—The great Charter which was granted by King John of England to the Barons, and has been viewed by after-ages as the basis of English liberties. The oppressions and exactions of a tyrannical and dastardly Sovereign called into existence a Confederacy of the Barons or Tenants-in-Chief of the Crown, who took up arms for the redress of their grievances. Their demand was for the restoration of the laws of Henry I., laws which might probably be characterized as an engrafting of Norman Feudalism on the "ancient custom of England," or previously existing Saxon and Danish Free Institutions, in which "ancient custom" were comprehended the laws of Edward the Confessor. A conference between the Sovereign and the Barons was held at Runnymede, near Windsor, a place where treaties regarding the peace of the kingdom had often before been made. King and Barons encamped opposite each other; and after several days of debate, John signed and sealed the Charter with great solemnity, on June 15, 1215.

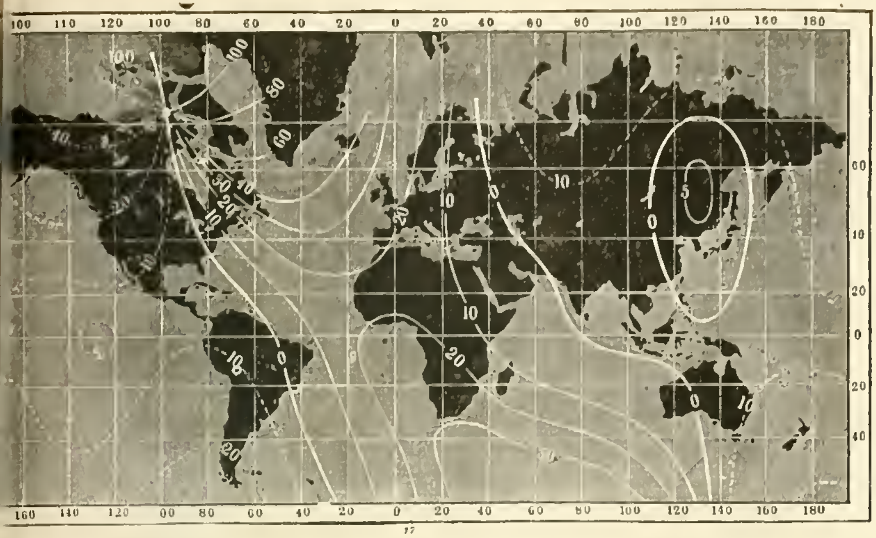
MAGNESIUM.—Although the discovery of the metal magnesium was made by Sir H. Davy in 1808, it was looked upon as little more than a chemical curiosity for about half a century. In 1830 a French chemist, Bussy, obtained globules of the metal by fusing globules of potassium, in a glass tube, with anhydrous chloride of magnesium. Bussy's labors were followed by somewhat improved methods, adopted by Bunsen, and subsequently by Matthiessen, who succeeded in pressing some grains of the metal into wire. The first great advance was in 1856, when Deville and Caron effected the reduction of the pure chloride of magnesium by mixing it with fused chloride of sodium in clay crucibles, using fluoride of calcium as a flux, and throwing in fragments of sodium; they thus obtained magnesium on a larger scale than any of their predecessors. The most important part of their investigations was the discovery of the volatility of the metal. All these were, however, mere laboratory experiments. In 1859 Bunsen, of Heidelberg, and Roscoe (now of Manchester), published a memoir on the great importance of magnesium for photographic purposes, owing to the high refrangibility and the great actinic power of the light emitted by burning magnesium-wire. The study of this memoir led Mr. Sonstadt to consider whether, the magnesian salts being so abundant, the metal might not be obtained, on a comparatively large scale, at a moderate price. After a prolonged series of expensive experiments he succeeded, in 1862, in producing very satisfactory specimens of the metal varying from about the size of a pin's head to that of a hen's egg. Although it burned freely enough, it was still wanting in ductility and malleability, in consequence of the presence of certain impurities; but by May, 1863, these difficulties were overcome by a process of purification by distillation; and by the close of that year he considered it safe to begin manufacturing. The Magnesium Metal Company was consequently organized, and soon operations commenced at Manchester, where magnesium is now made on a very considerable scale, as well as by an American Magnesium Company at Boston. One great advantage of Sonstadt's method is its simplicity; it can be accomplished by the hands of ordinary workmen ignorant of all chemical knowledge. The process of manufacture may be thus described: 1. An anhydrous chloride of magnesium is prepared by saturating lumps of rock-magnesia (carbonate of magnesia) with hydrochloric acid, and then evaporating the solution to dryness. 2. One part of metallic sodium cut in small pieces is placed in a iron crucible, and covered with five parts of the chloride. The crucible is covered, and heated to redness, when the chlorine leaves the magnesium and unites with the sodium, for which it has a stronger affinity. When the crucible has cooled, and its contents are removed *en masse*, and broken, the magnesium—in that state known as crude magnesium—is seen in nuggets of various sizes, varying from granules to masses as large as a hen's egg. 3. The distillation of the crude metal is effected in a crucible through which a tube ascends to within an inch of the lid. The tube opens at the bottom into an iron box, placed beneath the bars of the furnace, where, on the completion of the operation, magnesium is found in the form of a heap of drippings, which may be melted and cast into ingots or any desired form. The difficulty of obtaining a metal with so little ductility in the form of wire—the only form that was originally used for yielding light—had still to be overcome; and after various partially successful attempts to press small quantities into wire by Matthiessen and some other chemists, Mr. Mather, of Salford, devised a piece of machinery by which the metal is pressed into wire of various thickness. Mr. Mather also was the first who obtained the metal in ribbons, in which form, from the larger exposed surface, combustion takes place more completely. The apparatus for making the wire and ribbon is very ingenious. The chief feature of it is a small hollow cylinder, adapted to receive a ram at one end, and covered at the other by an iron screen perforated with two or more holes opposite the chamber. This press, as the cylinder is called, is subjected to the action of gas from a blow-pipe, and the heat employed is only sufficient to soften the metal in the press. The pieces of magnesium are thrust into the chamber, the ram is placed in the mouth of the press, and a pressure of between two and three tons—obtained by hydraulic apparatus or by steam—forces the ram against the softened metal, and the latter oozes in continuous strings of wire through the perforations already named. To make ribbon, the wire thus obtained is passed between two hollow heated rollers, and is received in a flattened state upon a reel. To Mr. Mather is also due the credit of having constructed the first magnesium lamp, in which the end of the wire or ribbon is presented to the flame of a spirit-lamp. A concave reflector sent the light forward, and protected the eyes of the operator.

The first time that a photograph was taken by this light was at Manchester in the spring of 1864, by Mr. Brothers and Dr. Roscoe. That the magnesium light, in a more or less modified form, must prove of extreme value to photography, cannot be called in question. Besides overcoming the obstacle of unsuitable weather for the employment of sunlight, it may be applied both for the exploration and the photography of various dim structures, underground regions, etc., such as the interior of the pyramids, of catacombs, natural caverns, etc., which could not otherwise be examined or photographed.

Its color approaches very much nearer daylight than that of the light from oils, candles, or coal-gas. As compared with the sun, its luminous intensity is $\frac{1}{525}$, but its chemical intensity is $\frac{1}{36}$, and this high actinic power makes it specially valuable for photographic purposes. Although it does not nearly equal the electric light as an illuminating agent, like it the magnesium light gives off no noxious vapors. But while it burns, white clouds of the vapor of magnesium are formed which would be more or less



THE COMPASS, MAGNETISM, POLARITY, etc. 1. Magnetic poles. 2. Magnetic rod (suspended). 3. Mag magnetic polarity. 7. Magnetizing iron. 8, 9. Natural magnet, with armature. 10. Horse-shoe tion. 15. Apparatus for determining the degree of declination. 16. Magnetism of the terrestri variation of inclination. 22 to 24. Magnetometer. 25. Magnetic variations or disturbances.



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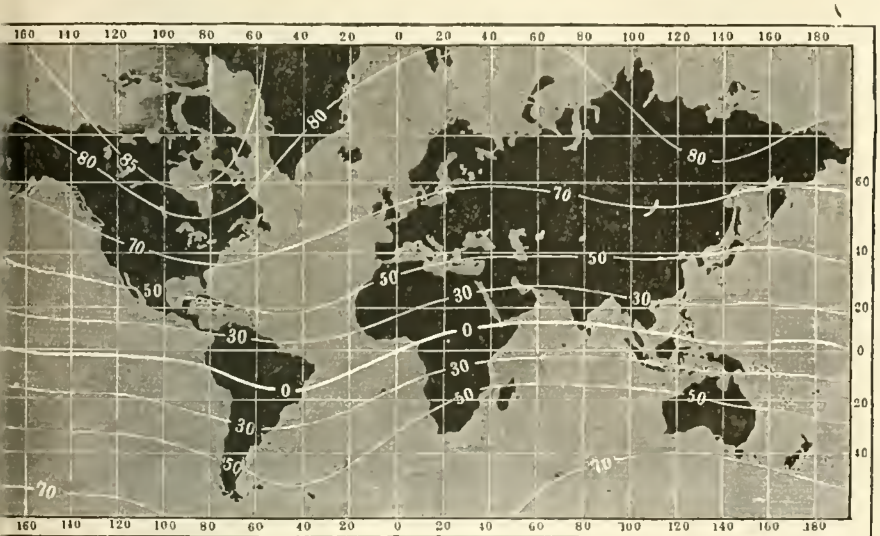

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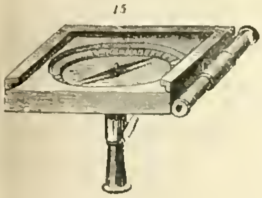

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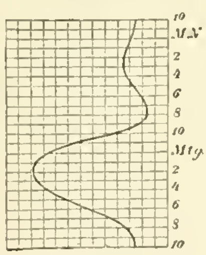

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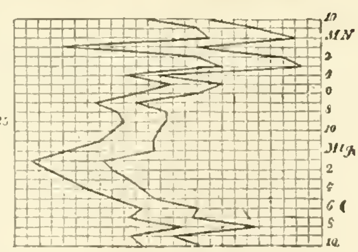


4. Magnetic needles with marked poles. Magnetic staff, broken at various points. 6. Illustration of Magnet armature. 12. Action of a magnet at a distance. 13. Magnetization by friction. 14. Declina-Map of declination. 18. Magnetic inclination. 19. Inclinatorium. 20. Map of inclination. 21. Diurnal

troublesome in private rooms. This objection is said to be to some extent removed, without diminishing the brilliancy of the light, by alloying with zinc; and at any rate it would scarcely at all interfere with its use in large public buildings. Still less would it do so when the light is burned in the open air. There is, however, not much hope of the magnesium light successfully competing with the electric light for the illumination of large buildings, streets, or even of ocean steamers. Recent trials with the electric light at the British Museum and other places have now proved conclusively that wherever a great deal of light is required, gas is beaten out of the field on the score of economy. As respects the maintenance of an equal amount of light, gas is twenty times more costly, a difference which will speedily cover the original expense of the necessary electrical apparatus. The magnesium light, on the other hand, is much more costly than gas; and although the ores which could be used as a source of magnesium are very abundant, yet any probable cheapening of the process of extracting the metal from these is not likely to make the light a very economical one. Still, for any purpose where, for a comparatively brief time, a very intense light is required, magnesium wire or ribbon has about it almost the simplicity of a wax taper; nor are the lamps at all complex by which the metal may be burned for hours continuously.

Two kinds of magnesium lamps are made. In one of these kinds, wire or thin ribbon of the metal is coiled about a reel or bobbin. From this reel the ribbon is drawn by means of two small rollers and projected through a tube to the focus of a metallic reflector, where it passes through the flame of a spirit-lamp to insure its continuous combustion. These rollers are kept in motion either by an operator turning a small wheel, or in the more expensive forms by clock-work. In the other kind of lamp the magnesium is used in the form of dust, which is mixed with fine dry sand in the proportion of one of the former to two of the latter. This mixture is placed in a funnel-shaped reservoir, and conducted, by means of a narrow tube provided with a stop-cock, to the flame of a spirit-lamp which serves to ignite and maintain the flame of the powdered magnesium. If nitrate of strontia be substituted for sand, a splendid red light is produced, and in this way, by using other chemicals, various colors can be obtained. It was about the year 1864 that magnesium was first made on a commercial scale, and it is found that the demand for it, although not decreasing, is scarcely at all extending. It is almost wholly used for burning in photographic lamps, for flash lights, and for fire-works. It has been attempted to make magnesium useful for other purposes. Various alloys have been made with it and other metals such as lead, tin, zinc, cadmium, and silver; but they are all brittle and liable to change. It is very doubtful, therefore, if any of these alloys will become useful in the arts, and the metal itself is scarcely likely to be available in the construction of objects of ornament or utility, since, when exposed to damp, it soon becomes coated with a film of hydrate of magnesium.

MAGNETISM.—The power which the magnet has to attract iron. Magnets are of two kinds, *natural* and *artificial*. Natural magnets consist of the ore of iron called magnetic, familiarly known as loadstone. Artificial magnets are, for the most part, straight or bent bars of tempered steel, which have been magnetized by the action of other magnets, or of the galvanic current. The power of the magnet to attract iron is by no means equal throughout its length. If a small iron ball be suspended by a thread, and a magnet be passed along in front of it from one end to the other, it is powerfully attracted at the ends, but not at all in the middle, the magnetic force increasing with the distance from the middle of the bar. The ends of the magnet where the attractive power is greatest are called its poles. By causing a magnetic needle moving horizontally to vibrate in front of the different parts of a magnet placed vertically, and counting the number of vibrations, the rate of increase of the magnetic intensity may be exactly found.

A magnet has two poles or centers of magnetic force, each having an equal power of attracting iron. This is the only property, however, which they possess in common, for when the poles of one magnet are made to act on those of another, a striking dissimilarity is brought to light. It might be thought that, by dividing a magnet at its center, the two poles could be insulated, the one half containing all the north polar magnetism, and the other the south. When this is done, however, both halves become separate magnets, with two poles in each—the original north and south poles standing in the same relation to the other two poles called into existence by the separation. *We can therefore certainly never have one kind of magnetism without having it associated in the same magnet with the same amount of the opposite magnetism.* It is this double manifestation of force which constitutes the polarity of the magnet. The fact of a freely suspended magnet taking up a fixed position has led to the theory that the earth itself is a huge magnet, having its north and south magnetic poles in the neighborhood of the poles of the axis of rotation, and that the magnetic needle or suspended magnet turns to them as it does to those of a neighboring magnet. All the manifestations of terrestrial magnetism give decided confirmation of this theory. It is on this view that the French call the north pole of the magnet the south pole *(pôle austral)*, and the south the north pole *(pôle boréal)*; for if the earth be taken as the standard, its north magnetic pole must attract the south pole of other magnets, and *vice versa*. In England and Germany the north pole of a magnet is the one which, when freely suspended, points to the north, and no reference is made to its relation to the magnetism of the earth. All artificial magnets are either bar magnets or else horse-shoe magnets, (See Fig. 1.) When powerful magnets are to be made, several thin bars are placed side by side, with their poles lying in the same way. They end in a piece of iron, to which they are bound by a brass screw or frame. Three or four of these may be put into the bundle, and all these again into bundles of three and four. Such a collection of magnets is called a *magnetic magazine* or *battery*. A magnet of this kind is more powerful than a solid one of the same weight and size, because thin bars can be more strongly and regularly magnetized than thick ones. A good form of magnet is a parallelopiped of magnetic iron ore, with pieces of soft iron, bound to its poles by a brass frame encircling the whole. The lower ends of the soft iron bars act as the poles, and support the armature. The magnetic needle is a small magnet nicely balanced on a fine point. When a short bar of soft iron is suspended from one end of a magnet it becomes for the time powerfully magnetic. It assumes a north and south pole, like a regular magnet, as may be seen by using a small magnetic needle; and if its lower end be dipped into iron filings, it attracts them as a magnet would do. When it is taken away from the magnet the filings fall off, and all trace of magnetism disappears. It need not be in actual contact to show magnetic properties; when it is simply brought near, the same thing is seen, though to a less extent. If the inducing magnet be strong enough, the induced magnet, when in contact, can induce a bar like itself, placed at its extremity, to become a strong magnet; and this second induced magnet may also transmit the magnetism to a third, and so on, the action being, however, weaker each time. If a steel bar

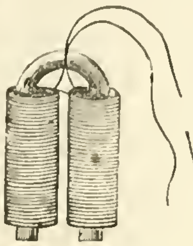


Fig. 1.

be used for this experiment, a singular difference is observed in its action; it is only after some time that it begins to exhibit magnetic properties, and, when exhibited, they are feebler than in the soft iron bar. When the steel bar is removed, it does not part instantly with its magnetism, as the soft iron bar, but retains it permanently. Steel, therefore, has a force which, in the first instance, resists the assumption of magnetism; and, when assumed, resists its withdrawal. This is called the *coercitive force*. The harder the temper of the steel, the more is the coercitive force developed in it. It is this force, also, in the loadstone, which enables it to retain its magnetism. The inductive action of terrestrial magnetism is a striking proof of the truth of the theory already referred to, that the earth itself is a very large magnet. When a steel rod is held in a position parallel to the dipping-needle, it becomes in the course of some time permanently magnetic. The result is reached sooner when the bar is rubbed with a piece of soft iron. A bar of soft iron held in the same position is more powerfully but only temporarily affected, and when reversed, the poles are not reversed with the bar, but remain as before. If when so held it receive at its end a few sharp blows of a hammer, the magnetism is rendered permanent, and now the poles are reversed when the bar is reversed. The torsion caused by the blows of the hammer appears to communicate to the bar a coercitive force. We may understand from this how the tools in work-shops are generally magnetic. Whenever large masses of iron are stationary for any length of time they are sure to give evidence of magnetization, and it is to the inductive action of the earth's poles acting through ages that the magnetism of the loadstone is to be attributed. Magnets, when freshly magnetized, are sometimes more powerful than they afterwards become. In that case they gradually fall off in strength till they reach a point at which their strength remains constant. This is called the *point of saturation*. If the magnet has not been raised to this point, it will lose nothing after magnetization. We may ascertain whether a magnet is at saturation by magnetizing it with a more powerful magnet, and seeing whether it retains more magnetism than before. The saturation point depends on the coercitive force of the magnet, and not on the power of the magnet with which it is rubbed. When a magnet is above saturation, it is soon reduced to it by repeatedly drawing away the armature from it. After reaching this point, magnets will keep the same strength for years together if not subjected to rough usage. It is favorable for the preservation of magnets that they be provided with an armature or keeper. The power of a horse-shoe magnet is usually tested by the weight its armature can bear without breaking away from the magnet. Häcker gives the following formula for this weight: $W=a\sqrt[3]{m^2}$; W is the charge expressed in pounds; a, a constant to be ascertained for a particular quality of steel; and m is the weight in pounds of the magnet. Small magnets, therefore, are stronger for their size than the large ones. The reason of this may be thus explained: Two magnets of the same size and power, acting separately, support twice the weight that one of them does; but if the two be joined, so as to form one magnet, they do not sustain the double, for the two magnets being in close proximity, act inductively on each other, and so lessen the conjoint power. Similarly, several magnets made up into a battery have not a force proportionate to their number. Coulomb discovered, by the oscillation of the magnetic needle in the presence of magnets, that *when magnets are so placed that two adjoining poles may act on each other without the interference of the opposite poles*, that is, when the magnets are large compared with the distance between their centers, *their attractive or repulsive force varies inversely as the square of the distance*. Gauss proved from this theoretically, and exhibited experimentally, that when the distance between the centers of two magnets is large compared with the size of the magnets, that is, *when the action of both poles comes into play, their action on each other varies inversely as the cube of the distance*. When a magnet is heated to redness it loses permanently every trace of magnetism; iron, also, at a red heat, ceases to be attracted by the magnet. At temperatures below red heat the magnet parts with some of its power, the loss increasing with the temperature. The temperatures at which other substances affected by the magnet lose their magnetism differ from that of iron. Cobalt remains magnetic at the highest temperatures, and nickel loses this property at 662° F.

Electro-magnetism includes all phenomena in which an electric current produces magnetism. The most important result of this power of the current is the electro-magnet. This consists (Fig. 1) generally of a round bar of soft iron bent into the horse-shoe form, with an insulated wire coiled round its extremities. When a current passes through the coil, the soft iron bar becomes instantly magnetic, and attracts the armature with a sharp click. When the current is stopped, this power disapears as suddenly as it came. Electro-magnets far outrival permanent magnets in strength. Small electro-magnets have been made by Joule which support 3,500 times their own weight, a feat immeasurably superior to anything performed by steel magnets. When the current is of moderate strength, and the iron core more than a third of an inch in diameter, *the magnetism induced is in proportion to the strength of the current and of the number of turns in the coil*. When the bar is much thinner than one-third of an inch, a maximum is very soon reached beyond which any additional turns of the wire give no additional magnetism; and even when the core is thick, these turns must not be heaped on each other, so as to place them beyond influencing the core. It follows from the above principle, that, in the horse-shoe magnet, where the inductive action in the armature must be taken into account, *the weight which the magnet sustains is in proportion to the squares of the strengths of the currents and to the squares of the number of turns of the wire*. This maximum is in different magnets proportional to the area of section or to the square of the diameter of the core. The electro-magnet, from the ease with which it is made to assume or lay aside its magnetism, or to reverse its poles, is of the utmost value in electrical and mechanical contrivances. The action of the electro-magnet is quite in keeping with Ampere's theory, as the current of the coil, acting on the various currents of the individual molecules, places them parallel to itself, in which condition the soft iron bar acts powerfully as a magnet. The direction of the current and the nature of the coil being known, the poles are easily determined by Ampere's rule. Builders of magnetic engines take advantage of the facility with which the poles of an electro-magnet may be reversed, by which attractions and repulsions may be so arranged with another magnet as to produce a constant rotation. The forms in which they occur are exceedingly various. Fig. 2, shows a simple and common construction, whereby a double-beam engine of much power is obtained. Powerful machines of this kind have been made with a view to supplant the steam-engine; but such attempts, both in respect of economy and constancy, have proved utter failures.

Magneto-electricity includes all phenomena where magnetism gives rise to electricity. Under *Induction of Electric Currents* it was stated that when a coil, in which a current circulates, is quickly placed within another coil unconnected with it, a contrary induced current in the outer coil marks its entrance, and when it is withdrawn, a direct induced current attends its withdrawal. While the primary coil remains stationary in the secondary coil, though the current continues to flow steadily in the primary, no current is induced in the secondary coil. It is also shown, that if, while the primary coil is stationary,

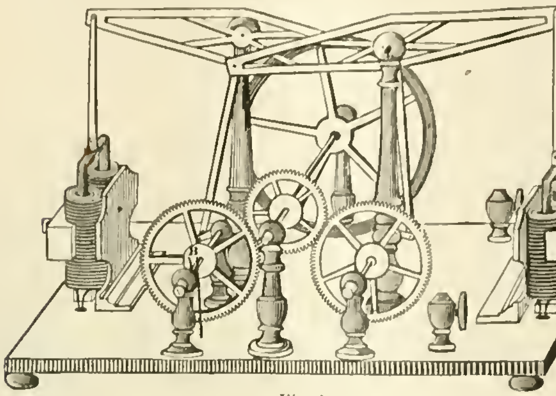


Fig. 2.

the strength of its current be increased or diminished, each increase and diminution induce opposite currents in the secondary coil. Change, in fact, whether in the position or current strength of the primary coil, induces currents in the secondary coil, and the intensity of the induced current is in proportion to the amount and suddenness of the change. In singular confirmation of Ampere's theory, a permanent bar-magnet may be substituted for the primary coil in these experiments, and the same results obtained with greater intensity. When a bar-magnet is introduced into the secondary coil, a current is indicated, and when it is withdrawn, a current in a contrary direction is observed, and these currents take place in the directions required by Ampere's theory. A change of position of the magnet is marked by a current, as in the former case. If we had the means of increasing or lessening the magnetism of the bar, currents would be induced the same as those obtained by strengthening or weakening the current in the primary coil. It is this inductive power of iron at the moment that a change takes place in its magnetism, that forms the basis of magneto-electric machines. Of late years quite a new era has arisen in the construction of magneto-electric machines. The compactness, simplicity of construction, and marvelous power which the new machines possess, give them quite a novel importance in practical electricity. The names chiefly associated with the new improvements are Wilde of Manchester, Siemens and Wheatstone, and Gramme of Paris. Mr. H. Wilde, in 1866, patented a magneto-electric machine, founded on the principle that *a current or a magnet indefinitely weak can be made to induce a current or a megnet of indefinite strength.* A Wilde's machine 1½ ton in weight, measuring about 5 feet in length and height, and 20 inches in width, driven by a steam-engine, produces a most brilliant electric light, and exhibits the most astonishing of heating powers. Wheatstone and Siemens gave a new interpretation to Wilde's principle.

The great drawback of all the forms of the machine is the enormous velocity at which they rotate some 2,000 or more revolutions in the minute. At this speed a machine soon wears itself out. Another disadvantage is the heating of the armatures in Wilde and Ladd's machine. Ferguson's has never been tried on a large scale. It is found necessary to keep the armatures cool by a flow of cold water. This heat, however removed, is manifestly a mere squandering of the energy of motion, and a loss to the current given off. A third objection is the loss that always takes place when the side-springs change from the one ring to the other, sparks more or less bright accompanying the change. For the electric light, however, the alternate currents are used, and this source of loss is not experienced. These defects are removed in the latest form of the electro-magnetic machine by Gramme, of Paris. In it, instead of a solid armature of iron, a ring is employed on which a great number of bobbins of wire are set. Astonishing as were the effects produced by Wilde's machine, those obtained from Gramme's seen quite to eclipse them. In comparing two magneto-electric machines, we must take into account the kind of wire used for the revolving armature. For tension purposes, a thin and long wire gives the best results; for quantity or heating purposes, a short and thick wire does best. To compare a tension with a quantity armature, the same test even in the same machine would give most contradictory results. But comparing, so far as possible, machines intended for the same purpose Gramme seems to have the advantage of all others. In the first place, the speed of revolution seldom exceeds 800 revolutions per minute; 300 is sufficient for most purposes. A Gramme machine driven by the hand will melt 10 inches of an iron wire $\frac{1}{25}$ of an inch in diameter, a feat not accomplished by any other arrangement. The electric light got by a 3-horse-power engine working a machine a ton in weight is equal to upwards of 8,000 sperm candles. A signal-light of this kind has been constructed for the House of Lords, under the superintendence of the eminent engineer Conrad W. Cooke, who has rendered no small service in perfecting the machine. The carbons consumed last four hours, and when burned out are instantaneously replaced. A Gramme machine adapted for electro-plating, and worked by a 1-horse-power engine, deposits nearly 27 oz. of silver per hour, an achievement far transcending the similar performance of other machines. Among the heating wonders of the Gramme machine we are told of a file half an inch in diameter being burned up in 5 minutes, of 15 feet of No. 18 platinum wire being brought to a glowing heat, and of 8 feet of iron wire .051. See *Electricity* and *Galvanism*.

MAHRATTA HELMET.—An Indian casque, having a long movable nose-piece of a singular shape; a large mail hood which protects all the head, and a neck-guard which descends to the loins.

MAIDEN.—A name given to a machine for beheading criminals, which was in use in Scotland from about the middle of the 16th century to nearly the end of the 17th century. It is said to have been introduced into Scotland by the Regent Morton, who had seen it at Halifax, in Yorkshire, and was himself the first to suffer by it, whence the proverb, "He that invented the maiden first handselled it." Morton, for anything that is known to the contrary, may have introduced the maiden; but he certainly was not its first victim. Fifteen years before he was put to death by it (1581 A. D.) it was employed to behead Thomas Scott, of Cambusmichael, one of the murderers of Rizzio (1566 A. D). It would seem at first to have been called indifferently "The Maiden" and "The Widow"—both names, it may be conjectured, having their origin in some such pleasantry as was glanced at by one of the maiden's last victims, the Earl of Argyle (1681 A. D.), when he protested that it was "The sweetest maiden he had ever kissed." A frightful instrument of punishment used in Germany in the Middle Ages was called "The Virgin." But it had no resemblance to the maiden, which was exactly like the French guillotine, except that it had no turning-plank on which to bind the criminal. The maiden which was used in the Scottish capital is now in the Museum of the Antiquaries of Scotland at Edinburgh. The term *maiden* is also applied to a fortress which has never been taken.

MAIL.—A term signifying a metal net-work, and ordinarily applied to such when used as body defensive armor. Well-made mail formed an admirable defense against all weapons except fire-arms, and its pliability and comparative lightness gave it favor over the more cumbrous plate-armor.

MAILLET.—A kind of mallet formerly used by the French in their engagements. The maillet was used at the famous battle "Des Trente" in 1351. Under the reign of Charles VI. a Parisian mob forced the arsenal, and took out a large quantity of mallets, with which they armed themselves for the purpose of murdering the custom-house officers. The persons who assembled on this occasion were afterwards called *Maillotins*. In the days of Louis XII. the English archers carried mallets as offensive weapons.

MAILLOTIN.—An old French term which signified an ancient weapon that was used to attack men who wore helmets and cuirasses. A faction in France was also distinguished by this appellation. See *Maillet*.

MAIN.—A term signifying first in size, rank, or importance. It has many useful compounds attached to it, such as: *Main body* of an Army, the body of troops, other than those forming the advanced or rear guard. *Main guard*, a body of men generally of the strength sufficient to guard a person or place from injury or attack. It remains on duty 24 hours before being relieved. Large forts or fortresses have a main guard chosen from the troops garrisoning them, under which guard all disturbers of peace, drunkards, etc., are placed, as well as all people who cannot by night give an account of themselves, or who do not know the parole. *Main magazine*, the principal magazine in a work or battery, in which there is more than one magazine. *Main work*, in fortification, the principal work as distinguished from the outworks.

MAINADE.—The French term for a body of marauders commanded by a chief.

MAIN-GAUCHE.—A dagger of Spanish origin especially used in duels in the 16th century. On one side of the hilt it has a guard, which is curved and carried up to the pommel in the form of a half shell; from the *talon*, or heel of the blade, on the opposite side, is a hollow indent, intended to hold the thumb. The weapon was held in the left hand, with the thumb above and the guard below; and it was used, while making an attack, with the sword held in the right hand to ward off the blows or thrusts that the adversary might make with his sword. See *Pennated Dagger*.

MAIN PIN.—A strong cylindrical bar passing vertically through a hole in the front bolster of the wagon body, and through one in a corresponding bolster in the fore carriage. The pull of the traces is conveyed from the fore carriage to the body solely through the *main-pin*. This means of connection between fore carriage and body allows the former to turn horizontally independently of the latter.

MAIN-SPRING.—The spring in a gunlock which drives the hammer. See *Lock*.

MAINTENANCE.—The Cap of Maintenance, sometimes called *Cap of Dignity*, a cap of crimson velvet lined with ermine, with two points turned to the back, originally only worn by Dukes, but afterwards assigned to various families of distinction. Those families who are entitled to a cap of maintenance place their crests on it instead of on a wreath. According to Sir John Fearne, "the wearing of the cap had a beginning from the Duke or General of an army, who, having gotten victory, caused the chiefest of the subdued enemies whom he led to follow him in his triumph, bearing his hat or cap after him, in token of subjection and captivity." Most of the reigning Dukes of Germany, and various families belonging to the peerage both of England and of Scotland, bear their crests on a cap of maintenance.

MAISON DU ROI.—The King's Household. Certain select bodies of troops were so called during the Monarchy of France, and consisted of the *Gardes-du-Corps*, the *Gendarmes*, the *Chevaux-legers*, the *Mousquetaires*, the *Gendarmerie*, the *Grenadiers à Cheval*, the regiments belonging to the French and the Swiss Guards, and the *Cent Suisses*. The Maison-du-Roi was not considered a separate establishment from the rest of the Army until the reign of Louis IV. This establishment was successively formed by different kings out of militia companies, which they took into their body-guard.

MAITRE D'ARMES.—A term in general use among the French, signifying a Fencing Master. Every regiment has a Maitre d'Armes attached to it.

MAJESTY.—A title of honor now usually bestowed on Sovereigns. Among the Romans, *Majestas* was used to signify the power and dignity of the people; and the Senatorial, Consular, or Dictatorial Majesty was spoken of, in consequence of these functionaries deriving their power from the people. After the overthrow of the Republic, *Majestas* became exclusively the attribute of the Emperors, *Dignitas* being thenceforth that of the Majestrates. The *Majestas* of the Emperors of Rome was supposed to descend to those of Germany as their successors; but the adoption of the attribute by other European Sovereigns is of comparatively late date. Its use began in England in the latter part of the reign of Henry VIII., up to which time, "Your Grace" or "Your "Highness" had been the appropriate mode of addressing the Sovereign. Henry II. was the first King of France who was similarly styled, and Louis XI. and his successors became entitled, in virtue of a papal bull, to call themselves by the title of "Most Christian Majesty." Ferdinand and Isabella of Spain similarly obtained for themselves and their successors the title of "Most Catholic Majesty;" and Stephen, Duke of Hungary, and Maria Theresa, of "Apostolic Majesty." The Emperor of Austria is now styled His Imperial Royal Majesty; in German, "K.K. (abbreviated for Kaiserliche Konigliche) Majestat" Emperors, Kings, and Queens are now generally addressed as "Your Majesty," not including the Sultan of Turkey, whose proper style is "Your Highness." The Sovereign of the United Kingdom is personally addressed as "Your Majesty," and letters are addressed to "The King's" or "Queen's" "Most Excellent Majesty." In Heraldry, an eagle crowned and holding a scepter, is blazoned as an "Eagle in his Majesty."

MAJOR.—1. An officer next in rank above a Captain and below a Lieutenant-colonel. He is the lowest Field Officer. Since the reorganization of the English army, the Major is a selected man, and his term of service in this rank is for five years, after which, if not re-employed, he is put on half-pay. This does not relate to Majors of the artillery and engineers. The duties of a Major depend upon the nature of the service on which he is employed. In the line, whilst with his regiment, he has to see to the drill and equipment of the men in conjunction with the Adjutant. Being a Field Officer, he is mounted on all parades and in action. In the artillery and engineers, the rank of Major has been recently reintroduced, and single batteries of artillery are now commanded by officers of this rank, instead of by a Captain, as hitherto. It was in the year 1827 that the rank of Major in the artillery was abolished, its holders being made Lieutenant-colonels. It appears that this class of Field Officer did not exist in the army until the seventeenth century. 2. Used adjectively, the word *Major*, in the army signifies a superior class in a certain rank, as Sergeants-Major, who are superior Sergeants; except in the case of General Officers, in which its signification is arbitrarily limited to Major-general, the third of the four classes of Generals.

MAJOR GENERAL.—The rank next below that of Lieutenant-general, and above Brigadier-general. He usually Commands a Division. A Major's command in peace time in England is that of a District; in India, a Division of the Army. A Brigade of the army is properly a Major-general's command, Thus, on service with a large army, a General would command a *Corps d'Armée*, a Lieutenant-general a Division, and a Major-general a Brigade.

MALABAR GUNS.—Heavy pieces of ordnance, which were made in the Malabar country, and were formed by means of iron bars joined together with hoops. They were very long and extremely unwieldy.

MALCHUS.—A short sword of Italian origin, used in the fifteenth century, and very much like the *Anelace*.

MALINGERER.—A soldier who feigns himself sick. Any soldier convicted of malingering, feigning or producing disease, or of intentionally protracting his cure or aggravating his disease, is liable to be tried by a Court-Martial for "Conduct prejudicial to good order and military discipline," and to suffer the punishment attached to that offense. See *Feigning of Disease*.

MALKIN.—A sponge with a jointed staff for cannons.

MALLEABILITY.—The property which certain metals possess of being reducible to thin leaves, either by hammering (hence the corresponding German word *hämmerbarkeit*) or by lamination between rollers. The order in which the malleable metals exhibit this property is as follows: gold, silver, copper, platinum, palladium, iron, aluminium, tin, zinc, lead, cadmium, nickel, cobalt. Gold far surpasses all other metals in malleability, being capable of reduction into films not exceeding the 200,000th of an inch in thickness; and silver and copper may be reduced to leaves of great tenuity. Although gold and silver also present the property of *ductility* in the highest degree, there is no constant relation between the two properties; for example, iron, although it may be reduced to extremely thin wire, is not nearly so malleable as gold, silver, or copper.

MALLET.—A wooden hammer. It is used for a variety of purposes in the field, such as driving pickets, tent-pins, etc. The head is made of elm, and the helve of ash. Mallets vary in size and shape, and are made in India of babool or soondry wood. Mallets are also very generally used by mechanics, such as joiners and carpenters, coopers, tinmen, etc.

MALLET'S MORTAR.—A monster mortar manufactured some years ago by Mr. Mallett. It consisted at the lower end of a solid cast-iron breech, abutting on which were a series of wrought-iron hoops, following each other in succession up to the muzzle; these were inserted into each other by rebates, and were firmly secured by six iron staves, at equal intervals, about its surface, extending longitudinally the whole length of the mortar. The total weight of the mortar was 50 tons 13¼ cwt.; the diameter of the shell 3 feet, and its weight, when unfilled, 26¼ cwt. From the experiments made with this mortar, it appears that there was a tendency to separation between the trunnions and the cascable, and consequently there was reason to think that it never could be employed on service. This piece of ordnance is not in the service, but a model of it may be seen in the Royal United Service Institution, Whitehall, London.

MALTA.—The most ancient and celebrated of Military Orders is that of *Saint John of Jerusalem*, which owes its origin to the Hospital of St. John, founded in Jerusalem in the year 1048. It became in 1118 a Religious Order of Knighthood, and from 1309 the Knights were called *Knights Hospitallers of Rhodes*, and from 1530 *Knights of Malta*. The representative of this Order in England was the Prior of Clerkenwell, who had a seat in Parliament, and was styled the First Baron of England. This Order is now almost extinct, no Grand Master having been elected since 1805. The badge worn by all the Knights is a Maltese cross, enamelled white and edged with gold, suspended to a black ribbon. Some members of this Order did duty during the war of 1870-71 with the sick and wounded, the order thus appropriately ending, as it had begun, in hospitals.

MALTESE CART.—A cart which can be used with either single or double draught. The two side pieces of the cart form the shafts, and are bolted across an axle-tree bed, and connected also by a hind ear-bed, splinter-bar, and axis slats. The cart is formed of wood, and is adapted for man draught. Its weight is under 7 cwt.

MALTESE CROSS.—A cross of eight points, of the form worn as a decoration by the Hospitallers and other Orders of Knighthood.

MAMELIERE—Armor for the breast, from which depended two chains, one attached to the pommel, and the other to the scabbard of the sword.

MAMELUKES—MAMLOUKS—MEMLOOKS.—An Arabic word signifying *slaves*, the name given in Egypt to the slaves of the Beys, brought from the Caucasus, and who formed their armed force. When Genghis Khan desolated great part of Asia in the 13th Century, and carried away a multitude of the inhabitants for slaves, the Sultan of Egypt bought 12,000 of them, partly Mingrelians and Tcherkesses, but mostly Turks, and formed them into a body of troops. But they soon found their own power so great that, in 1254, they made one of their own number Sultan of Egypt, founding the Dynasty of the Baharites, which gave place to another Mameluke Dynasty, that of the Borjites, in 1382. The Caucasian element predominated in the first Dynasty, the Tartar element in the second. In general, they formed able and energetic rulers, and Egypt under their sway arrived at a degree of prosperity and power to which she had been a stranger from the days of Sesostris. Selim I., who overthrew the Mameluke Kingdom in 1517, was compelled to permit the continuance of the 24 Mameluke Beys as Governors of the Provinces. This arrangement subsisted till the middle of the 18th Century, when the number and wealth of the Mamelukes gave them such a preponderance of power in Egypt that the Pasha named by the Porte was reduced to a merely nominal ruler. The number of them scattered throughout all Egypt was between 10,000 and 12,000 men. Their number was kept up chiefly by slaves brought from the Caucasus, from among whom the Beys and other Officers of State were exclusively chosen. Their last brilliant achievements were on the occasion of the French Invasion of Egypt, and during the time immediately following the retirement of the French. At this time Murad Bey stood at their head. But in 1811 they were foully massacred by Mohammed Ali, afterwards Viceroy of Egypt.

MAMMOTH POWDER.—A variety of powder formed by breaking up mill cake. Exact uniformity of size and shape of grains does not therefore exist. The average granulation is 85 to the pound. The diameters of the holes in the testing sieves are .75 inches and .90 inches. See *Gunpowder*.

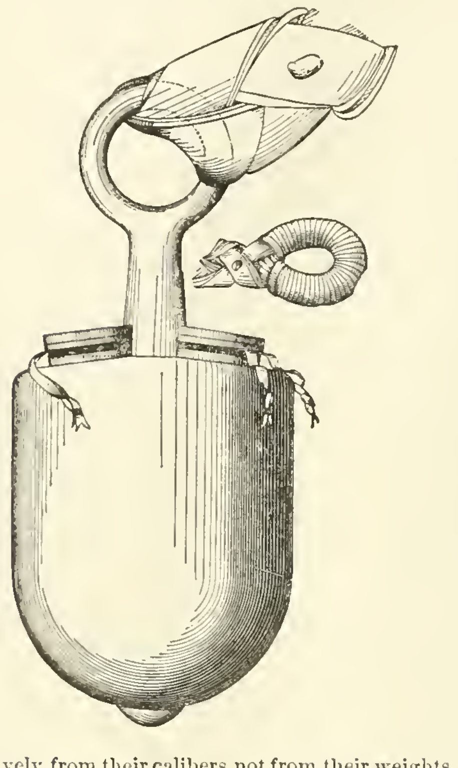
MANACLES.—Handcuffs or *nippers* for prisoners. The two pieces of metal are hinged together, the upper portion of which is curved so as to fit the wrist, and the lower portion is straight except at a point near its outer end, where it is slightly bent.

MANBY SHOT.—Without entering upon a detailed description of the different plans proposed, from time to time, for establishing communication between a stranded vessel and the shore, it will, perhaps, be well to mention that Manby's apparatus is not the only one which has been used for this purpose. Kites have also been suggested as a simple means of carrying a line from a wreck to the shore, and are manufactured for this purpose by the "Shipwrecked Mariners' Society, London Bridge." The board of trade employed, to a great extent, until 1865, Dennett's rockets, in preference to Manby's shot; and there can be no question that the balance of advantages inclines strongly to the side of the rockets.

In 1865 a rocket proposed by Colonel Boxer, R. A., was adopted by the board of trade to supersede Dennett's rocket, to which it is preferred because.—1st.

The range of Colonel Boxer's rocket is little, if at all, inferior, and in every other respect it is much superior; 2d. The combination of Mr. Dennett's two rockets is very objectionable, and from their velocity they frequently carry away the line, and sometimes both do not ignite. They are also double the expense. These rockets are fast superseding Manby's shot at all stations, and the latter may shortly be expected to become entirely obsolete.

There are two natures of Manby's shot in the service, the 24-pounder oblong or "cylindrical," shown in the drawing, and the 6-pounder spherical shot. They are designated 24-pounder and 6-pounder, re-



spectively, from their calibers, not from their weights. The 24-pounder oblong, or "cylindrical" Manby's shot, is a cast-iron cylindro-conoidal projectile, with a slightly rounded base, and about $1\frac{1}{4}$ calibers in length. The shot is drilled down its longer axis for the reception of a wrought-iron bolt, which passes completely through the projectile from end to end, and projects about five inches beyond the base, terminating in an eye, to which is attached a plaited hide thong 2 feet in length. Four holes, for the reception of "fuses," are drilled into the shot at the base, equidistant from one another and from the center of the base, and slightly inclining inwards. These holes are conical in form, and are about the same diameter as the fuse-holes of the 13 and 10 inch mortar shells. They are about $3\frac{1}{2}$ inches in length and are roughed in the interior to afford a better hold to the fuses. The hide thong, or "strop," which is fastened to the eye-bolt, is made of four strips of raw horse-hide, doubled through the eye and tightly plaited, the plait being further secured by being stitched in several places with hide. The end of the thong is formed into a loop which is tightly woolded with fine tarred spun-yarn. These projectiles weigh (with thong) about $30\frac{1}{2}$ pounds.

The 6-pounder spherical Manby's shot is rarely demanded, and is scarcely to be considered as a service projectile. It consists of a diaphragm shell filled with lead, and having an iron loop fixed into it, to which is attached a thong similar to that of the oblong projectile. This shot is without fuse-holes. It weighs about 8 pounds.

The action of a oblong shot is as follows: The end of the line is made fast to the loop-hole of the thong, the rest of the line being carefully coiled either in a basket or upon the ground or deck, and a fuse is placed in each of the four holes made for the purpose. The fuses being uncapped, the projectile is carefully placed in the piece with its base toward the muzzle, and upon the discharge of the piece carries out the line, one end of which being retained, a good communication is thus established between the vessel and the shore. The use of the hide thong is to remove the line from the immediate flash of the discharge, and so prevent it from being burned. The fuses serve, by the bright light which they give forth, to indicate the path of the shot and guide the firing party in laying the piece. The strength and direction of the wind must be considered in determining the direction to be given, the trajectory being affected by them to a very great extent, owing to the influence which the wind has upon the line. With deep-sea line, and with the ordinary charge of 12 ounces, the range varies from 400 yards downward, according to the strength and direction of the wind. The 6-pounder is used in the same way, with the exception that, having no fuses, the operation of fixing and uncapping them is dispensed with. These projectiles are mainly used to establish a communication between the shore and a stranded vessel, but the principle is applicable to a variety of other purposes, etc.

The maximum charge for the 24-pounder oblong Manby's shot is only 12 ounces, giving, with 45° of elevation, a range from 400 yards downward, according to the strength and direction of the wind. If a higher charge is used, the line is generally broken. See *Life-saving Rockets*.

MANCH MAUNCH.—A frequent charge in English Heraldry, meant to represent a sleeve with long pendant ends, of the form worn by ladies in the reign of Henry I. Or, a manch gules, has been for a long time the arms of the Hastings family, one of whom was steward of the household to Henry I.

MANDARIN.—A term applied to Chinese officers of every grade by foreigners. It is derived from the Portuguese *mandar*, to command; the Chinese equivalent is *Kwan*. There are nine ranks, each distinguished by a different-colored ball or button placed on the apex of the cap, by a peculiar emblazonry on the breast, and a different clasp of the girdle. The balls are ruby, coral, sapphire, a blue opaque stone, crystal, opaque white shell, worked gold, plain gold, and silver. Theoretically, these grades are indicative of relative merit, but as office and titles are sold to a great extent, the competitive examinations, which are the only legitimate road to distinction, have lost much of their value. A Mandarin is not allowed to hold office in his Native Province; the intention being to prevent intrigue, and to draw to Pekin the ambition and talent of the country, where temporary employment is given in subordinate offices, prior to appointments to the Provinces. He is not allowed to marry in the jurisdiction under his control, nor own land in it, nor have a near relative holding office under him; and he is seldom continued in office in the Station or Province for more than three years—a system of espionage which serves further to strengthen the Imperial Government. It is incumbent on every Provincial Officer to report on the character and qualifications of all under him, which he periodically transmits to the Board of Civil Service; the points of character are arranged under six different heads. viz., to those who are not diligent, the inefficient, the superficial, the untalented, superannuated, and diseased. According to the opinions given in this report, officers are elevated or degraded so many step in the scale of merit, like boys in a class. They are required to accuse themselves when remiss or guilty of crime.

MANDILION.—A soldier's loose coat—usually an outer garment without sleeves.

MANDREL.—An arbor or axis on which work is temporarily placed to be turned. The arbor which revolves in the headstock of a lathe and carries the upper pulley and also the chuck or face-plate, if one be used. Traversing mandrels are used in connection with lathes, and are driven by gearing from a countershaft overhead. The term is also employed in forging, to denote a rod used to preserve the interior form of hollow-work.

MANEGE.—The art of horsemanship or of training horses; also, a school for teaching horsemanship, and for training horses. See *Horsemanship*, and *Menage*.

MANEUVER.—A term from the French, commonly written *manœuvre*, and signifying 'handy-work,' is somewhat vaguely used in English dimilitary and naval language to denote collateral movements, not openly apparent, of bodies of men or squadrons of ships, by which an enemy is coerced, or by which it is sought to compel him to take some course adverse to his interests.

MANEUVERING WHEELS.—The eccentric truck-wheels used on Sea-coast Carriages for regulating the motion to and from battery. When it becomes necessary to check the recoil of the gun-carriage, the wheels are thrown out of gear by means of a handspike inserted in the socket attached to the end of the axle-tree, and the carriage moved on sliding friction. When the gun is to be moved into battery, the wheels are thrown into gear in a similar manner, and the front of the carriage moves on rolling friction. In the 15-inch carriage there are two pairs of maneuvering wheels, one pair being placed in front and the other pair near the rear end of the carriage. See *Sea-coast* and *Garrison Carriages*.

MANEUVER MARCHES.—Marches made to gain a position, the possession of which compels the enemy to leave the position he is occupying. When such marches are under the observation of the enemy, they are termed *Manoeuvres*. An example of manoeuvre marches is seen in the movements of the different corps of the French Army in 1805, from the time they crossed the Rhine until they crossed the Danube, since by their execution, the Austrian position at Ulm was turned and was no longer tenable by the Austrian army. See *Concentration Marches*, *Marches* and *Tactical Marches*.

MANEUVER OF HEAVY GUNS.—The introduction of iron-clad vessels of war, and of larger cannon using projectiles of greatly increased power, has rendered it necessary that more complete protection for the gun and for the cannoniers should be provided than that furnished in the batteries of the present day. This want has brought forth a system of Depressing Carriages, by which the gun, after being fired, is drawn below the parapet and there loaded. Of these carriages the "Moncrieff" in Europe, and those known as the "King" and "Buffington," invented in the United States, have met with the most favor, but the general adaptability for service of no one of them has yet been established. The only plan proposed, with the view of offering increased protection in maneuvering heavy cannon on the carriages now in our service, is that of the late Colonel Benton, of the Ordnance Department. In this system the movements are effected by *two chains* or *ropes*, worked by a *windlass* placed within a casemate in the parapet or in a traverse, between two guns.

The power being situated to the right of the gun, "rope No. 1" passes from the windlass to a pulley in the axis of the platform, thence to a pulley at the left of the platform, back over a pulley attached to the fork of the left rear traverse wheel, up over a pulley on the rear transom of the chassis, thence forward under a pulley at the front transom of the top carriage, and the end of the rope is attached to a staple on the under side of the gun in front of the trunnions. "Rope No. 2" goes from the windlass over a pulley attached to the fork of the right rear traverse wheel, thence up over a pulley on the rear transom of the chassis, then to a pulley at the rear transom of the top carriage; the end of this rope is fastened to a pin in the base of the breech of the gun. The ropes passing loosely over the pulleys, the application of force to "No. 1" will depress the muzzle and to "No. 2" will depress the breech. The gun is drawn "*from battery*" by force bing applied to both ropes at once, or to one rope alone, the traverse wheels being choked. A rope attached to a handspike and passing over a pulley at the upper part of the cheek enables a gunner protected by the parapet to place the rear truck wheels "in gear" and allows the gun to run "*into battery*" by the force of gravity, the windlass being out of gear.

To *traverse* the gun, "rope No. 1" must be locked to the pulley at the front of the top carriage. Movement to the *left* will then be accomplished by "No. 1," the force being exerted at the pulley at the left fork, and to the right by "No. 2," which will exert its force at the right fork. To *load* the gun, the muzzle is depressed below the parapet; the projectiles are on a shelf along the face of the parapet, and are conveniently transferred to the piece on a *carriage*, which is worked by a *rope* and *pulley* running on a movable inclined tramway. A *sectional* or *telescopic* sponge and rammer must be used, and the carriage may be employed to force the projectile home. The gunners, whilst loading, are protected from shot and shell by a piece of boiler plate set in the face of the parapet. The sights are placed on the under side of the gun as near as convenient to the cheek. The elevation may be given by an arc, a pointer being on the trunnion. The gun is mounted with the *vent down*, which enables it to be fired with the least exposure to the cannoniers. Each windlass is capable of maneuvering two guns. See *Mechanical Maneuvers*.

MANEUVERS.—In all changes of position that demand a disturbance of the fundamental order of battle of the unit, it is broken into its subdivisions, which are placed in certain relative positions with respect to each other, according to the object in view. These combinations are termed *maneuvers*, and their chief object usually is to change the direction of the front of the unit, according to the particular exigency. Maneuvers, like all the rest of the mechanism pertaining to the unit, should be stamped with simplicity and uniformity. The tactics of the present day present, in this respect, a remarkable contrast to those of the period anterior to it; which is owing, in no small measure, to the little scope left for individual fancy; every proposal being submitted to the formal examination of an enlightened board. Stage spectacles alone now occasionally furnish some notions of those whimsies of olden times; so happily hit off in the well-known article of Salmagundi, where the street-pump figures as an almost impassable obstacle to the show soldier of that day. See *Evolutions*.

MANGAN.—An ancient war machine. The term *Mangan* was generally adopted to signify any species of warlike machine; but it more particularly meant the largest and most powerful machine that could be used for warlike purposes—whether it was practiced to throw enormous stones against besieged places, or to cast javelins, etc. This machine answered the double purpose of defending or attacking fortified places, and it was sometimes used at sea. Also written *Mangon*, and *Mangonel*. The Mangonel proper was a very strong and powerful *cross-bar*, from 15 to 20 feet long, used for throwing arrows, darts or stones. The *Trebucket*, *Ribaudequin*, etc., were only a variety of the above.

MANGANESE.—A metal resembling iron in its chemical properties, and seldom if ever absent from cast-iron. It is commonly found in iron ores, and the same operation which reduces the iron in the blast-furnace also reduces the manganese, and this metal becomes alloyed or closely mixed with the melted iron. The influence exerted by the manganese upon the character of the cast-iron is very decided, tending to the production of the white variety, the manganese diminishing the tendency of the carbon to separate in the form of graphite. White cast-iron, therefore, is found to contain the largest proportion of manganese. The spathic iron ores yield a cast-iron containing a particularly large quantity of manganese, sometimes exceeding one-tenth of the weight of the cast-iron. Such an iron is capable of containing upwards of one twenty-fifth of its weight of carbon in combination with it, and the compound thus formed chrystallizes in large and shining plates, whence it is named by the Germans *Spiegeleisen*, or *mirror-iron*. It is largely employed in the manufacture of Bessemer steel. The presence of manganese in iron increases the fluidity of the slag, and encourages the passage of phosphorus, sulphur and silicon into the slag, thus reducing the proportion of those injurious impurities in the metal. Its most important property, however, consists in its affinity for oxygen, preventing the formation of oxides of iron. See *Cast-iron.*

MANGE.—An infectious disease which attacks horses when neglected. It results from the attacks of minute mites, or *acari*, which burrow in the skin, especially if it be dirty or scurfy, cause much irritation, heat, and itching, and the eruption of minute pimples, with dryness, scurfiness, baldness, and even bleaching of the skin. The treatment consists in destroying the *acari* and insuring the cleanliness and health of the skin, both of which objects are effected by washing the parts thoroughly every second day with soft soap and water, and dressing daily with sulphur or mild mercurial ointments, or with a solution containing four grains either of corrosive sublimate or arsenic to the ounce of water. Castor-oil seeds, bruised and steeped for twelve hours in buttermilk, are very successfully used by the native Indian farriers. Where the heat and itching are great, a few drops of tincture of belladonna may be added to the usual dressing, or applied along with a little glycerine. Where the general health is indifferent, as in chronic cases, the patient should be liberally fed, kept clean and comfortable, have an occasional alterative dose of any simple saline medicine, such as niter or common salt, and a course of such tonics as iron or arsenic. Cleanliness and occasional washing and brushing maintain the skin in a healthy state, and thus prevent its becoming a suitable nidus for the *acari*.

MANIFAIRE.—Armor covering the mane and neck of a horse.

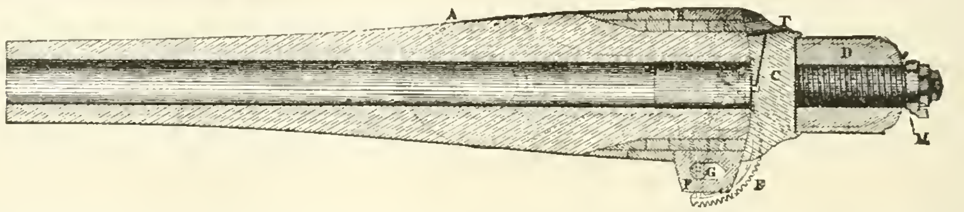
MANIFESTO.—A public declaration issued by a Sovereign Prince, or by a Government on some state emergency, expressive of intentions, opinions, or of motives. Immediately before entering on a war, a Manifesto is issued containing a statement of the reasons which have been held to justify the Sovereign or Government in taking up arms. In case of a revolt, a Manifesto is sometimes issued to recall subjects to their allegiance.

MANIGLIONS.—The two handles on the back of a piece of ordnance.

MANIPULARIS.—The chief office in a *Manipulus* of the Roman infantry. This office was likewise ordinary.

MANIPULUS.—In the tactics of the Romans, each class of the infantry of the line was subdivided into ten persons, each termed a *Manipulus*. The velites were attached to these by equal portions. The cavalry were divided into ten troops, termed *Turma*. To each manipulus there were assigned two centurions, and two file-closers; and to each turma two decurions. The velites, although forming a part of the manipuli, had centurions assigned to them, to lead them in battle. The normal order of battle of the Romans, prior to the time of Marius, was in three lines; the hastati in the first; the principes in the second; the triarii in the third; and the cavalry on the wings. The manipulus, which was the unit of force, was drawn up in 12 files, with a depth of 10 ranks, in the line of hastati and principes; in the line of triarii there were only 6 files. The right and left files of the manipulus were led by a centurion, and closed by an officer file-closer. The manipuli of the three lines were disposed in quincunx order; the manipulus of one line opposite to the interval between the manipuli in the one in front, this being the same as the manipulus front. The intervals between the lines were the same as the depth of each line. An interval of about 3 feet was left between the ranks and the files of the manipulus. The same order of battle was followed for the social troops on the wings. The two legions occupied the center; but what interval was left between them, or between the center and wings, or how far the cavalry was posted from the infantry, is not well ascertained.

MANN GUN.—The breech mechanism of this gun belongs to that system in which the breech-block remaining stationary, the body of the gun is made to revolve upon its trunnions the necessary degree to open and close the breech. It may be generally described as consisting of a breech-block attached by straps to the trunnions, with suitable devices for securing, first, the requisite closeness of contact with the breech of the gun to produce the necessary revolution about the trunnions. To describe more particularly: In the drawing, A represents the cast-iron body of the gun, re-inforced about the breech with forged-rings, B, of wrought iron, shrunk on. The mass of metal C D, closing the bottom of the bore, consists of two pieces. The piece C, in front, constituting the breech-block proper, is loosely recessed upon the piece D in rear, and has a slight play back and forth, so as to admit of being pushed up in close contact with the breech when the gun is prepared for firing. The means of producing this movement in the block is furnished by the screw N, which, passing centrally through the fixed breech-piece D—the latter being bored and threaded to receive it—abuts against the rear face of the movable block. The outer extremity of the screw is fitted with a weighted lever or handle, having "lost motion" checked by a lug, M, attached to the circumference of the screw shoulder. A point of support for the breech-apparatus is supplied by the elevating device. This consists of two screws of the same pitch, one on either side on the breech, connected by a worm-gearing and operated by cranks which extend beyond the carriage. The rimbases are concentric with the trunnions, but project sufficiently beyond the surface of the gun to accomodate the loops of the breech-straps. In order to open or close the breech, the raising or lowering of the breech of the gun is effected by means of a crank and pinion, centered upon the side of each breech-strap and working in a large-toothed segment, E, the crank-



shaped axle G of which passes under the gun and through a slotted lug, F, and thus communicates the motion produced by the crank to the breech of the gun. The fixed breech-piece D and the straps are of wrought iron; the movable block C is of cast-iron.

The gun is rifled with eleven lands and grooves, each of equal width, and of a uniform pitch of one turn in 60 feet.

Width of lands and grooves, ...	1''.18524
Depth of grooves, ...	0''.125

The chamber is concentric with the bore, and of a diameter slightly greater than that of the bore between grooves; its capacity is sufficient to contain a charge of 30 pounds of powder and a shot of 170 pounds, the latter being inserted in the bore as far as its front band. The top of each land is connected with the cylindrical surface of the chamber by a suitable ramp or bevel. The gun is center-fire through a vent in the breech-block. This vent makes a turn at nearly right angles, so as to make its exit on top of the gun. Its interior opening is through a steel disc. The gas-check (designed by the inventor) used in this gun is cup-shaped, and is pierced with a hole to admit the flame from the vent. It is necessary to remove this check before and replace it after loading. Gas-checks of this pattern, but of different alloys of copper, tin, zinc, and lead, were prepared with the view of determining the most suitable material. The projectile for this gun consists of a cast-iron body, having a front and rear band of soft metal—lead and antimony—encircling it. The iron body of the projectile allows the usual windage, but the lead bands exceed slightly the diameter of the bore, including grooves. The weight is from 150 to 170 pounds.

The gun is loaded as follows: The breech-screw is loosened, and the crank-handles turned until the gun, revolving on its trunnions, assumes a position in which the chamber is sufficiently exposed above the breech-block for the insertion of the charge. The gas-check is then removed, and the projectile inserted by sliding it along the trough T in the top of the breech-block, and pushing it forward until the front band stops against the rifling. The charge then follows, the gas-check is replaced, and the crank reversed until the gun is restored in line with the breech-block; finally, the breech-screw is tightened by means of a two-handled lever. The gun is mounted on a 10-inch carriage, widened to accommodate the increased length of the rimbases, with such other alterations as are required by the nature of the elevating-devices. The recoil-check is of the Parrott friction clamp-pattern. The following are the principal dimensions:—

Exterior diameter of gun at muzzle,	15.00	inches.
Maximum diameter, ...	28.50	"
Diameter of trunnions, ...	10.00	"
Diameter of rimbases, ...	17.00	"
Diameter of breech-screw, including threads, ...	8.50	"
Diameter of bore, ...	8.40	"
Diameter of chamber, ...	8.60	"
Radius of breech,(trunnions to breech)	51.25	"
Distance from trunnions to muzzle,	92.75	"
Total length of gun, ...	144.00	"
Length of breech-screw, including nut, ...	28.00	"
Thickness of breech-straps, . . .	4.50	"
Depth of breech-straps at trunnions,	25.00	"
Depth of breech-straps at breech-block, ...	16.00	"
Depth of breech-straps at middle point, ...	11.00	"
Length of chamber, including ramp,	24.00	"
Total length of bore.	144.00	"
Number of grooves, ...	11	
Depth of grooves, ...	0.125	inch.
Width of grooves and lands, . .	1.18524	inches
Pitch uniform; one turn in, . . .	60	feet.
Total length of gun over all, . .	178.50	inches.
Total weight of gun, ...	20,000	pounds.

See *Ordnance*.

MANOMETER. Properly an instrument for measuring the rarity of the air or of other gases; but the name is most frequently applied to instruments for indicating the elastic force of gases which is always inversely proportional to their rarity. The several kinds of barometers are really manometers, and so is the steam-gauge of a steam-engine.

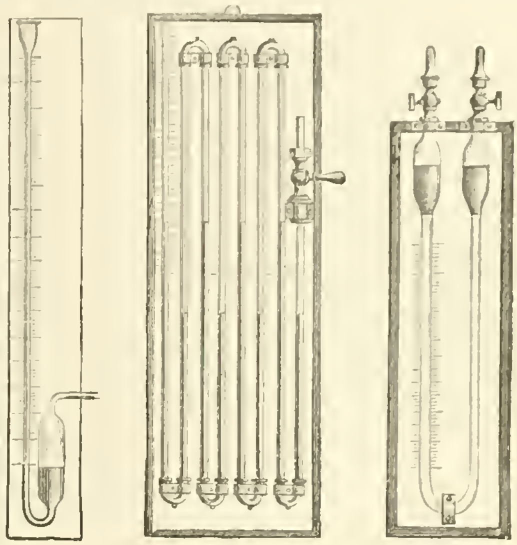
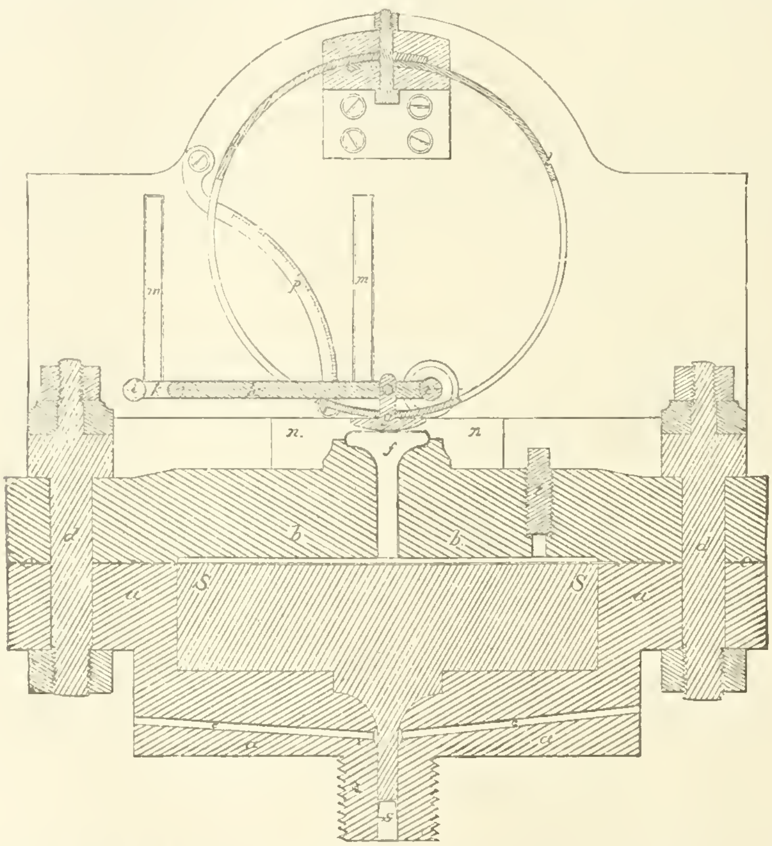


Fig. 1. Fig. 2. Fig. 3.

The various forms of manometer may be classified under three heads: 1, the open-air manometer, on the principal of the barometer; 2, the confined-air manometer,on the principle of Mariotte's instrument; and 3,the metallic-spring manometer. A simple open-air manometer consists of a glass tube, open at both ends, placed upright in a strong bottle of glass or iron the bottom of which contains mercury. The tube passes through a tight packing box in the neck. In the upper part of the bottle there is an orifice which admits compressed air, acted upon by steam or vapor, whose tension it is desired to measure. But this form cannot be used for high pressures. The multiple-branch manometer is a modification of the simple open instrument, and is constructed by bending a long tube, open at both ends, in a series of V-shaped flexures of from 20 to 40 inches in height, the number of flexures depending upon the pressure the instrument is liable to be subjected to. Columns of mercury, of equal height, being placed in the lower halves of the V-shaped legs, will indicate the pressure excited at one end of the tube, by the sum of the excess of height of the mercurial columns in alternate legs, or by multiplying the excess of height in one leg by the number of legs containing such excess. The system is fastened to a board or metallic plate, which at one side, near the last branch, is furnished with a graduated scale. The compressed-air manometer is simply a strong V-shaped tube closed at one end, while at the other is attached the pipe communicating with the gas or vapor whose tension it is desired to measure or ascertain. A portion of the flexure of the V contains mercury, and the space between it and the closed end is filled with common air. Now, according to Boyle's or Mariotte's law, a pressure exerted on the column of mercury sufficient to force the air into half the space it occupies at the normal atmospheric pressure, must become doubled, or 15 lbs. to the square inch must be added. Again, to compress the air into half the remaining space, 30 lbs., or double the pressure required for the reduction to the first half, must be added, making in all a pressure of four atmospheres for the reduction to one-fourth the original volume. It is evident, therefore, that a graduated scale, to exhibit the degrees of pressure, must have its spaces decrease from below upwards. The graduation is accomplished by means of an open-air multiple manometer. The metallic-spring manometer consists of an index traversing a graduated arc, and having applied to a spring connected with it—which may be in the form of a spiral—a piston actuated by the force of the gas or vapor in the boiler or steam-chamber. Fig. 1 represents the common open manometer; Fig. 2 is a compound open manometer: and Fig. 3 the differential manometer. The latter is used to register very small differences in pressure. It consists of a bent glass tube, placed upright and having a cylindrical bulb and a stop-cock on each arm. One bulb and both tubes, as far as zero of the scale, are filled with a mixture of alcohol and water. The other bulb and the remaining part of the corresponding tube are filled with a colored oil, of exactly the same specific gravity as the former mixture. A very slight difference in pressure is thus strikingly shown.

MANOMETRE A POUDRE.—An apparatus, designed by M. N. Korshunoff, of Paris, and embodying an application of the reversed hydraulic press to the measurement of powder pressures in gunnery. For the conversion of unwieldy weights and strains into amounts conveniently measurable, the inversion of the principle of the hydraulic press possesses the same advantages of compactness and simplicity that characterize that press in its normal applications. It meets with elegant illustrations in some forms of heavy weighing machines, in the Edward's instrument for registering "proof strains," etc., but certain practical difficulties have heretofore precluded its use in registering powder pressures. In the "manometre" under consideration, however, not only is this object claimed to have been attained, but a graphic record of the pressures, during the passage of the projectile through the bore, is traced in a moving band of paper. The apparatus is suitable for resolving the following problems: 1. To determine the force of expansion of powder, thus permitting the comparision of powders differing in their chemical composition and form. 2. To determine what is the best charge for a given caliber, according to the nature and quality of the powder. 3. To determine the different pressures of the gases in the bore during the departure of the projectile, and thus to decide upon the best dimensions for a cannon according to its charge and the nature and weight of its projectiles.

Referring to the drawing, we may make the following description of parts; *a*—A cylinder carrying a screw plug, which serves to attach the apparatus to the breech of the gun. *b*—Cover of the cylinder. *c*—Sheet of platinum forming the cylinder at its upper portion. *d*—Nuts securing the cover of the cylinder. *e*—Tubes for the escape of the gases which may be above the fitting S. *f*—Very thin capsule of platinum, inserted in a central aperture of the cylinder, fitting into the annular *cannelures* with which the wall of the aperture is furnished, and clinched upon the lower face of the cover. *g*—A small button resting on the capsule, actuating the spring *l*, and having a fork for the support of the lever *h*. *h*—Steel lever hinged at the point *v*, and carrying at its extremity *y*, a pin for raising another



lever *k*. *h*—Steel lever hinged at the point *i*, and carrying at its farther end a style or pencil *z*, limited in its movements by a curved guide *p*. *l*—Steel spring fixed to the plate *r*, perforated by a slot for the admission of the lever *h*, and by a second slot symmetrical therewith. This spring is traversed by the stem of the button *g*, and presses vertically upon the head of this same button. *m*—Brass rollers fixed in the plate *r*, and guiding the band of paper. *n*—Clock-work giving motion to the large toothed-wheel which transmits it to the roller *o*, against which is arranged a compressing cylinder, which effects the unrolling of the paper carried by the reel *ó*. *p* Circular guide for style or pencil. *r*— Brass plate fixed to the cover of the cylinder. *t* Screw closing the orifice which serves to introduce the mercury, oil, or alcohol into the capsule *f*, as well as between the cover and the sheet of platinum *e*.

Calling P the pressure upon a unit of surface exercised by the gases of the powder; *s* the surface of the piston receiving direct pressure of the gases; S the surface transmitting the pressure to the liquid; *p* the resulting pressure upon a unit of surface of the liquid, we shall have:

$$p = \frac{Ps}{S}$$

It is evident from this formula that the value of *p* can be reduced to any desirable amount by varying the ratio of the surfaces; that is to say, by increasing S or diminishing *s*.

Let us assume *s* equal to a circle of $0^{m}.005$ diameter $= 0^{cm}.19635$. S equal to a circle of $0^{m}.100$ diameter $= 78^{cm}.54$. P equal to 6500 kilogrammes to the square centimetre.

$$p = \frac{6500^{k} \times 0.19635}{78.54}$$, or $16^{k}.25$ per square centimetre. It becomes evident that the immense pressure of the gases of the powder thus manifests itself by a greatly reduced and perfectly measurable pressure: moreover, the space traversed by the piston is, in effect, almost nothing; the volume of liquid which penetrates into the capsule, supposing that the point in contact with the button rises one millimetre, will be equivalent in volume to a cone having for base a circle of about 20^{mm} diameter and 1^{mm} in height; so that

$$\frac{\pi D^2}{4} \times \frac{h}{3} = \frac{3.1416 \times 20^2}{4} \times \frac{1}{3} = 104^{mm}.75.$$

The surface S of the piston under the sheet of platinum being 7854^{mm} the elevation of this piston for the above displacement of volume will be $\frac{104.72}{78.54}$ or $0.^{mm}013$; that is to say, a trifle over one hundredth of a millimetre.

The apparatus is fixed upon the breech of the cannon, in a hole tapped for the purpose, communicating with the interior of the piece by an aperture of the same diameter as the piston *s*. The pressure of the powder gases acts upon the piston *s*, and distributes itself by the surface S upon the sheet of platinum, which transmits it to the liquid contained in the capsule *f*. This pressure causes the upper portion of the capsule to rise in a spherical form, raises, by this movement, the button *g*, which raises in its turn the lever *h*, thus making it describe an arc of a circle about the point *r*. In order to verify the pressures of the curve, it is necessary that, for reference, horizontal lines be previously traced by the pencil under different pressures, each maintained constant for a determinate time. For this purpose it is necessary, at a previous experiment, to arrange a recurved tube fixed by one of its arms to the screw plug of the cylinder. This tube, filled with liquid, should terminate at its other extremity in a stuffing box, traversed by a stem, upon which graduated pressures can be maintained by means of a lever, which should be hinged by one end to some fixed point, should press upon the stem, and should be capable of being loaded at its other end with successive weights corresponding to the pressures which it is desired to exercise upon the piston.

Each pressure being maintained for an instant, the pencil traces during that time a horizontal line indicating the height which corresponds to that pressure. These different heights, when compared, with the curve, indicate exactly the pressures existing during the departure of the projectile. It is contemplated that in all the above mentioned experiments the cannon be mounted on some mechanical device which shall neutralize the effect of recoil; such, for instance, as that of M. l'Admiral Labrouse. This apparatus may, however, be employed for the following uses; 1. To measure hydraulic pressures. 2. To measure the pressures required to liquefy gases. In these applications it will be desirable to increase the diameter of the piston *s*, and to diminish that of the piston S. The sheet of platinum may be replaced by a diaphragm of gutta-percha, thus reducing the cost of the machine, and, in fact, the clockwork. The paper and the pencil may be omitted, their place being supplied by an index moving upon a dial-plate, as is represented in the drawing of the hydraulic manomètre.

MANTA.—A water-proof canvas, five feet square used as a pack-cover. It serves to protect the loads in transit, during damp and rainy weather; and is used for the shelter of the stores and the packers, when in camp.

MANTEAU.—A term, literally signifying a cloak, but frequently used among the French to express the covering that Hussars or Light Infantry carry for the double purpose of shielding their bodies from the inclemencies of the weather in outposts, etc., and for spreading over their heads, by means of poles, when they occasionally halt, and take a position. The *Manteau d'Armes* was a round shield much used during the fifteenth and sixteenth centuries.

MANTILLIS.—A kind of shield, anciently fixed upon the tops of ships as a cover for archers.

MANTLE.—A long flowing robe, worn in the Middle Ages over the armor, and fastened by a fibula in front, or at the right shoulder. The mantle is an important part of the official insignia of the various orders of knighthood. Ladies of rank wore similar mantles, in many instances decorated with heraldic charges, in which case the mantle bore either the impaled arms of the lady and her husband or her husband's arms only. A number of examples may be seen in monumental effigies.

MANTLET.—A shield placed over the mouth of an embrasure to prevent musketry bullets and fragments of shells from flying through and injuring those serving the piece. A hole in the lower part allows the muzzle of the piece to pass through into the embrasure when it is to be fired. The size of

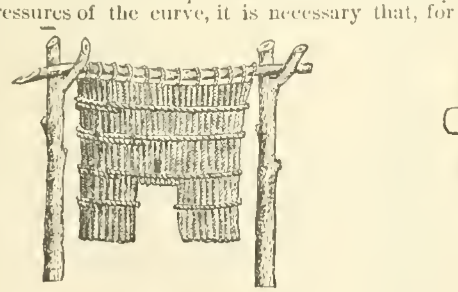


Fig. 1.

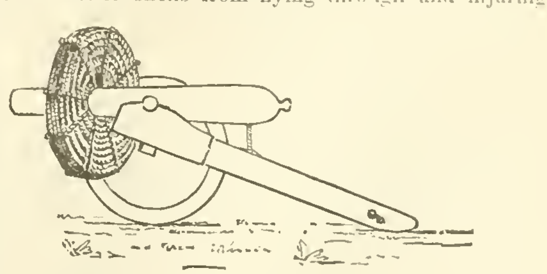


Fig. 2.

these openings will depend upon the dimensions of the piece. Rope is the best material for constructing mantlets. The usual size of a mantlet is 5 feet high, 4.5 feet across, and 4 inches thick. For siege guns the opening is 1.6 feet high by 1.3 feet across. Three-inch rope is a suitable size, it is laid in three or five thicknesses, each of the two outer layers being in one piece bent vertically.

The inner layers are bent and laid horizontally, and the whole well tied together. The mantlet is hung on a horizontal pole supported by forked uprights set in the ground, on each side of the embrasure, at the foot of the interior slope, as shown in Fig. 1.

The elasticity thus afforded by the supports greatly increases the resistance of the mantlet. A small hole or slit is pierced in the mantlet to allow the piece to be aimed.

Mantlets of this size weigh about 400 pounds.

A small ring mantlet of rope, shown in Fig. 2, placed upon the chase of the gun is sometimes used.

When rope cannot be obtained, one of similar shape may be made of wood.

Mantlets may be made of wood or of iron, or of wood and iron combined. Those of the latter kind furnished for the siege of Yorktown were made of two thicknesses of $\frac{1}{4}$-inch wrought-iron spiked to 3-inch oak plank. On the head was a 2-inch square iron bar riveted to the edge of the iron plates, against which the oak planks abutted. The ends of this bar projected 6 inches, and were rounded, serving as supports to rest upon upright stakes or timbers standing against the interior slope of the parapet. See *Gun-shelters*.

MANTLING.—A heraldic ornament depicted as hanging down from the helmet, and behind the escutcheon. It is considered to represent either the cointise, an ornamental scarf which passed round the body, and over the shoulder; or the military mantle, or robe of estate. When intended for the cointise, it is cut into irregular strips and curls of the most capricious forms, whose contortions are supposed to indicate that it has been torn into that ragged condition in the field of battle. When the mantling is treated as a robe of estate, the bearings of the shield are sometimes embroidered on it. A mantling adjusted so as to form a background for the shield and its accessories, constitutes an *Achievement of Arms*. It is not till the latter end of the 14th century that the mantling appears as a heraldic ornament on seals. In British Heraldry, the mantling of the Sovereign is of gold lined with ermine; that of Peers, of crimson velvet lined with ermine. Knights and gentlemen have generally crimson velvet lined with white satin; but sometimes the livery colors are adopted instead, as is generally the practice in Continental Heraldry. See *Lambrequin*.

MANSLAUGHTER.—The unlawful killing of another without malice, express or implied. Manslaughter is either voluntary, i. e., where there was an intent to commit the injury; or involuntary, where there was no such intent. It differs from murder in its absence of malice, and, as it is supposed to be committed in hot blood, no person can be an accessory before the fact. Among cases of homicide which constitute a manslaughter may be mentioned killing a person by gross negligence, though in the discharge of a lawful act; killing a person who has given great provocation; and killing an officer acting without or beyond his authority, though this may also be excusable homicide. The killing of an officer acting within his legal authority is murder. The provocation above-mentioned must be immediate, not remote; and though proof of provocation sufficiently repels the presumption of malice which the law attaches to every case of homicide, it is not sufficient to lower an offense from murder to manslaughter, if express malice be made out. In most of the United States manslaughter is divided into different degrees, punished with longer or shorter terms of imprisonment.

MANUAL.—A prescribed exercise by means of which soldiers are taught to handle and use their weapons. The *Manual of Arms*, the *Manual of the Piece*, the *Manual of the Sword*, etc., are explained in detail in the Tactics and Regulations of an army.

MANUAL OF ARMS.—An exercise with the musket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or rifle, through which recruits are drilled, to give them a free use of their limbs, and of the weapon regarded merely as a pike. It comprises the first course of instruction after the rifle has been placed in the learner's hands.

In the United States service, the piece is in the right hand: the barrel nearly vertical, and resting in the hollow of the shoulder, the guard to the front: the arm hanging nearly at its full length, near the body, the thumb and forefinger embracing the guard, the remaining fingers closed together and grasping the stock just under the hammer, which rests on the little finger. This is the position of *carry arms*, the position is represented in Fig. 1.

Recruits often have defects in the conformation of the shoulders, breast, and hips. On first bearing arms they are liable to derange their positions, by lowering the right shoulder and the right hand, or by sinking the hip and spreading the elbows. The Instructor endeavors to correct these faults, so that the position of the pieces in the same line may be uniform, without constraint to the men.

The Instructor sees that the piece at a carry is neither too high nor too low; if, too high, the right elbow will spread out, the soldier will occupy too much space in his rank and the piece be unsteady; if too low, the files will be too much closed, the soldier will not have room enough to handle his piece with ease, the right arm will become fatigued, and will draw down the shoulder.

cruits progressively, after becoming familiar with handling the piece. As the motions relative to the cartridge, the fixing and unfixing of the bayonet, cannot be executed at the rate prescribed, nor even with a uniform swiftness, they are not subjected to the cadence. The Instructor, however, causes these motions to be executed with promptness and with regularity. As soon as the recruits thoroughly understand the several motions, they execute them alternately with and without the numbers, in order to attain the proper cadence, and to become perfect in the mechanism. The piece is habitually carried at half-cock.

To avoid repetition the following rules in the Manual of Arms are *general:*

1. In resuming the "carry" from any position in the manual, the motion next to the last concludes with the left hand at the height of the shoulder, fingers extended and joined, the thumb close to the forefinger, back of the hand to the front, the elbow close to the body, the right hand embracing the guard with the thumb and forefinger.

2. In all positions of the left hand at the lower band, except *charge bayonet* and *arms port*, the thumb is extended along the barrel, the end of it touching the lower band. In *charge bayonet* and *arms port* the thumb clasps the piece immediately below the lower band.

3. In all positions of the piece in front of the center of the body, the barrel is to the rear, and vertical.

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The Manual of Arms is taught to four men, placed at first in one rank, elbow to elbow, and afterwards in two ranks. To make the mechanism better known, the execution of each command is divided into motions. The rate or swiftness of each motion in the manual of arms, with the exceptions herein indicated, is fixed at the ninetieth part of a minute. The same interval of time should separate the command of execution from the preparatory command. The Instructor at first looks more particularly to the execution of the motions without requiring a nice observance of the cadence, to which he brings the re-

The drawings show the various positions of the soldier and piece in executing the Manual of Arms, authorized for the United States Army. See *Aim, Arms Port, Carry Arms, Charge Bayonet, Fix Bayonet, Load, Order Arms, Parade Rest, Present Arms, Rest on Arms, Reverse Arms, Right Shoulder Arms, Secure Arms, Support Arms, Trail Arms*, and *Unfix Bayonet*.

MANUAL OF THE PIECE.—The term piece, as here used, applies to cannon, whether gun, howitzer, or mortar. As a matter of convenience, it is also used to designate both cannon and carriage when the cannon is mounted. The men employed in the service of artillery are called artillerymen. Those for a single piece constitute a *gun-detachment*, and vary in number with the size and kind of piece. The *detachment* is composed of two non-commissioned officers, and from two to ten privates. The senior non-commissioned officer is called *chief-of-detachment*; the other *gunner*. The privates are called *cannoneers*. The detachment is formed in double rank, and told off from the right as follows: No. 1 is on the right of the rear rank; No. 2 in front of No. 1; No. 3 on the left of No. 1; No. 4 on the left of No. 2; the other numbers follow in the same order, even numbers in the front, odd in the rear rank. When, by facing about, the front becomes the rear rank, the numbers of the cannoneers do not change.

The service of the piece consists of all the operations required in loading, pointing, and discharging it.

To avoid repetitions, the following general rules are noted collectively:

1. The implements and equipments required for a piece are taken to it by the detachment when going to the exercises, or they may be placed there previous to that time. They are removed, at the conclusion of the exercises, by the same means, and returned to their proper places in the store-house. It is the especial duty of the chief-of-detachment to see that all that appertains to his piece is complete and in good order.

2. When the equipments are distributed, the gunner buckles the strap of his pouch around his waist, wearing the pouch in such position as to interfere as little as possible with his movements. The cannoneer who wears it, buckles on the primer-pouch in like manner. The gunner removes the vent-cover, and clears the vent with the priming-wire. Cartridge-pouches are carried suspended from the left shoulder to the right side.

3 In sponging or in ramming, the knee on the side toward which the effort is made is always bent, the other straightened. The weight of the body is added, as much as possible, to the effort exerted by the arms. When the sponge fits so tightly as to be difficult to move in the bore, Nos. 1 and 2 may use both hands in inserting and withdrawing it. Cartridges are inserted into the bore, bottom foremost and seams to the sides. All projectiles having fuses are inserted into the bore so that the fuse shall be towards the muzzle.

4. A primer is prepared for insertion in the vent by holding it between the thumb and forefinger of the left hand: the lanyard, wound upon its handle, is held in the right hand, the hook by the thumb and forefinger: the hook is attached by passing it upward through the eye of the primer; the hook and primer, thus attached, are held by the thumb and forefinger of the right hand; the primer is pushed into the vent by the thumb. After the primer has been inserted in the vent, the cannoneer who fires the piece drops the handle, allowing the lanyard to uncoil as he steps back to the position from which he is to fire; holds the handle, with the cord slightly stretched, passing between the middle fingers of his right hand, back up, and breaks to his left and rear a full pace with the left foot, the left hand hanging naturally by his side.

5. In aiming guns and howitzers, the gunner places the breech sight in its seat or socket, and aims through it; gives the proper direction by causing the trail to be moved, commanding *left* or *right*, tapping, at the same time, on the right side of the breech for the trail to be moved to the left, and on the left side for it to be moved to the right. The cannoneers at the trail will closely observe the motions of the gunner. With mortars, the gunner signals, with his hands, the direction in which he wishes the carriage moved. When the piece is pointed, the gunner raises both hands as a signal; the cannoneers moving the piece then unbar and resume their posts.

6. At the command *fire*, the cannoneer who discharges the piece turns his face from it, pulls the lanyard quickly, but steadily, and fires. Immediately after the discharge he resumes the erect position, rewinds the lanyard upon its handle, returns it to his pouch, and resumes his post. The gunner, after pointing, goes where he can observe the effect of the shot; when he resumes his post. At the command, *cease firing*, pieces that are loaded remain so until further orders; those that are partly loaded—if with the cartridge only—the cartridge is rammed home; if the projectile has been inserted, it likewise is rammed home. In both cases the priming-wire is left in the vent, as an indication that the piece is loaded. If the piece is not loaded it is sponged out. All the cannoneers resume their posts.

7. The habitual post of the chief-of-detachment is facing the piece and two yards in rear of the platform or rearmost part of the carriage. He has, under the instructor, or officer immediately over him, general supervision of all duties performed by his detachment. During firings he looks after the supply of ammunition, and sees that those engaged in preparing and serving it to the piece perform their duties properly. All ammunition must be prepared for firing at the service magazine. Projectiles should be carefully cleaned of all rust, dirt, or protuberances liable to cause them to stick, or injure the bore.

8. In the service of a battery of several pieces, the pieces are designated Nos. 1, 2, 3, etc., from right to left: these numbers are independent of the *permanent* numbers assigned to pieces in a work. In directing the pieces to be fired, they are always designated by their *battery* numbers; as, *Number one*—FIRE; *Number two*—FIRE, etc. When the wind comes from the right, the firing should commence on the left, and reciprocally. Under the fire of the enemy, the men are directed to cover themselves by the parapet or traverses as much as may be consistent with the execution of their duties.

9. Previous to proceeding with any exercise with the pieces, and frequently at other times during the exercises, the instructor, assisted by the other officers, will explain to the men the nomenclature of everything appertaining thereto; the application and use of the various parts, machines and implements used; the names and use of the different parts of the work adjacent to the piece: the kinds of ammunition used; charges of powder; kinds of fire; and, generally, all matters that assist in making the men efficient artillerists.

10. In aiming, first get a clear view of the object, and see that the piece is approximately in the line of fire before looking through the sights, and if the object be not in the line, instantly give the command to move the trail to the right or left. Always aim quickly, as the eye will not then become wearied. The prop upon which the sponge and rammer are supported is a low trestle, or simply a block of wood sufficiently high to prevent the sponge taking up dirt from the ground. The rammer is always laid on the side nearest the piece. To prevent the projectile from starting forward, guns should be given at least five degrees elevation previous to being run into battery, and running into battery should be done so as to prevent sudden jar against the hurters.

11. In all exercises for instruction, duties should be performed as nearly as possible as in actual service, and not by pretense only. To do this, in the service of the piece a dummy cartridge should be used, together with actual projectiles. The cartridge may be made of canvas or stout gunny-sacking, filled to the proper weight with coal broken to the size of the powder used for the piece. A worm serves for withdrawing the cartridge. A strong lanyard attached to the fuse-plug will serve to withdraw the projectile. The free end of the lanyard remains out of the muzzle as the projectile is pushed home. See *Artillery*.

MANUAL OF THE PISTOL.—To draw the pistol the Instructor commands: 1. DRAW; 2. PISTOL. At the command *draw*, unbutton the flap of the holster with the right hand, and grasp the stock, the back of the hand to the body. At the command *pistol*, draw and raise the pistol, the hand holding the stock with the thumb and last three fingers, the forefinger over the guard, guard to the front, barrel vertical, elbow near the body, the wrist as high as the right shoulder and six inches in front of it.

To LOAD the pistol, lower into the left hand, the barrel pointing to the left and front, and downward at an angle of forty-five degrees, half-cock the pistol (cock it if necessary); grasp the stock with the right hand. (Two) Open the chamber, if necessary eject the cartridge-cases, take a cartridge from the cartridge-box with the right hand, and hold it near the chamber between the thumb and first two fingers. (THREE.) Place the cartridge in the chamber, pressing it home with the thumb; continue to insert cartridges until the chambers are loaded: close the chamber, carry the right hand to the stock, and resume the position of *raise pistol*.

At the command READY, cock the pistol with the thumb of the right hand. To AIM, lower the pistol to the front, the arm about three-fourths extended, forefinger upon the trigger; close the left eye and sight with the right. To FIRE, press the forefinger against the trigger, fire, and take the position of *raise pistol*. To return pistol, the instructor commands: 1. *Return*, 2. PISTOL. Drop the muzzle, insert the pistol in the holster, back of the hand to the body, button the flap, and drop the hand by the side.

The squad being in the position of *raise pistol*, the instructor commands: 1. *Inspection*, 2. PISTOL, passes along the rank, and examines the pistols. To inspect the pistol minutely, he takes it in his hands, and then returns it to the recruit, who grasps it at the stock and takes the position of *raise pistol*.

MANUAL OF THE SABER. The manual of the saber is taught in the following order, and by the following commands: 1. *Draw*, 2. SABER. At the command *draw*, unhook the saber with the thumb and first two fingers of the left hand, thumb on the end of the hook, fingers lifting the upper ring: pass the right hand through the saber-knot, and push the sliding loop up to the wrist with the left hand: grasp the scabbard with the left hand at the upper band, bring the hilt a little forward, seize the gripe with the right hand, and draw the blade six inches out of the scabbard, pressing the scabbard against the thigh with the left hand, Fig. 1. At the command *saber*, draw the saber quickly, raising the arm to its full extent, at an angle of about forty-five degrees, the saber in a straight line with the arm, and make a slight


Fig. 1.


Fig. 2.


Fig. 3.

pause: hook up the scabbard with the thumb and first two fingers of the left hand, thumb through the upper ring, fingers supporting it: and drop the left hand by the side; at the same time, bring the back of the blade against the hollow of the shoulder, the blade vertical, the arm nearly extended, the left side of the gripe with the thumb against the thigh, the little finger on the back of the gripe. *This is the position of carry saber dismounted*, and is represented in Fig. 2. 1. *Present*, 2. SABER. Carry the saber vertically to the front, raising the hand as high as the neck, and six inches in front of it, edge to the left, the thumb extended on the back of the gripe, little finger by the side of the others, Fig. 3. 1. *Inspection*, 2. SABER. Take the position of *present saber*. (Two.) Turn the wrist outward to show the other side of the blade, the edge to the right; make a slight pause, and then turn the wrist back. (Three.) Resume the carry. 1. *Return* 2. SABER. At the command *return*, take the position of *present saber*; at the same time unhook and lower the scabbard with the left hand, and grasp it at the upper band. At the command *saber*, carry the right hand opposite and six inches from the left shoulder; lower the blade and pass it across and along the left arm, the point to the rear; turn the hand slightly to the left, fixing the eyes on the opening of the scabbard, and insert the blade six inches in the scabbard. (Two.) Return the blade, and free the wrist from the saber-knot; turn the head to the front and drop the right hand by the side; at the same time hook up the saber with the left hand, turning the saber toward the body, guard to the rear, and drop the left hand by the side.

MANUAL OF THE SWORD.—The Manual of the Sword in the United States Army, is as follows: 1. DRAW, 2. SWORDS. At the command *draw*, unhook the sword with the thumb and first two fingers of the left hand, thumb on the end of the hook, fingers lifting the upper ring; grasp the scabbard with the left hand at the upper band, bring the hilt a little forward, seize the gripe with the right hand, and draw the blade six inches out of the scabbard, pressing the scabbard against the thigh with the left hand. At the command *sword*, draw the sword quickly, raising the arm to its full extent, at an angle of about forty-five degrees, the sword in a straight line with the arm, and make a slight pause: hook up the scabbard quickly with the thumb and first two fingers of the left hand, thumb through the upper ring, fingers supporting it, and drop the left hand by the side: at the same time bring the back of the blade against the shoulder, the blade vertical, back of the gripe to the rear, the arm nearly extended, the thumb and forefinger embracing the gripe, the left side of the gripe with the thumb against the thigh, the other fingers extended and joined in rear of the gripe. *This is the position of carry sword.* Officers mounted unhook the sword before mounting, and, in the first motion of *draw sword*, reach with the right hand over the bridle-hand, and without the aid of the bridle-hand draw the sword as before; the right hand in the *carry* rests on the right thigh. When the sword-knot is worn, the right wrist may be placed in it in the first motion, before grasping the gripe. 1. *Present*, 2. Sword. At the command *present*, carry the sword vertically, and promptly to the front, raising the hand as high as the neck and six inches in front of it, the thumb on the back of the gripe, back of the gripe to the right, elbow close to the body. At the command *sword*, drop the point of the sword by extending the arm, so that the right hand may be brought to the side of the right thigh, the back of the hand down, the blade inclining downward and to the front.

In rendering honors with troops, officers execute the first motion of the salute at the command *present*, the second motion at the command *arms*. The sword is returned to the *carry* at the command, 1. *Carry*, 2. ARMS. When arms are *ordered*, the officers and non-commissioned staff drop the point of their swords, the back of the hand invariably up. At *parade rest*, they clasp the hands directly in front of the centre of the body, the left hand uppermost, the point of the sword between the feet.

In marching in double time, the sword is carried diagonally across the breast, edge to the front, the point in front of and at the height of the left shoulder; the left hand steadies the scabbard. At funeral ceremonies, the sword is reversed under the right arm, the left hand clasping the blade behind the back. When the escort *rests on arms*, the officers stand at *parade rest*, inclining the head. Officers on all duties under arms, draw and return sword without waiting for any command. All commands to soldiers under arms are given with the sword drawn. In route marches the sword is carried in the scabbard. The non-commissioned staff and sergeants with swords drawn salute by the first motion of *present sword*, as explained for officers. This position is taken at inspection, and the wrist turned outward to show the flat of the sword toward the face. 1. *Return*, 2. Sword. At the command *return*, take the position of the first motion of *present sword;* at the same time unhook and lower the scabbard with the left hand, and grasp it at the upper band. At the command *sword*, carry the right hand opposite and six inches from the left shoulder; lower the blade and pass it across and along the left arm, the point to the rear; turn the head slightly to the left, fixing the eyes on the opening of the scabbard, and insert the blade six inches in the scabbard, (Two.) Return the blade, free the wrist from the saber-knot (if inserted in it), turn the head to the front, and drop the right hand by the side; at the same time hook up the sword with the left hand, turning the sword toward the body, the guard to the rear, and drop the left hand by the side. Officers mounted return swords without using the left hand; the sword is hooked up on dismounting

MANUBALLISTE.—A cross-bow. There were two kinds used in the reign of Henry VIII. viz., the *latch* which was used for quarrels and the *prodd* for bullets.

MAP.—A map is a delineation, on a plane, of some portion of the surface of a sphere, celestial or terrestrial, on which the objects intended to be shown are traced, whether stars or towns, mountains, etc. Terrestrial maps are termed *geographical*, when they refer to the land; and *hydrographical* maps, or *charts*, when they delineate the shores of the sea. A perfect representation of a country, with all its parts in true proportions and relative positions, may be made on a globe; but since the surface of the earth is spherical, it is not possible so to delineate any large portion of it on a plane as to retain these properties. Hence geographers resort to different methods of representation called projections, which are of two kinds—either real perspectives from different points of view, or approximate developments. The five principal projections are—the orthographic, the stereographic, the globular, the conical, and the cylindrical, or Mercator's In the first of these, the flat surface on which the map is drawn is supposed to pass through the center of the earth, and according to the distance of the eye, the projection is either of the first, second, or third kind. In the *orthographic*, the eye is assumed to be at an infinite distance from the center of the earth, so that all rays of light proceeding from every point in its surface are parallel and perpendicular. From the nature of this projection, it is evident that while the central parts of the hemisphere are almost accurately represented, towards the circumference the countries are crowded together and diminished in size. On this account it is of little use for geographical, though of considerable value for astronomical purposes. In the *stereographic*, the eye or point of projection is assumed to be placed on the surface of the sphere opposite the one to be delineated. If the globe were transparent, the eye would then see the opposite concave surface. Contrary to the orthographic, this method contracts the center of the map, and enlarges it towards the circumference. Owing to the unequal area of the divisions, and the difficulty of finding the true latitude and longitude of places, this projection is not much employed. In order to rectify the opposite effects of the two preceding, the globular projection, a modification of the two, is generally adopted. If we suppose the eye to be removed from the surface to a distance equal to the sine of 45° of the circumscribing circle, the projection is called globular. In other words, if the diameter of the sphere be 200 parts, it must be produced 70 of these parts in order to give the point of projection. All meridians and parallels in this projection are in reality elliptical curves, but as they approach so nearly to being circular arcs they are very rarely shown otherwise.

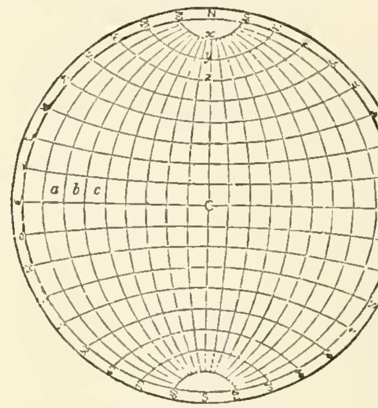


Fig. 1.—Globular, or Equidistant Projection of a Hemisphere.

The construction of the globular or equidistant projection is as follows (Fig. 1). Describe a circle NESW, to represent a meridian, and draw two diameters, NCS and WCE, perpendicular to each other, the one for a central meridian, the other for the equator. Then N and S will represent the north and south poles. Divide each of the quadrants into 9 equal parts, and each of the radii CN, CE, and C also in 9 equal parts. Produce NS both ways, and find on it the centers of circles which will pass through the three points 80 *x* 80, 70 *y* 70, etc., and these arcs described on both sides of the equator will be the parallels of latitude. In like manner, find on WE produced, the centers of circles which must pass through *a*, *b*, *c*, and the poles. Having selected the first meridian, number the others successfully to the east and west of it. A map in this way may be constructed on the rational horizon of any place. The impossibility of getting a perfect representation of special parts of the sphere by any of the previous methods, led to the desire for others less defective. Of all solid bodies whose surfaces can be accurately developed or rolled out upon a plane without alteration, the cone and cylinder approach nearest to the character of the sphere. A portion of the sphere between two parallels not far distant from each other, corresponds very exactly with a like conical zone; whence it is that conical developments make the best projections for special geographical maps, and even with some modifications for large portions of the globe.

Since all meridians on the globe are great circles passing through the poles, the north and south points at any places correspond with the poles of the earth. The east and west points, however, are indicated by a line at right angles to the meridian, and do not, except at the equator, correspond with those of the earth. In all the projections hitherto described, the direction either of the north and south, or of the east and west points, is represented by a curved line, so that on such a map the course of a vessel would almost always be laid down in a curve, which could only be described by continually laying off from the meridian a line at an angle equal to that made with the meridian by the point of the compass at which the ship was sailing. If the vessel were to steer in a direct N. E. course by one of the previous projections, she would, if land did not intervene, describe a spiral round, and ultimately arrive at the north pole; therefore, the mariner requires a chart which will enable him to steer his course by compass in straight lines only. This valuable instrument is supplied by Mercator's chart, in which all the meridians are straight lines *perpendicular* to the equator, and all the parallels straight lines *parallel*

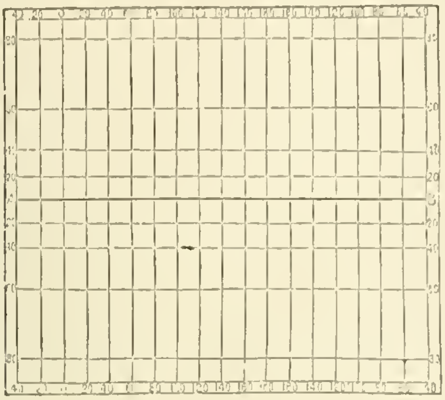


Fig. 2.—Mercator's Projection.

to the equator. It is constructed as follows (Fig. 2): A line AB is drawn of the required length for the equator. This line is divided into 36, 24, or 18 equal parts, for meridians at 10°, 15°, or 20° apart, and the meridians are then successively drawn through these points perpendicular to AB. From a table of meridional parts (a table of the number of minutes of a degree of longitude at the equator comprised between that and every parallel of latitude up to 89°), take the distances of the parallels and of the tropics and arctic circles from the equator, and mark them off to the north and south of it. Join these points, and the projection is made. This projection, of course, does not and is not intended to give a natural representation of the earth, its effect being to exaggerate the polar regions immensely. The distortion in the form of countries and relative direction of places, is rectified by the degrees of latitude being made to increase proportionably to those of longitude. This is the only map which gives an unbroken view of the whole surface of the earth. The term *map* is specially applied to representations of land, or land and water together; while that of *chart* is limited to the coast and water surface only, showing currents, rocks, anchorage, light-houses, harbors, soundings, and other objects of importance.

A geographical map proper is a general map of the world, or of a large extent of country. A topographical map differs from it in being limited in area, and much more detailed. The ordnance survey of Britain is a good example of a topographical map. Besides purely geographical and topographical maps, others are constructed for special purposes, which may be physical, political or civil, military, statistical, historical, etc. In order to construct a map and to determine accurately the positions of places on it, a knowledge of two elements is essential—viz., latitude or distance from the equator, and longitude or distance east or west of the meridian adopted. Every map, whatever its dimensions, is in some definite relation to the actual size of the globe. This relation is indicated by a scale—a graduated line showing, by its divisions, the number of miles corresponding to any space measured on the map. The scales of geographical maps range from about 800 m. to an inch (for maps of quarters of the globe) to 10 miles to an inch; those of topographical maps range from 1 inch to 25 inches to a mile, the largest topographical maps we have, admitting of the most minute details. The ordnance survey of Great Britain is on the scale of $\frac{1}{63360}$ of nature, or 1 inch of paper to one mile of surface. A recent improvement introduced into our best maps is that of printing the water-courses in blue ink, making the orography and skeleton of every country stand out in clear relief, thus avoiding the confusion resulting from all the lines being black.

MARAUDING.—This word common, under orthographic variations, to most of the European languages, and, probably, of identical root with the verb "to mar" means irregular plunder or violence offered to the inhabitants of a country by the individuals of an army. In all armies where discipline is maintained, marauding is, at least professedly, punished by death; the Provost Marshal having power to inflict that penalty summarily on all offenders taken in in the act.

MARCASITE.—Sulphurous pyrites, which superseded the *match*, in discharging fire-arms. The pyrites when struck, ignited, and fired the charge.

MARCEL-DEPREZ REGISTER.—In order to replace the induction-spark as means of registration, Mr. Marcel-Deprez had recourse to electro-magnets whose armature, retracted by a counteracting spring, was furnished with a pen which rested on the surface of the cylinder of the chronograph, this pen being so arranged as to be displaced in the direction of a generatrix during the movement of the armature. As a result of this arrangement, the pen traced on the

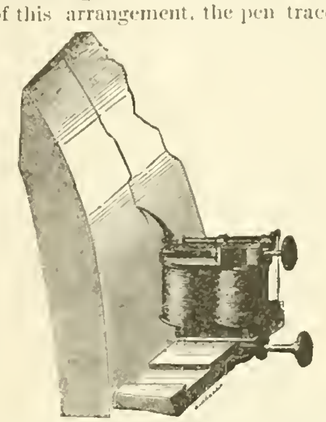


Fig. 1.

cylinder in motion a given circumference so long as the current passing in the electro-magnet of the register kept the armature attracted; when the current was broken, the pen, drawn laterally by the armature, traced a hook, and connected with the preceding circumference by a curve, the form of which depended on the relative velocities of the cylinder and the pen, and finally, the armature being arrested by a catch which limits its course, the pen traced a new circumference a little distant from the preceding, Fig. 1. If the current was re-established at the end of a certain time, the armature was attracted anew, the pen traced a second hook, and was replaced on the original circumference of which it continued the trace. The two hooks obtained indicate the instants when the breaking and the closing were produced. The employment of electro-magnets as registers was not new; these devices had been applied since 1844 to the Wheatstone and Breguet chronographs, and Regnault employed them also with the chronograph that he used in his celebrated experiments on the measure of the velocity of sound. If we were limited to the reproduction of the arrangements adopted by these different experiments, it would be impossible to obtain a precision susceptible of competing with the employment of the induction-spark. The usual electro-magnets, similar to those used in telegraphy, have, in fact, a functional retardation which is far from unimportant. If we seek for these apparatus, employing, for example, the time that elapses between the moment when the current which animates an electro-magnet is broken and that when its armature is set in motion under the action of the counteracting spring which retracts it, we find that this time, which may be called retardation of disconnection, attains and often exceeds a hundredth of a second. The time that elapses between the moment when the current is re-established, and the armature returned to its original place is greater still; it may be called retardation of connection. The sum of these two retardations forms the time lost between two successive signals, and limits the number of signals to be required in a second by a given electro-magnetic register. Hence, we see that an ordinary electro-magnet could scarcely give more than 40 signals in a second.

In order that we might count on the precision of these signals, it would be necessary, besides, that the functional retardations, or at least the retardations of disconnection, should be absolutely constant for the same register. If this condition was fulfilled, we could, in fact, notwithstanding their slow action, obtain a great precision of measure in the valuation of a difference of durations; we could also measure, with equal precision, portions of time smaller than the time lost by the apparatus, by using two electro-magnets for registering the two signals which determine the time to be measured, provided that we had the means of determining exactly the supposed constant retardation of each apparatus. This means exists, as we shall see further on; but the retardation of disconnection is unfortunately not constant in the ordinary electro-magnets. This retardation, is composed of two parts: a retardation in the cessation of the magnetic attraction, which retardation is owing to the phenomenon usually designated by the name of remaining magnetism, and a retardation owing to the setting in operation the mechanical organs of registration: this latter retardation can be made constant, but it is not the same with the retardation of demagnetization, which depends on several various circumstances, and especially on the intensity of the current, which may vary with the resistance of the

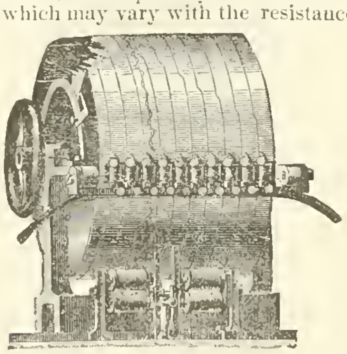


Fig. 2.

circuit or the activity of the battery; the retardation depends also on the manner in which the current is broken. The variations of the retardation or demagnetization, although very trifling in themselves, would, by using the usual electro-magnets, have attained limits greater than the degree of precision sought would allow; it was necessary, then, to find the means of regulating the working of the devices. The course to pursue naturally presented itself: it was necessary first of all to seek to reduce, in absolute value, the retardation of demagnetization, because thus the variations of this retardation must be reduced in the same proportion, while at the same time the apparatus could be made sufficiently rapid in its operation to follow, in most cases, the succession of the phenomena to be observed. The employment of these small registers, formed of diminutive electro-magnets, like those which are now used in some special apparatus, such as the electric toys of Mr. Trouve, must, after what is known of the working of these toys, secure the first improvement. Another motive led to the employment of very small apparatus, or at least of very small movable pieces; it was the necessity for accelerating as much as possible the movements of the tracing-pen.

In ordinary electro-magnets, where the counteracting force applied to the armature, as well as the attractive force which is opposed to it, are comparable to the weight of this armature, the latter moves with only a very feeble acceleration, at the disconnection as well as the connection. The result is that if the rotatory movement of the cylinder on which the pen, guided by this armature, makes its trace is a little fast, the traces obtained unite tangentially by a lengthened curve with the circumferences described by the pen in its two extreme positions, so that it is very difficult to catch the line at the precise moment when the pen is set in motion. If, on the contrary, the pen is animated by a rapid movement, so that its velocity is promptly comparable to that of the cylinder, the lines that it leaves are cleanly detached from the extreme circumferences and give signals easy to distinguish with precision. Now, this result can be obtained by employing very small armatures, so constructed that the inertia of the movable pieces develops only a very feeble resistance to the movement, and so arranged that the energy exerted on them by the counteracting spring that impels them may be considerable in proportion to the masses set in motion. These considerations induced Mr. Marcel-Deprez to establish very small electro-magnetic registers, furnished with still smaller armatures, that the magnetic attraction might be relatively great in proportion to the mass of these armatures, and to employ long and light pens, placed, as well as the movable masses, as near as possible, or practicable, to the axis of rotation, in order to reduce to a very minimum the moment of inertia of the system. Moreover, in order to diminish the retardation of disconnection, Mr. Marcel-Deprez provided his registers with a means of regulating the counteracting force applied to the armature in such a manner as to cause this force to form nearly an equilibrium with the magnetic attraction, so that disconnection takes place as soon as the attraction becomes slightly reduced and instantly after the rupture of the electric current. The forms given to the Marcel-Deprez registers, in departing from these principles, were very variable, and we will content ourselves with describing some especially applicable to the chronograph and other ballistic apparatus.

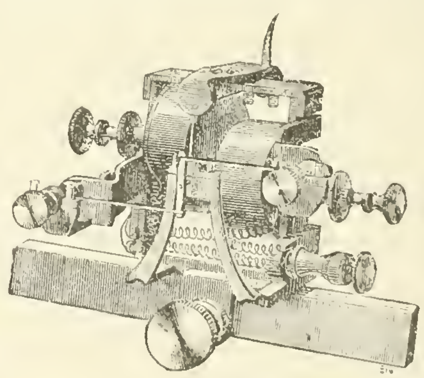


Fig. 3.

Fig. 1, represents one of the registers placed against the cylinder of a modified Schultz chronograph, and Fig. 2, represents the registers arranged side by side 10 in number, on a horizontal form fixed in front of the revolving cylinder: they are mounted each on a little screw-slide on which a counteracting spring acts, and which allows each pen to come into contact with the cylinder or to withdraw from it at will. A general lever movement of the form removes at will all the pens at the same time, or, on the contrary, brings them together in contact with the cylinder. Each electro-magnet, Fig. 1, is composed of two helices of about 12mm (0.4724 inch) diameter, placed vertically in a plane normal to the cylinder, and furnished with polar masses, relatively strong; between them is fixed a small armature of prismatic form, which weighs only a few milligrammes, and which, being thus immersed in the magnetic field, is subjected to an attractive force which can be raised to 10 000 and 20,000 times its weight. The supporting power of the electro-magnets may amount to 200 grammes (6.4303 oz. troy). This armature is secured to a very light horizontal axis of steel, placed as near as possible, and which has at one extremity a small, very slender steel pen, and at the other a small lever, directed from the side opposite to the armature, and whose extremity, bent into a hook, hooks into the ring of a double thread of extended caoutchouc. The tension of this caoutchouc thread can be regulated with precision to any degree desired; the lower part of the double thread passes through a small clasp, where it is held by a tension-screw; by loosening this screw a determined weight can be suspended at the extremity of the thread; the tension is allowed to be produced, and when equilibrium is established the clasp is tightened and the weight (become useless) is removed. Thus the thread is a repository of a tension exactly measured by the weight, and which accordingly can be reproduced at any instant.

In order to establish an equilibrium between the tension thus produced and the attractive force of the electro-magnet, a small additional piece of soft iron is employed, placed on the electro-magnet in contact with the polar mass, in proximity to the armature, and on the side opposite to the axis of rotation, Fig. 1. This mass can be displaced gradually by means of an adjusting screw; by setting it nearer to or farther from the armature the attractive force is diminished or augmented, and this force may thus be sufficiently reduced to cause the spontaneous disconnection of the electro-magnet; if the mass is then removed a little farther off by a very slight movement of the screw, the attraction is augmented in a measure just sufficient to maintain the armature, so that the least reduction in intensity of the current suffices to liberate it, and consequently it is set in motion as soon as the current is broken, or at least with a retardation exceedingly small and very constant. The arrangement represented by Fig. 2, and which shows the working of 10 registers placed side by side against the chronograph cylinder, is especially applied to the measuring of the durations of phenomena following each other in too rapid succession to permit the connection of a register between each signal. In this case, in fact, it is necessary to employ as many registers and distinct circuits as there are signals to observe, requiring for each register only one signal, for the necessity is thus dispensed with of making the registers connectors, that is to say, of regulating the course of the armatures in such a manner that they might be recalled by the magnetic attraction at the time of the re-establishment of the current. This latitude facilitates in a singular manner the employment of the apparatus, because it allows of giving to the pens a course large enough to make the traces easy to read, and of regulating the position of the additional mass so as to render the electro-magnets very sensitive, which could not be done to the same degree if an excess of force must be left to the attractive force, in order to restore the armature from a distance. This is the arrangement which it would be most proper to adopt for the electro-magnet almost exclusively, if the fact of employing different electric circuits did not, on the other hand, introduce causes of uncertainty and difficulties in their use often very great.

The employement of electro-magnets, also, simply as disconnecters, has been reserved in practice for the case where the intervals of the successive signals are so short that it is not possible to find registers sufficiently rapid in their course to follow the production of these signals. The limit is now very much extended by the recent improvements which Mr. Marcel-Deprez has made in his registers, which can execute as many as 2,000 movements per second.

At the time when his first investigations were executed, in concert with the marine artillery service, he had already produced registers whose retardation of disconnection was reduced to less than one two-thousandth of a second, and which, placed in the circuit of a fork sustained by electricity and giving 1,000 simple vibrations per second (500 periods), could follow the movement of this fork, and thus produce 500 rupture signals and 500 closing signals per second, by leaving on the revolving cylinder of a chronograph traces which indicated that the register remained still at rest for an appreciable time in the interval between the two signals.

But however rapid the registers might be, they would not have given the 10 signals which it was the object to obtain in case of need during the development of the pressures in the bore of a gun from the moment of the inflammation of the charge to the moment of the maximum pressure which, it is known, can scarcely be two or three thousandths of a second in duration, so that the successive signals could only be two ten-thousandths of a second apart, and even less. It would also be necessary to adopt for these special researches the employment of many independent registers, each giving but a single signal, as Fig. 2 shows.

For other researches, such as the studies of exterior ballistics, or even that of the law of the movement of the projectile in the bore, reconnecting registers could be employed.

Fig. 3 shows a register with large, wide helices arranged with regard to each other in such a manner as to cause the oscillation of a small armature mounted symmetrically on a horizontal axis, which is terminated at one end by a small lever, to the extremities of which can be fixed the threads of extended caoutchouc, two in number. The armature can only receive a very slight oscillatory movement, which is regulated in case of need by displacing the cores of the helices, and a great force of attraction is thus obtained to induce the reconnection. The movement of the armature is communicated to the pen which is on the extremity of a small parallel axis, placed on the upper part, by means of a very light lever, secured in a small fork, and which produces a notable amplification. In another mode of construction much used, two registers mounted side by side so as to be simultaneously utilized, are arranged

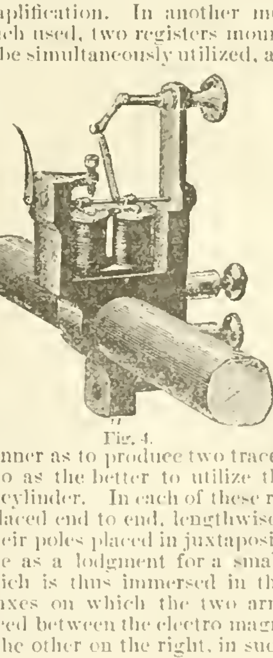


Fig. 4.

in such a manner as to produce two traces very near each other, so as the better to utilize the available space on the cylinder. In each of these registers the helices are placed end to end, lengthwise to one another, and their poles placed in juxtaposition are cut so as to serve as a lodgment for a small prismatic armature which is thus immersed in the magnetic field. The axes on which the two armatures are fixed are placed between the electro magnets, one on the left and the other on the right, in such a manner as to bring the pens near to each other; these axes have each a pen at one of the extremtiies and support, in their middle, a small plate of spring-steel placed vertically, against the extremity of which rests a horizontal screw, that can be worked with a key, so as to produce a counteracting effort adjustable at will. A vertical supporting screw, whose position can be regulated with the same key, serves to limit the course of the armature, so as to make the connection possible, allowing at the same time a sufficient course for the pens. In order to obtain the connection in these registers, it is necessary always to give to the magnetic attraction an excess of force over the tension of the counteracting spring, which does not permit the retardation of demagnetization to be reduced to the minimum which it would be possible to attain without this necessity; but the excessive reduction of the dimensions of the helices, which in the last apparatus figured did not exceed 5 millimetres (0.1968 inch) each in diameter and 7 millimetres 0.2756 inch) in length, permits the reduction of the retardation to a value extremely small and makes the variations in it altogether insignificant. We are assured, in fact, by the arrangement which will be described farther on, that the retardation of disconnection of these registers can be reduced to one three-thousandths of a second, and that the variations of this retardation, from one disconnection to another do not attain to one fifty-thousandth of a second.

In the apparatus sketched, which was arranged for mounting by means of a collar with a clamp screw, on a cylindrical shaft placed before the chronograph cylinder, one of the registers was mounted stationary on the common support, the other was sustained by a small movable slide which a square-headed screw permitted to move backwards or forwards, by means of the key already used for the other adjusting screws; this regulated the two pens so that they might rest equally on the surface of the cylinder of the chronograph. Fig. 4 represents another type of register, frequently employed. It is adapted to a number of mechanical arrangements, especially when it is desiered to combine side by side, as we shall see upon investigation, several indedependent registers. The helices, which in this case measure 7 millimetres (0.2756 inch) in diameter and 9 millimetres (0.3543 inch) in length, are placed vertically as in the apparatus, Fig. 1. The employment of a prismatic armature lodged between two polar masses is abandoned on account of the difficulties in construction and adjusting which it involved, and a flat armature is substituted which acts directly on the poles and approximates the arrangement of the ordinary electro-magnets; this armature is hollowed out, however, outside of the poles, in order, thereby, to diminish the mass, and it is made movable around an axis parallel to its length, and as near as possible to diminish the movement of inertia. The resistance due to the inertia of the lever on which the counteracting spring in the register (Fig. 1,) is applied is also avoided by applying directly on the armature the effort which is here produced by a small spiral spring. This spring can be extended at will by a mill-headed button, fitted very tightly, and which acts upon a crank to the extremity of which it is fastened. An adjusting screw, whose point touches against the armature, limits at will the course of the pen which is soldered on a small pipe fitted on the extremity of the shaft. By loosening this screw the course can be made so great that the register cannot naturally connect; in this case, a tension may be given to the counteracting spring slightly inferior to the attractive force so as to reduce as much as possible the retardation of disconnection. On the contrary, by revolving and tightening the screw so as to diminish the course, and by reducing also the tension of the counteracting spring, a preponderance may be restored to the attractive force, great enough to produce the connection of the apparatus which is then in a condition to give numerous successive signals, but the retardation of disconnection is, in this case, slightly augmented, according to the intensity of the current.

These registers are each secured to a ring-shaped mounting with its under part open. By these rings they are fitted side by side on a cylindrical shaft; they constitute so many clasps susceptible of being each tightened on this shaft, in any position whatever, by means of a mill-headed screw. To each of these registers may thus be given an individual movement of rotation around this shaft, by which movement the pens are brought on the same line, and a general rotary movement of the shaft afterwards removes them altogether, or makes them bear equally and at the same time on the surface designed to receive the registry. By what precedes, we see that the property of connecting automatically can be given to a register only on the important condition of limiting the course of the pen and in also reducing the counteracting force which determines the rapidity of its movement of disconnection; the magnetic attraction, exerted on the armature, diminishing according to the square of the distance, we imagine that, in practice, in order to preserve a course sufficiently rapid, we may be led to reduce, to a very small quantity, the amplitude of the displacement of the pen, which renders the readings difficult. A remedy was sought for this defect by the employment of organs for multiplying the movement like those represented by Fig. 3. Mr. Napoli also constructed registers such as that represented by Fig. 5, in which the amplification of the movement was produced by

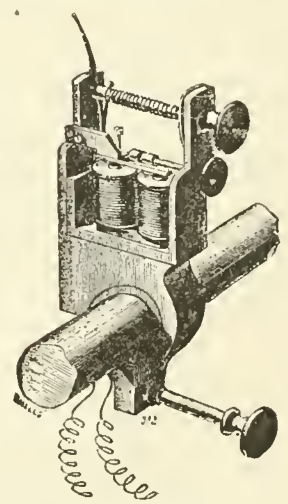


Fig. 5.

the medium of two cams resting one on the other, with surfaces arranged in such a manner as to vary, at each instant, according to a proper law, the relation of the arms of the lever and consequently the action of the counteracting spring acting then directly on the shaft which contains the pen; this is the, arrangement known by the name of "distributer of Robert Houdin." Mr. Marcel-Deprez also sought to overcome this difficulty by using electro-magnets, combined in pairs and of different forces, working successively by the same action of the disconnection; the attraction of the armature, in ordinary circumstances, was produced by a very small and very sensitive electro-magnet, whose retardation of disconnection could be made small, and, at this time of the disconnection, the armature established contact which introduced in the circuit a larger electro-magnet susceptible of acting with force on the armature in order to return it to its place. When the current was reestablished, it was this second electro-magnet which caused the connection, and when the armature was thus brought into contact all things were restored automatically to their place: the current was then sent again into the small electro-magnet. See *Sebert and Marcel-Deprez Chronograph.*

MARCH.—A term applied to a piece of music composed chiefly for military bands, to accompany the marching of troops, to help them to preserve time and to act as a preventive against fatigue. Marches are played on wind instruments or by the fifes and drums, and are generally some simple popular air. Each regiment in the British service has its special march for marching past; the Fusiliers are allowed to play on that occasion the "British Grenadier."

MARCHANDS.—Petty sutlers who follow an army on its march. As they generally deal in articles which are required by the officers and soldiers, it is the business of every General to see them properly treated, to insure their safety, and to permit them, under certain regulations, to have access to the camp.

MARCHES. 1. The boundaries between England and Scotland, also between England and Wales. The term signified primarily the *mark* of a country's limits (the *march*); and hence was applied as a designation of the border countries or districts of the German Empire, conquered from neighbouring nations. Thus, we read of the *marks* of Austria, of Northern Saxony or Brandenburg, Lausatia, Moravia, Steiermark, etc. The governors intrusted with the charge of these border districts, or *marks*, were called *markgrafs*, corresponding to the English and Scottish *Wardens of the Marches.* 2. The movements by which a body of troops is conducted from one place to another. They should be well directed and should be ordered so as to conduct the troops to their destination with the least amount of privation and fatigue compatible with the object to be attained. The art of directing properly a march belongs to "Strategy", while the art of arranging the details of its execution is a part of "Logistics." As the success of many military operations depends almost entirely upon their execution marches form a most important element in the Art of War. Marches when made at a distance from the enemy and where it is not necessary to take precautions to guard against an attack are known as *route* marches: those made in the theater of operations and where the enemy may at any moment make his sudden appearance, are called *strategical* marches; those made in the immediate vicinity of the enemy and so near, that they may be observed by him, are called *tactical* marches. Besides these three classes of marches which are based upon the position of the enemy, writers use various other classifications, based upon the object to be attained, or upon some other characteristic feature. These are known as *marches of concentration, maneuver marches, retreats, flank-marches,* etc.

Although the object of the movement and the nature of the ground determine the order of march, the kind of troops in each column, and the number of columns, the Commander must so act as to present his men in fighting order at any moment. With this in view, it will be necessary to observe the following points: 1. All things to be arranged in the same order in which they are likely to be required. 2. The cheerfulness and efficiency of the men to be secured, carefully considering the proper indulgences, the weather, the physical features of the country, and important hygienic principles. 3. The animals to be herded, loaded, driven and guarded with the greatest care. When distant from the enemy, or when in broken or dusty country, certain considerations of the first order may very properly give way to ease and comfort, but, as a general rule, the transportation (kept well closed up) should follow closely in the rear of the main command.

The simple movements of the troops, like that of forming into line of battle from a column formation, or the converse, or a change of position in the actual presence of the enemy, form a part of tactics; but the following general rules are applicable at most times and places:—Batteries of artillery and their caissons move with the corps to which they are attached; the field train and ambulances march at the rear of the column, and the baggage with the rear guard. Cavalry and infantry do not march together, unless the proximity of the enemy makes it necessary. In cavalry marches, when distant from the enemy, each regiment, and, if possible, each squadron, forms a separate column, in order to keep up the same gait from front to rear, and to trot, when desirable, on good ground. In such cases, the cavalry may leave camp later, and can give more rest to the horses, and more attention to the shoeing and harness. Horses are not bridled until the time to start. The officers and non-commissioned officers of cavalry companies attend personally to the packs and girths. When necessary, the orders specify the rations the men are to carry in their haversacks. The Field Officers and Captains make frequent inspections during the march; at halts they examine the knapsacks, valises, and haversacks, and throw away all articles not authorized. When it can be avoided, troops should not be assembled on high-roads or other places where they interrupt the communication. Generals of divisions and Commanders of detached corps send a Staff Officer to the rendezvous, in advance, to receive the troops, who, upon arriving, take their place in the order of battle, and then form in close column, unless otherwise ordered. Artillery, or trains halted on the roads, form in file on one side. The execution of marching orders must not be delayed. If the Commander is not at the head of his troops when they are to march, the next in rank puts the column in motion. If possible, each column is preceded by a detachment of pioneers to remove obstacles to the march, aided, when necessary, by infantry. The detachment is divided into two sections; one stops to remove the first obstacle, the other moves on to the next.

In night marches, and at bad places on the line of march, when practicable, and at cross-roads, if necessary, intelligent non-commissioned officers will be posted to show the way, and are relieved by successive details from the regiments as they come up. The Sergeant-major of each regiment remains at the rear with a trumpeter or a drummer, to give notice when darkness or difficulty stops the march. In cavalry, a trumpeter is placed in rear of each squadron, and the signal is repeated to the head of the regiment. The General and Field Officers frequently stop, or send officers to the rear, to see that the troops march in the prescribed order, and keep their distances. To quicken the march, the General warns the Colonels, and may order a signal to be sounded, which is repeated in all the regiments. In approaching a defile, the Colonels are warned; each regiment passes separately in column of fours in the order designated by the Commanding Officer, two battalions, when possible, marching abreast; on emerging from the defile, the battalions form line under the immediate direction of the General, the flank battalions being so posted as to prevent the enemy from passing between them and the entrance to the defile. Halts to rest and reform the troops are frequent during the day, depending on the object and length of the march. They are made in preference after the passage of defiles. Led horses of officers, and the horses of dismounted men, follow their regiments. The baggage wagons never march in the column. When the General orders the field train and ambulances to take place in the column, he designates the position they shall take. If two corps meet on the same road, they pass to the right, and both continue their march, if the road is wide enough; if it is not, the first in the order of battle takes the road, the other halts. A corps in march must not be cut by another. If two corps meet at cross-roads, that which arrives last halts if the other is in motion. A corps in march passes a corps at a halt, if it has precedence in the order of battle, or if the halted corps is not ready to move at once.

A column that halts to let another column pass resumes the march in advance of the train of this column. If a column has to pass a train, the train must halt, if necessary, till the column passes. The column which has precedence must yield it if the Commander, on seeing the orders of the other, finds it for the interest of the service.

The rate of march ordinarily for different troops is as follows:—Infantry, $2\frac{3}{4}$ miles an hour; field-artillery $3\frac{1}{2}$ miles an hour; horse-artillery or cavalry, 4 to 5 miles an hour. These rates only apply to small bodies marching independently. Practically, infantry in large bodies can only march at the rate of 2 miles an hour. Infantry, being the slowest marchers, necessarily regulate the pace of mixed columns. It is computed that a division of infantry of 12 battalions, of 800 men, marching in fours, will occupy about 7,680 yards. Its artillery (two batteries), without wagons, and marching by divisions, occupies about 400 yards. A division *complete*, including the advanced and rear guard, will cover about 7 miles. To determine the time of march (T) of a column: Let D = the distance (in feet) to be passed over; L = the length of the column in feet; D′ = the distance (in feet) passed over in one minute by the column, including halts; and T′ = the time of delay (in minutes) due to the elongation of the column in passing defiles, the physical condition of the command and all the irregularities of the route; then, $\frac{L}{D'}$ = the time (in minutes) for the column to pass over a distance equal to its length, and T (in minutes) =

$$T' + \frac{L}{D'} + \frac{D}{D'} = \frac{D'\,T' + L + D}{D'}$$

Thus, for a column of troops 860 feet in depth, moving at the rate of 100 yards per minute (including halts) and delayed eleven minutes, to pass over six miles.

$$T = \frac{300 \times 11 + 860 + 31680}{300} = 119\tfrac{14}{30} \text{ minutes.}$$

The average march for infantry is from fifteen to twenty miles per day. When troops move in large bodies, and particularly in the vicinity of the enemy, the march should be conducted in several columns, in order to diminish the depth of the columns, and to expedite the deployment into line of battle. The order of march should state the time for each division to commence its movement, so as not to interfere with the march of the division preceding or following, and to prevent fatigue from keeping men longer under arms than is necessary. In route marches, regiments usually alternate in leading the brigade; in like manner brigades alternate in divisions, and divisions in corps. In large commands, the roads, if possible, are left to the artillery and trains. The order of march should state whether the troops or trains should have the right of way. Each brigade is provided with a corps of pioneers under charge of a commissioned officer. The pioneers precede the column for the purpose of removing obstacles and preparing the way for the troops. Whenever fences, hedges, walls, ditches, or small streams, are encountered, a passage-way is made wide enough for four men, or eight men if in double column of fours, to march abreast without obstruction. This will prevent the column from lengthening out, and also prevent the fatigue and delay of regaining distances. On long marches, a halt of half or three-quarters of an hour should be made for the regular meals. The halt, if practicable, should be made in the vicinity of wood and water. When long distances have to be overcome rapidly, it is done by changing the gaits; the double time is used for ten or fifteen minutes, and the quick time for five minutes; the most favorable ground is selected for the double time; special care should be taken not to exhaust the troops immediately before engaging the enemy. Whenever delays occur in front, the brigades may form in column of battalions, and stack arms. It is the duty of all Commanders, within their commands, to investigate, personally or by means of staff-officers, every cause of delay, and staff-officers should be frequently sent ahead for the purpose of gaining any information that might shorten the march, and lessen the fatigue of the troops.

When cavalry and artillery form part of the column, Commanding Officers must bear in mind that their efficiency depends almost entirely upon the *condition of the horses*, which alone makes them able to get over long distances in short spaces of time. The horses must, therefore, be nursed with great care, in order that they may endure the utmost fatigue when emergencies demand it. When near the enemy, the artillery always marches with the bulk of the troops, its place being near the center or rear of the infantry or cavalry, never at the head of the column. In campaign, if a battery does not march with troops of the other arms, a sufficient escort must always be provided.

When an accident happens to a carriage, it is pulled out of the column, if possible, so as not to interrupt the march; otherwise, the carriages in rear pass it by the most convenient flank and close to proper distance. The disabled carriage resumes its place as soon as the damage is repaired; if the road be narrow, it must fall into the first interval it finds, and regain its proper place as soon as the ground permits. The caisson of a disabled piece remains with it; a piece, however, does not remain with its disabled caisson, the caisson corporal, and men to assist him, if necessary, being left behind.

When a piece and its carriage are overturned, it is better to disengage the piece by letting the breech rest on the ground, or on a block of wood, and by then raising the muzzle with a handspike, while the cap-squares are taken off; the carriage is then righted and the piece mounted. To right the carriage without disengaging the piece, detach the limber, secure the cap-squares, and lash the knob of the cascabel to the stock; place the middle of a rope over the nave of one wheel, pass the ends of it downward between the lower spokes of that wheel, then under the carriage, through the corresponding spokes of the other wheel, and then upward over the wheel and across the top of the carriage to the side where it was first attached; the ends of the rope and the wheel to be raised are then manned, and the carriage pulled over, two men being required to steady the trail. If necessary, the ends of the rope may be fastened to the limber, and horses used to assist in righting the carriage. A piece and its carriage may also be righted without disengaging the piece as follows: detach the limber; fasten two prolonges, or the middle part of a picket-rope, to the trail; chock the wheels; and dig an oblong hole under the muzzle about two and a half feet deep; pass one of the prolonges, or one end of the picket-rope, over the carriage to the front; man the ends of the prolonges, or picket-rope; then raise the trail and pass it over the axle to the opposite side. Other methods may be resorted to, depending upon the circumstances of the case, and the appliances at hand. Light carriages may be righted by hand without using a rope.

After pulling up a short, steep hill, the horses should be halted to recover their wind; when this cannot be done, they will move very slowly. In going up a difficult hill, the carriages may be halted to rest the horses, by bringing them across the declivity and locking the limbers or chocking the wheels; for this purpose, it may be expedient to start the sections, or platoons, from the bottom in succession, leaving a distance of twenty or thirty yards between the different portions of the column. If the draught be so difficult that the teams are liable to stall, some of the carriages in the rear are halted and their leaders hitched to the teams in front; on completing the ascent, these leaders are sent back to the carriages which have halted, with as many additional pairs as may be required. As it is very hard to make the horses pull together, not more than five pairs can be hitched with effect to a single carriage. The drivers never dismount in going down hill; the wheel-driver holds his near horse well in hand, and his off horse very short; the other drivers barely stretch their traces. If the hill be steep, the wheels may be locked; if very steep, the prolonge may be used by the cannoneers to hold back; in this case the wheel-horses only remain hitched to the carriage, the others being led in rear. In mounted batteries, the cannoneers usually attend to the locking; in horse batteries, the swing-driver, or with a team of but two pairs, the lead-driver, dismounts for this purpose; should there be a ditch or other dangerous place on the road-side, the wheel toward that side is locked in preference to the other. If a carriage have to move along a declivity so steep that a slight jolt may overturn it, a prolonge is fastened to the lower side of the carriage, and held by two or three cannoneers who march on the upper side of the slope; the rope passes over the carriage. When crossing a ditch, if it be wide and deep, the prolonge is fixed and the handspike taken out; the team is halted on the edge, and the piece run by hand close to the limber, which then moves slowly until the piece reaches the bottom of the ditch, when it moves quickly until the piece is out. If the ditch be deep and narrow, it may be necessary to cut down the edges, and hold back with prolonges; should the trail sink into the ground in passing over, it is disengaged with a handspike, or by fastening a prolonge to it. In passing shallow ditches, drains, or deep furrows, the carriage must cross them obliquely. When moving over marshy ground, each carriage moves at a distance of ten or twelve yards from the one preceding it, to avoid having to halt; officers, or non-commissioned officers, are posted at the worst places to instruct the drivers how to conduct their teams. The horses must pull freely and quicken the gait; if the ground be very miry, it may be necessary to assist with prolonges, or even to use them alone, the teams crossing separately.

When about to cross a ford, if it be not well known, it must be examined, and the dangerous places marked, before the carriages attempt to cross. If the water be deep and the current strong, great care is necessary. The men are instructed to keep their eyes fixed on some object on the opposite bank which marks the place of exit; they must not look at the stream, and move rather against the current, so as to better resist its power. If the ford have a bad bottom, and the banks be difficult, the teams are strengthened by adding pairs; an officer or non-commissioned officer, is posted at the entrance to regulate the distance between carriages, and to instruct the drivers how to proceed; a second officer, or non-commissioned officer is posted at the exit to direct the drivers how to leave the ford. The management of the team is the same as in crossing marshy ground; the horses must not be allowed to halt, or trot, either in passing the ford or in leaving it, unless the stream be neither deep nor very rapid; in this case, the carriages may be halted to let the horses drink, or at least to give them a mouthful of water. Upon reaching the opposite bank, the leading carriages are halted after they have moved far enough forward to leave room for the carriages in rear. If the chests be not water-tight, and are at the usual height of two feet ten inches above the ground, a ford deeper than two feet four inches cannot be crossed without danger of wetting the ammunition. If the chests be water-tight, or means have been taken to raise them high enough, a depth of three and one-third feet may be safely attempted. When the ford is deeper than this, the cannoneers must carry over the cartridges, fuses, and primers, in pouches which they hold above the water. The chests are sometimes removed and taken over in boats. In crossing rivers which cannot be forded, when there are no bridges, the horses are swum, and the carriages and harness crossed on rafts, etc., if the rivers be broad and swift, it is too hazardous for horses to be ridden; in this case a horse, known to be a good swimmer, is ridden without a saddle, as a leader, the other horses following without riders; the horses are led or driven to the bank, and can generally be made to take the water without much trouble. The bridle-reins must be secured to prevent the horses from getting their legs entangled. A horse swims easily and safely with a man floating and holding to the mane or tail. In the passage of a military bridge, when at the entrance of the bridge, the lead and swing drivers dismount and lead their pairs. A distance of twelve yards is taken between the carriages, and the gait is free and decided; the drivers keep the carriages as near the middle of the flooring as possible, and must not halt; if the bridge crack under a carriage, it must increase its gait and get over as fast as possible. If the flooring be wet, battens should be nailed across it to keep the horses from falling. If the bridge begins to rock, the passage of the column is suspended. In passing over a flying bridge, all the drivers dismount and hold their horses; it may be occasionally advisable to take the horses out; and in boisterous weather, or at night, the wheels may be locked.

The disposal of the troops for a march and the manner of executing it and overcoming the difficulties attending the same belong, as we have already observed, to the practical details of the profession, for which specific rules are laid down in every service; and with which it is presumed that every man who accepts the resposibility of a General's position has made himself acquainted. All of this may be summed up in a few words. First, the trains of every description must be covered by the troops, for which purpose they must, in an advance movement, be either in the rear, or on that flank where they will be least exposed to the enemy. In a retreat they must be in advance. When an army moves in several nearly parallel columns, the combination must be such that an imposing force can soon be concentrated on any point threatened. The divisions of each column must, in like manner, be in supporting distance of each other, but, for convenience, not crowded on the march. As to advanced guards, flankers, and rear guards, both their strength and composition must depend on the General's judgment, founded on the force, character and position of the enemy, and of the nature of the country through which the march is made. Just in proportion as he has read, has reflected, has had opportunities for action, will his judgment lead him to take right measures; whilst still more certainly, if he has wanted these aids to forming an enlightened judgement, will he take wrong one. See *Concentration Marches, Flank Marches, Maneuver Marches, Route Marches, Strategical Marches*, and *Tactical Marches*.

MARCHING.—One of the first necessities to distinguish a body of disciplined troops from a mere crowd of men, is a regular cadenced step, taken by every individual at the same time and with the same foot. The necessity of this for harmonious action is obvious. The ancient Roman legions had military music to beat the time for their march. In the feudal ages, when infantry fell into disrepute, cadenced marching was unattended to, and seems only to have been thoroughly revived by Marshal Saxe. The best music for a march is found to be some simple tune, such as can readily be performed by drums and fifes. The music, besides preserving the time, acts as a preventative of fatigue.

In the British service there are the slow march of 75 paces, each of 30 inches, in a minute—only used on parade; the quick march, of 110 paces, in which all evolutions are performed; and the double-quick, of 150 running paces, with the knees raised high. This last cannot be sustained for any great distance, and is employed in a charge, or in suddenly occupying a hill or some commanding position, and in a few short internal movements of regiments.

In the United States service, the length of the step in common and quick time is 28 inches, and the cadence is at the rate of 90 steps per minute for common time and 110 for quick time; in double time, the length of the step is 33 inches, and the cadence at the rate of 165 steps per minute, but it may be increased to 180. When troops are to march a long distance, the *route* step is employed, the men keeping their proper places in the ranks. See *Marches.*

MARCHING MONEY.—The additional pay which officers and soldiers receive for the purpose of covering the expense necessarily incurred when marching from one place to another.

MARCHING ORDER.—A soldier is said to be in *marching order* when he is fully equipped with arms, ammunition, and a portion of his kit. In the English service this equipment weighs from 30 to 35 pounds. In *service marching order*, by the addition of provisions and some campaigning necessaries, he carrys nearly 50 pounds. The *heavy marching order*, which was yet heavier, is now happily abolished.

MARCHING ORDERS.—The orders issued preparatory to troops marching. In these orders, the routes, the orders of march, and detailed instructions for the different arms of the service are clearly set forth; and in the British service the marching orders are intended to cover at least six days.

MARCHING REGIMENTS.—A term given in England to those regiments having no permanent quarters, but liable to be sent to any part of Great Britain or to any part of her possessions abroad. Although the word *marching* is insensibly confounded with those of *line* and *regulars*, it was originally meant to convey something more than a mere liability to be ordered upon any service; for by marching the regular troops from one town to another, the inhabitants, who from time immemorial have been jealous of a standing army, lost their antipathy to real soldiers, by the occasional absence of regular troops. At present the English guards, infantry, etc., may be considered more or less as *Marching Regiments.* The marines and volunteers have stationary quarters.

MARCH PAST.—An expression made use of when a regiment or any larger body of men pass in review order before the Sovereign or Reviewing Officer. It is usually performed in column or quarter-column at quick march or at the double, and with the mounted branch, when so ordered, at a quick trot, canter, or gallop. In England, the "march past" of large bodies of troops is carried out after the completion of the autumn maneuvers or summer drills.

MARCOMANNI.—An ancient German people who, in the time of Cæsar, lived along the banks of the Rhine, but afterwards, as appears from Tacitus and Strabo, settled in Bohemia, from which they expelled the Boii. Their King, Maroboduus, entered into an alliance with the tribes living around them to defend Germany against the Romans. The combined forces of the alliance numbered 70,000 men, and the Emperor Tiberius signed a treaty with them 6 A. D.; but the Marcomannic Alliance was beaten 11 years later by the Cherusci and their allies, and in 19 the Gothic Catualda drove Maroboduus from the throne, and himself usurped the sovereignty. But he was soon overthrown, and the native dynasty established, under whose rule the Marcomanni extended their territory up to the Danube, till their encroachments alarmed the Romans, who attacked them in the time of Domitian. This war, which subsided for a time in the reigns of Trajan and Hadrian, broke out again under Marcus Aurelius, and was carried on with bitterness from 166 to 180, when it was ended by the peace of Commodus. The Marcomanni continued to make raids into the Provinces of Noricum and Rhætia, and in 270 invaded Italy as far as Ancona. From this time they are little heard of; and their identity finally disappears among the followers of Attila.

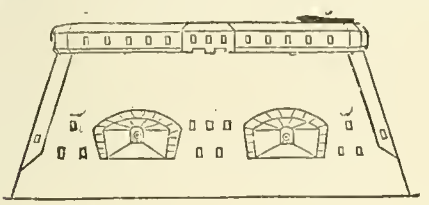
MARDI GRAS.—The French designation for what is known as Shrove Tuesday in the calendar of the English Church, the Festival held upon the Tuesday preceding Ash Wednesday, the first day of Lent; with the exception of Mi-Carême or Mid-Lent Thursday, the last of the prolonged festivities known as the Carnival. It is most extensively celebrated in Rome and Paris. In the latter it has been the custom for many centuries to lead in procession a fat or prize ox (*Bœuf Gras* whence *Mardi Gras*), followed in a triumphal car by a child called the Butchers' King. The entire day and night is spent in the wildest revelry, sometimes degenerating into unrestrained license. In the United States the only celebration of Mardi Gras worthy of note is that of New Orleans, where the first display was given in 1857, and since the end of the war the observance has been carried out with great pomp and splendor. For the preceding week the gayety has been universal, and on Mardi Gras the whole city is turned over to the rule of King Rex, who enters the gates on the previous day. On Tuesday the mimic monarch passes through the streets, escorted by his body-guard, the "Mystic Krewe of Comus," Knights of Momus, and various military and visiting organizations. To him are confided the gates of the city; minor police regulations are suspended, and until the dawn of Ash Wednesday the air is filled with music; in every street are dense throngs of merry-makers, and the glare of illuminations. In the evening occurs the great street pageant of the Mystic Krewe of Comus, in which are displayed elaborate tableaux, placed on moving platforms and brilliantly illuminated. These represent noted scenes of history, poetry, or fiction, and are constructed at great expense and with artistic elegance. All the arrangements of the parades and accompanying balls are under the control of societies composed of the most noted professional and business men of the city. The observance is gaining ground also in Memphis.

MARECHAL.—A Major General. This word is variously compounded in forming military terms. *Maréchal de Bataille* is a military rank which once existed in France, but was suppressed before the Revolution, or rather confined to the Body-Guards. An officer belonging to that corps received it as an honorary title. Its original functions, etc., with respect to general service, sank in the appointment of *Maréchal de Camp* and Major General. It was first created by Louis XIII. *Maréchal-Général des Logis de la Cavalerie* took place under Charles IX. in 1594. He had the chief direction of everything which related to the French cavalry. *Maréchal des Logis pour les Vivres* was a person belonging to the Quartermaster General's Department in the old French service. The person invested with the rank of *Maréchal de Camp* was a General Officer and ranked next to a Lieutenant General. It was his duty to see the army properly disposed of in camp or quarters, to be present at all the movements, to be the first to mount his charger and the last to quit him. He commanded the left in all attacks. The appointment under this distinction was first created by Henry IV. in 1598. *Maréchal-Général des Camps et Armées du Roi* was a post of high dignity and trust, which during the French Monarchy was annexed to the rank of *Maréchal de France.* Military writers differ with respect to the privileges, etc., which belonged to this appointment; it is, however, generally acknowledged that the General Officer who held it was intrusted with the whole management of a siege, being subordinate only to the Constable, or to any other *Maréchal de France*, who was his senior in appointment. *Maréchal-Général des Logis de l'Armée* was an appointment which existed during the old French government, and has since been replaced by the *Chef de l'Etat-Major*, which corresponds with that of Quartermaster-General in the British service.

MARECHAUSSEES DE FRANCE.—A species of military police which formerly existed in France. During the French Monarchy there were 31 companies of Maréchaussées à Cheval, or mounted policemen. These companies were formed for the purpose of preserving public tranquility, and were distributed in the different Provinces of the Kingdom. This useful body of men was first formed under Philip I. in 1060; they were afterwards suppressed, and again re-established in 1720, as constituting a part of the Gendarmerie of France. There were other companies of Maréchaussées, who were particularly distinguished from the 31 above mentioned; such, for instance, as that of the Constables, called the Gendarmerie.

MARGRAVE. A German Nobleman corresponding in rank to the English Marquis. *Margravine* is the wife of a *Margrave.* See *Marquess.*

MARINE FORTIFICATION.—Marine fortification differs from land fortification in that the approaches of the enemy which are to be resisted take place on the level of the sea, so that he can come near without having to overcome the dangerous slope of the glacis. The combat is simply one between two powerful batteries, and the question to be decided is whether the ship or the fort will first be placed *hors de combat;* the ship having ordinarily the largest number of guns, while the fort has more solid battlements, and its fewer guns of great caliber can be fired with a steadiness unattainable on so shifting a base as the ocean. Under these circumstances, the less relief a sea-fortress has the better, as by so much the less is it likely to be hit from the shipping. Its walls are usually built perpendicular, or nearly so. The magazines and quarters for the men are bomb-proof, as also are the casemates, from which the guns are usually fired, although sometimes, as in the martello-tower, the gun is worked on the top of the structure. Sea-fortifications may be of various importance, the simplest being the battery consisting



of a mere parapet formed in a cliff or on a hill, and mounted with guns to command the sea; these are generally built in such concealed situations that it is hoped the hostile ships will not perceive them until they actually open fire. They are numerous all around the British coast. Next greater in importance is the martello-tower. More powerful still are the beach-forts, such as those which on either shore defend the entrance to Portsmouth harbor; these are constructed of the most solid masonry, faced with massive iron plates, and armed with guns of the heaviest caliber, sweeping the very surface of the sea, so as to strike an approaching ship between wind and water. The guns are usually in bomb-proof casemates, and the fort is often defended on the land side if the coast be level; if, however, higher ground be behind, this would be useless, and then the sea-front alone is defensible. Most terrible of all sea-forts, however, are the completely isolated forts, with perpendicular faces and two or three tiers of heavy guns. Such are the tremendous batteries which render Cronstadt almost inapproachable, and by which Spithead and Plymouth Sound are now fortified. These forts are generally large, with all the requisites for a garrison to maintain itself; against them wooden ships stand no chance, and in the American Civil War fort Sumter, at Charleston, showed itself no mean antagonist for ironsides. In such forts iron is employed as the facing, in plates of such vast thickness and weight that it is supposed no ship can ever possess any comparable resisting power; and, as they are armed with guns the smallest of which will probably be 300-pounders, it is expected that they will be able to destroy any fleet that could be sent against them. At the present day the value of sea-fortifications is disputed, as iron-plated vessels may pass them with impunity unless the artillery in the fort be so heavy as to destroy the armor of the ships. In the long run, however, it is apparent that the fort can command the greater power, for its armor may be of any thickness, while that of the ship must be limited by her floating powers, and, on the other hand, the limit to the size of artillery must be sooner reached in a ship than in a solid and stationary fortress.

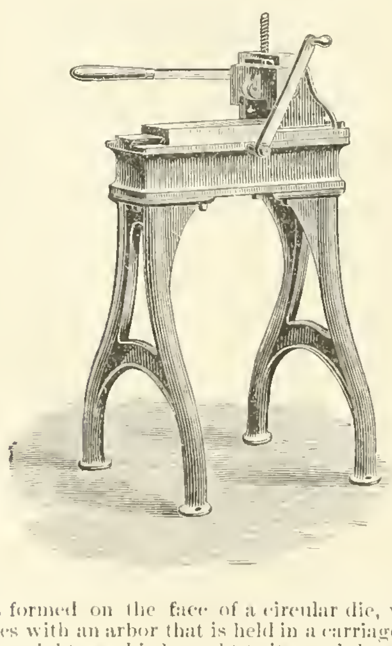
MARINES.—Troops who serve at naval stations, and on board ships of war. The men are drilled in all respects as soldiers (light infantry), and therefore on shore are simply ordinary land-forces. On board ship they are trained to seaman's duties, but still preserving their military organization. Their ordinary functions are as sharpshooters in time of action and at other times to furnish sentries for guarding the stores, gangways, etc. They are useful as exercising a good control over the less rigidly disciplined sailors, and having always fire-arms and bayonets ready, they have often been instrumental in suppressing the first outbreaks of mutiny. The introduction of Marines into the American Army took place by Act of Congress, passed Nov. 10, 1775, by which two battalions of this arm were directed to be organized. Again, by Act of July 11, 1798, "establishing and organizing a Marine Corps," this body became an established element in the naval force of the United States, liable to do duty either on board vessels of war at sea, in forts or otherwise upon shore as might be directed by the President. The Commandant of the Corps has the rank and pay of Colonel. It has no regimental organization, however, but may be formed into as many companies or detachments as the President may direct. When employed on naval service the Marines are subject to the laws and regulations which govern the Navy; but if engaged on shore duty, they are amenable to the authority of the Articles of War. The United States Marine Corps consisted in 1880 of 86 officers and 1,500 enlisted men. Marines were first established in England, as a nursery from whence to obtain seamen to man the fleet, by Order in Council of Oct. 16, 1664. Their utility becoming conspicuous, other regiments of Marine Forces were raised, so that by 1741 there were 10,000 men, and in 1759 as many as 18,000. During the great French war the number rose above 30,000, but a great reduction took place after peace was concluded. By recent Navy Estimates, 14,000 Marines were provided, including 2,900 artillery, at a yearly cost of £940,417. Their government rests solely with the Admiralty. The Royal Marines are divided into three divisions of light infantry and one of artillery. Promotion goes by seniority throughout the artillery and infantry respectively. In rank, Marine Officers correspond with Army Officers of similar grades according to seniority: as a corps the Marines take place between the 49th and 50th regiments of Infantry of the Line. Every ship, on being commissioned, has her complement of Marines drafted into her. The uniform is red, with blue facings and white belts. On their colors the men proudly bear the word "Gibraltar," in the famous defense of which fortress they bore an heroic part.

MARIOTTE'S LAW.—An empirical law deduced by Boyle and Mariotte from two independent series of experiments, though, strangely enough, reached by both at about the same time. It is generally expressed as follows: *The temperature remaining the same, the volume of a given mass of gas is in inverse ratio to the pressure which it sustains.* This law may be held to be substantially correct within a considerable range of pressure. But the labors of Regnault have made it evident that atmospheric air and most other gases, especially under very high pressures, are really more compressed than if they followed the law. This deviation is most marked in the case of gases capable of being liquefied, as they approach the point of liquefaction.

MARK 1. A German geographical term, which signified primarily the *mark* of a country's limits (the *march*); and hence was applied as a designation of the border countries or districts of the German Empire, conquered from neighboring nations. Thus, we read of the marks of Austria, of Northern Saxony or Brandenburg, Lausatia, Moravia, Steiermark, etc. The Governors intrusted with the charge of these border districts, or the *marks*, were called *Mark-grafs*, corresponding to the English and Scottish *Wardens of the marches*. See *Marquess*. 2. That toward which a missile is sent; the part of a target aimed at.

MARKER.—1. The soldier who forms the pivot of a wheeling column. 2. A person, whose duty it is to record the number of hits and misses made by soldiers at target-practice. 3. In maneuvers, for the purpose of indicating the direction of lines of battle, the battalion is provided with four markers, who are habitually posted in the line of file-closers, one near each flank of the right and left companies when in line, and the leading and rear subdivisions when in column. At parades and inspections, two markers are required, who retire, after the line is formed, behind the flanks of the color-company. At inspection they accompany the color-guard to the front and are inspected with it, taking post two yards from the rear rank, in rear of the right and left files.

MARKING MACHINE.—A tool for impressing textual or emblematic designs into finished work at the armory or foundry. The drawing shows a handy machine of this class, which is much used. The de-



sign is formed on the face of a circular die, which revolves with an arbor that is held in a carriage sliding in uprights, and is brought to its work by a foot-lever (not shown in the drawing), the device being impressed on the piece to be marked, as it is moved, with the table to which it is secured, by hand-lever under the die. Pieces of varying diameters may be marked in the same machine. The machine is mounted on legs of convenient height, and weighs about 300 pounds All cannon are required to be marked with the weight in pounds, the number of the piece, the initials of the Inspector's name the initials or name of foundry and year of fabrication. All pieces manufactured in the United States, since 1861 have these marks on the face: those of previous date have them distributed on the ends of the trunnions, the face, the breech, and the top. The numbers for each kind and caliber at each foundry are in separate series. Cannon that have been inspected and condemned are marked on the face X C. See *Inspection of Ordnance*.

MARKSMANSHIP.—To become skilled in *marksmanship*, one must possess a thorough knowledge of the rifle, the principles of its construction, its capabilities, and the care required to preserve it always in a condition of greatest efficiency, the laws governing the flight of the bullet, and the causes which tend to impress upon its motion certain irregularities; an understanding of the best positions for firing; a readiness for estimating distances; and the experience required to make allowance for the force of the wind, or the motion of the object aimed at. The acquirement of the requisite skill to fire accurately is one of the most important duties of the soldier; not only his own safety but that of his companions may often depend upon his ability to deliver his fire with effect, and the greatest proficiency in the manual of arms cannot atone for a want of dexterity in this particular. Any man having perfect vision can, through perseverance, become a fair marksman. Long practice with cartridges is not necessary; but a strict compliance with the rules for pointing and aiming, and a careful study of the causes modifying the accuracy of fire, will be sure to lead to more than average skill in firing.

When firing *in vacuo*, the trajectory is easily traced and its properties simply discussed. Considering its position with reference to the line of sight it will be seen that near the muzzle it is below the line of sight for some distance, then it cuts it; beyond this point it rises above the line of sight for some distance, then falls and cuts it again. This second point of intersection is the point-blank and determines the point-blank-range. With a rifle, up to 175 or 200 yards, the line of fire will not cut the line of sight; or, in other words, will not shoot high. Now, as it is necessary, in order to hit an object within or beyond the point-blank, to aim below or above it certain distances, it is readily seen how indispensable are the contrivances (sights) which will so alter the point-blank as to make it coincide with any object directly aimed at. The range in vacuo equals $\frac{2xy}{g}$ in which x and y are the horizontal and vertical components of the impulsive force, and g the acceleration due to the force of gravity. From this we see that (velocity being constant) the range will be the same when the angles of fire are equally distant from 45°; thus, angles of fire 36° and 54° will give the same range. It is also seen that the range will be a maximum when xy is a maximum, or when $x=y$, or when the angle of fire is 45°

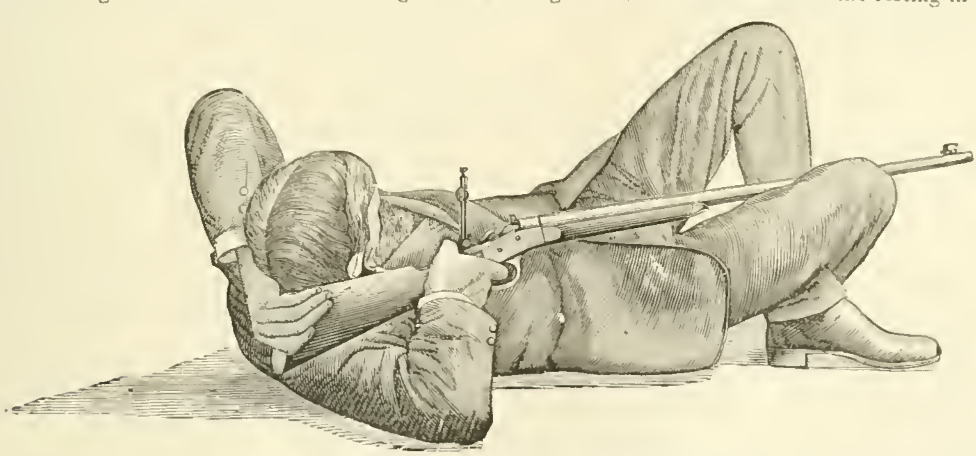
The motion of a bullet is greatly modified when the movement is through the air. The progressive velocity of fall of the bullet being so much less than its initial velocity, the air resistance opposed to its descent will be inappreciably small in comparison with that in the direction of its motion of translation (the resistances being proportional to the squares of the velocities). Hence, when the bullet would have been at certain points, in vacuo, it will in reality be at points below and in rear of them, by distances increasing from the point of departure (since the resistance of air causes the spaces passed over in equal times to become progressively smaller and smaller), thus causing the trajectory in air to be constantly below and in rear of its place in vacuo and changing its curvature, so that the left branch presents a flattened form while the right branch approaches the vertical. From thus destroying the symmetry of this curve, there results that the angle of fall is greater than the angle of ascent, and more considerably so as it is distant from the origin, that the point of culmination is lowered, and that the range is greatly diminished. To make proper allowances, the sights must be carefully manipulated, and when firing at long range a delicate estimation of distance is necessary to obtain accuracy of fire, even when using the best and most accurately graduated sights. Any ordinary man can be drilled to estimate distances up to 600 yards with great accuracy and dispatch, by the eye alone. Instruments may be used for greater distances, but their use is of no practical value in the field before an enemy, and can only be resorted to on the drill ground as an aid where time is an important element.

Having thoroughly mastered the principles of aiming, experience only can teach the best positions under various conditions and circumstances. The when the fire is in two ranks, the front rank kneel, not only to obtain a steadier position, but to get them out of the way of the rear rank, and thus secure a more rapid and accurate fire.

The favorite position for long-range firing, particularly with a military rifle, is that of the *Skirmisher Lying.* In taking this position, the legs should be well separated, the toes being turned outward, so as to cause the body to hug the ground as closely as possible. The left elbow should be kept almost straight under the rifle (if placed too far to the left, it strains the wrist), and the barrel grasped *firmly* with the left hand. The right elbow should be placed a little to the right. To prevent the elbows separating, as they are naturally inclined to do on hard ground, a depression may be made in the ground with the heel of the boot, or something soft placed under them.

regulation position, "firing standing," is generally preferred. Many find an easier and firmer position by bringing the left shoulder well to the front, and resting the rifle over the lower part of the left thumb. The advantage of this position is that it brings the left elbow directly under the barrel without any strain on the muscles. Its disadvantage is that, in a side wind, the body is too apt to sway sideways, which must be avoided by placing the feet further apart. The Hythe School directs that the rifle be pressed against the shoulder with the *left* hand, the right holding the stock lightly; but most marksmen prefer, while grasping the barrel firmly with the left hand, so as to keep it steady, to hold it well against the shoulder with the right. In The hips should be twisted to the left, and the right shoulder well raised, to keep the collar-bone out of the way and afford a firm seat for the rifle-butt, which must be held closely against it. Many of the best shots at Creedmoor and Wimbledon shoot, lying on their backs. Some lie slightly on the right side resting the rifle-barrel over the left leg, the left hand grasping the piece at the small of the stock, and pressing it against the shoulder. In this position, the distance of the rear sight from the eye requires a larger aperture than usual. The following is a favorite back position:—

The marksman lies on his back, his legs crossed, the left leg under the right knee, and firmly held by the right calf, the muzzle of the rifle resting in the



all cases, it will be found that the pull-off of the trigger will be lightened by a firm grip with the right thumb. The standing position depends so much on the personal equation of the marksman as to prevent that extreme nicety of aim required in long-range firing. It also renders the rifleman liable to be swerved by the wind, and offers the enemy a better target. It is seldom used before the enemy or at long-range. Kneeling is open to the same objections, but to a less extent. In the English army, crotch between the knees. The left arm is placed behind the head, the hand firmly grasping the butt of the rifle, the back of the head resting on the left forearm, and the right cheek touching the side of the butt. The right hand holds the small of the stock with a firm grasp, the elbow resting on the ground. In this position, not only the piece, but the entire person of the shooter is perfectly supported, and absolute steadiness is secured. Gildersleeve, Coleman, and other Americans have adopted this position, and

Sir Henry Halford and others at Wimbledon concede its advantages. It is doubtful whether any advantage is gained by lying on the back, in shooting with military rifles. The position, *Face Downwards*, is certainly preferable for military reasons, enabling the soldier to rapidly advance or retreat, to shelter himself behind cover or to entrench himself. Whether the-rifleman shoots standing, kneeling, sitting, or lying, after having once tested and become satisfied as to the position best suited to himself, he should practice it until it becomes perfectly natural and easy.

With a steady aim and position, the circumstances which cause the bullet to deviate from the spot at which it is aimed are so numerous, that it is rather the exception than the rule when a man can aim directly at the object to be struck. It is, therefore, necessary that the soldier should know how to make allowances for these causes of deviation; to know where he should aim in order to strike the object. A frequent cause of deviation of the bullet is a false or defective barrel, short swells and long depressions being often found on its interior. These swells or ridges, by increasing the friction, may so affect the recoil as to have an injurious effect on the fire, or so affect the exterior form of the bullet as to produce an irregularity in its motion. The swells and depressions, moreover, change the interior lines of the piece and give the bullet a false direction. Another cause of deviation of the bullet is the vibration of the barrel when firing caused by the want of a homogeneous distribution of metal about its axis, and often to binding bands. These vibrations tend to alter the direction of the bullet as it leaves the muzzle. Recoil causes the firer to turn to the side from which he fires, and produces deviation in that direction. It is supported by pressing the butt firmly against the shoulder, and is differently felt according as the position of the rifle, relatively to the horizontal, changes. The shock of the recoil against the shoulder is diminished by the bend in the stock, serving to decompose the force into two components, one acting through the stock against the shoulder, the other in the direction of the axis of the barrel, tending to raise it. Whatever lessens the recoil, theoretically, increases the range. The recoil is only 95 lbs. for the Remington rifle (70 grains powder and bullet of 450 grains), while in our service rifle, caliber 45, it is 175 lbs.

When the bullet reaches the muzzle of the rifle, it will revolve about its axis nearly 800 times in a second, and a point on its exterior side surface will have an axial velocity of about ninety feet per second. This, in connection with the resistance of the air produces a lateral drifting of the bullet in the direction in which the grooves have a turn. This is known as drift, and is greater in the descending than in the ascending branch of the trajectory. It increases as the diameter of the bullet, the angle of fire, the velocity of rotation and the range *increase*, and as the velocity of translation decreases. The drift in our service rifle, at 500 yards, is two feet. The pull of the trigger should not be too great, a *three-pound* pull being the minimum. It should be pressed by a steadily increasing pressure of the finger in the direction of the axis of the barrel, without communicating motion to the rifle, the breath being held until the hammer falls. If the trigger is too hard and is pulled convulsively, the muzzle will be turned to the right. There should be a quick and decided connection between the mind and finger. Few men can pull off the trigger of the service rifle with the first joint of a single finger. A defective position of the line of sight or incorrect graduation of the rear sight will cause a deviation of the bullet. If the front sight be to the right of its proper place, the bullet will go to the left, and *vice versa*. The bullet will also be raised (range increased), since the top of the sight is lower than it is when in its proper position. If the rear sight be to the right or left of its true place, the bullet will go to the right or left, and will be lowered (range diminished), since the top of the sight will be lower than when in its true position.

A serious cause of inaccuracy, originating with the firer, is the faulty position that he gives to the musket in firing, by inclining to the right or left, which tends to carry the bullet to the side to which the rifle is inclined, and to diminish the range. When firing at long ranges a trifling inclination to the right or left will throw the bullet very wide of the target. The condition of the atmosphere noticeably affects the course of the bullet. The more moisture there is in the air, the greater the elevation required; hence it is that the bullet is frequently noticed to fall immediately after a rain. Warm air offers much less resistance to the motion of the bullet than cold air does, even a fall of 20° in temperature causing the bullet, ordinarily, to lower ten or eleven inches at 300 yards range. In firing over water, the elevation must be increased, in consequence of the lower temperature of the air over the water. In ascending a mountain, the air becomes more and more rare, and consequently the resistance to the bullet is less on the mountain than at its base. Mirage, an optical illusion, occurring in level districts on very warm days, causes the target to apparently raise in the air and become distorted in shape. This materially affects such objects as are near the ground, and engenders a tendency to shoot too high.

The influence of light and shade on the effect of firing is remarkable. On a bright day the target is refracted so as to apparently stand higher, and will, theoretically, require a lower elevation than on a very dull day. When the light shines directly on the target, when the target is against a light background (so that the details are better brought out); when the sun shines on the firer's back, when the atmosphere is clear, when the ground is level and uniform in appearance or when it gradually rises toward the target, the same will appear much nearer, and will theoretically require a higher elevation. The best shooting is invariably done on cloudy days when the sun's light is evenly diffused. It is very difficult to shoot well when passing clouds intercept portions of the sun's light and heat. It is readily seen how this disturbance might set up currents in the air which would tend to carry the bullet from its course, and how the rays of light deflected from their course before reaching the eye would cause the target to apparently occupy a false position. It will be well to diminish the elevation should the sun suddenly appear and light up the target while the firer still remains in the shade, and to increase it should the target remain in the shade while the sun shines on the firer. Bright sights and barrels are obviously objectionable. The reflection of the sun's light on the sights causes them to appear as brilliant points and precludes the possibility of an accurate aim. If the sun's rays come laterally, the trouble will be still greater inasmuch as they will brighten the rear side of the front-sight and the opposite side of the notch of the rear-sight, and cause a tendency to shoot away from the sun. The refraction of the sun's rays from a polished barrel causes the target to become indistinct and to assume the appearance of motion. The sights and barrel about the muzzle should be blackened with smoke if nothing better is at hand.

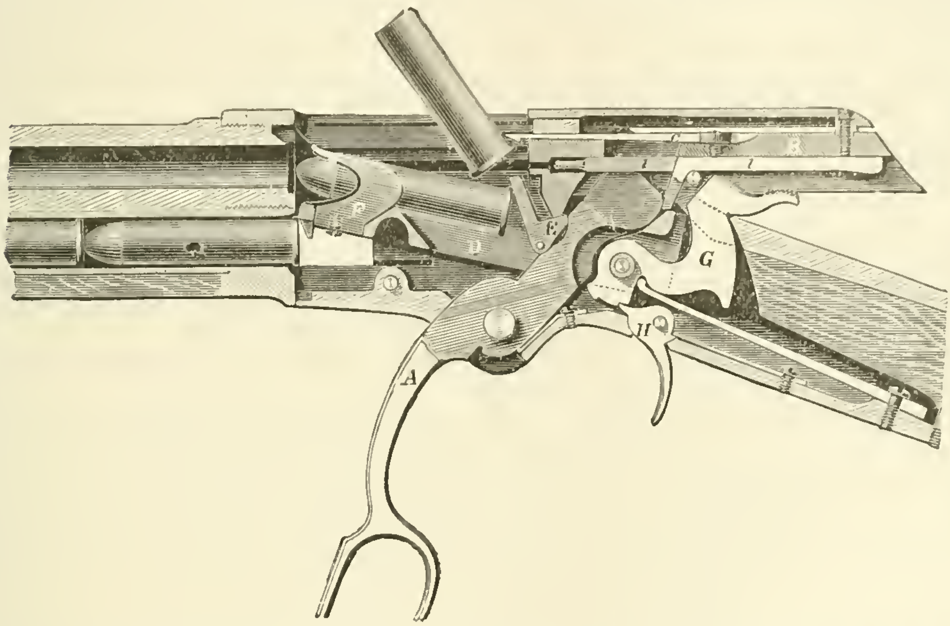
The effect of wind on the trajectory and the allowance to be made for it are most troublesome questions for the marksman. His best skill and judgment must be taxed when firing in windy weather, or in mountainous districts where there are many cross-currents with which to contend. All winds, except toward the target, retard the bullet and render a higher elevation necessary. A wind from the rear helps the bullet and tends to high shooting. Experience has shown it necessary to alter the wind-gauge twelve or more feet between two consecutive shots over a range of 1,000 yards, in order to make a bull's eye each time, when the wind was very high or variable. In Busk's 'Hand-book for Hythe' it is stated that "One hour a day of private practice in aiming-drill will, in a few weeks, make a man a first-class shot." This is true, for the position and aiming drills constitute the very foundation of any system of practice. It is an absurd mistake in any service to have recruits fire off-hand at a target one hundred yards distant, when they scarcely know the difference between a rifle and a shotgun, and cannot hit a barn-door when thirty paces distant with either. See *Rifle Practice.*

MARK TIME.—A command in the School of the Soldier. It is executed by moving each leg alternately in quick or ordinary time, without gaining ground. This movement is frequently practiced when a front line or column has opened too much, in order to afford the rear an opportunity of getting up; and sometimes to let the head of a column disengage itself, or a body of troops file by, etc.

MARLINE SPIKE.—A ponderous iron pin, with a large head and a taper point, used for separating the strands of rope preparatory to splicing or knotting; also employed as a lever in tightening rigging, etc.

MARLIN REPEATING RIFLE. An American rifle having notable advantages over most repeating arms. It belongs to the *bolt* class, so long used by many of the European Governments; but instead of operating the bolt by a cumbersome and ungainly handle projecting from the side, it is operated by a strong and powerful lever, on the under side of the arm, thus making a handsome model, easy of manipulation. The bolt comes solidly up to the base of the cartridge, covering it entirely; in this way all danger is avoided, even though a defective cartridge should happen to be used. A premature explosion cannot occur, and the greater the recoil, the more firmly the bolt is held in its place. The operation of the gun is of the simplest kind, and yet the action is the strongest that can be made. The drawing shows the rifle with all the operative parts in open position. Throwing forward the lever, A, withdraws the firing-pin, I, unlocks the bolt, B, and causes it to recede, carrying with it the extractor, C, which extracts the shell of the cartridge just fired, while the ejector E, attached to the lower section of the bolt, ejects the same from the receiver. By the same motion, the carrier-block, D, is raised from its natural position, in a simple manner, brings the cartridge with it, and places the same in line with tha chamber of the barrel, while the spring F firmly holds cartridge in place. The hammer, G, is brought to full-cock by the same motion, and held there by the action of the trigger, H, entering its full-cock notch. Bringing the lever back to its natural position causes the bolt to move forward, pushes the cartridge into the chamber, lowers the carrier-block to receive a fresh cartridge, securely locks the breech mechanism, and leaves the arm ready to fire.

The magazine is loaded through an opening in the side of the receiver, which opening is closed by a cover. It holds nine cartridges and one can be placed in the barrel. The cartridges can be inserted in the magazine either with the block open or closed. When the bolt is withdrawn the cartridge at the bottom of the magazine enters the carrier-block *gradually*, avoiding the concussion produced in many guns by the sudden jump of the whole column of cartridges with a momentum, in some cases, sufficient to explode a sensitive primer. All the advantages of a single breech-loader are also contained in this rifle; it can be used with great rapidity, the cartridge being inserted in the barrel instead of in the magazine, and cartridges specially loaded with patched bullets for target shooting can be used in this way. The rifle is made for two sizes of cartridges: 40 cal., 60 grains powder, 260 grains lead, straight shell; and 45 cal., 70 grains powder, 420 grains lead, being the regulation Government cartridge. In the 40 caliber we find a heavy charge of powder behind a comparatively light bullet, thus attaining a high initial velocity and very flat trajectory; with excellent results up to 800 yards. The barrel is octagonal in cross section, is 28 inches long, and the weight of the arm is 9½ pounds. See *Rifle.*



MARLINS.—Tarred white skeins or long wreaths or lines of untwisted hemp dipped in pitch or tar, with which cables and other ropes are wrapped round, to prevent their fretting and rubbing in the blocks or pulleys through which they pass. The same serves in artillery upon ropes used for rigging gins, usually put up in small parcels called skeins.

MAROLAIS SYSTEM OF FORTIFICATION.—This system adopts the fausse-braye, and the flanks are retired and casemated. It is a very fair sample of the *Dutch School.* See *Fortification.*

MARON.—A piece of brass or copper, about the size of a crown, on which all the hours for going the rounds were marked in the old French service. Several of these were put into a small bag, and deposited in the hands of the Major of the regiment, out of which they were regularly drawn by the Sergeants of Companies, for the officers belonging to them. The hours and half hours were engraved on each *Maron*. These pieces were numbered one, two, etc., to correspond with the several periods of the night; so that the officer, for instance, who was to go to the 10 o'clock rounds, had as many *Marons* marked ten as there were posts or guard-houses which he was directed to visit. Thus on reaching the first, after having given the *mot* or watch-word, to the Corporal, he delivers into his hands the *Maroon* marked one. These *Marons* being pierced in the middle are successively strung by the different Corporals upon a piece of wire, from which they slide into a box called *Boite aux Rondes*. This box is carried next morning to the Major, who keeps the key; and who on opening it can easily ascertain whether the rounds have been regularly gone by counting the different *Marons*, and seeing them successively strung.

MAROONS..—A name given in Jamaica and Dutch Guiana to runaway negro slaves. The term was first applied to those slaves who were deserted by their Masters, the Spaniards, when the British conquered Jamaica (1655), and who took refuge in the Uplands, where for 140 years they maintained a constant warfare with the British Colonists; but in 1795 they were subdued, and a portion of them removed to Nova Scotia, and afterwards to Sierra Leone. The remnant fraternized with their manumitted brethren in 1834-35. The Maroons of Dutch Guiana form a number of small independent communities.

MARQUEE.—An awning or cover of canvas forming an officer's tent; a tent complete. Marquees are of two kinds, viz., *Dining and Sleeping Marquees*: the former being used as officers' mess tents. Also written *Markee*.

MARQUESS—MARQUIS.—The degree of nobility which in the peerage of England ranks next to Duke. Marquises were originally Commanders on the borders or frontiers of countries, or on the sea-coast, which they were bound to protect. In England, the title of Marquis was used in this sense as early as the reign of Henry the III., when there were Marquises or Lords-marchers of the borders of Scotland and Wales: and the foreign equivalent of *Markgraf* was common on the Continent. The first English Marquis in the modern sense was Robert de Vere, Earl of Oxford, who was created Marquis of Dublin by Richard II., to the no small offense of the Earls who had to yield him precedence. The oldest existing Marquisate is that of Winchester, created by Edward VI. in 1551. The title was first introduced into Scotland in1599, when the Marquises of Huntly and Hamilton were created.

The Coronet of a Marquis, as worn in the United Kingdom, is a circle of gold, with four strawberry leaves (or oak leaves), and as many pearls alternating with them, and placed on pyramidal points of the same height with the leaves. The mantle is scarlet, with three and a half doublings of ermine. A Marquis is styled "The Most Honorable;" his wife is a Marchioness; his eldest son takes by courtesy the next lower title in the peerage, except where that is identical with the title of the Marquisate, in which case he must take the next lower still, as in the case of the Marquis and Earl of Salisbury, whose eldest son bears the courtesy-title of Viscount Cranborne. The younger sons of a Marquis are styled 'Lord,' and daughters 'Lady,' with the addition of Christian name and surname.

MARRIED ROLL.—A register kept in each regiment, troop, battery, or establishment, in the English Army, and in which are inserted the names of all non-commissioned officers and soldiers who are married with permission. All non-commissioned officers holding the rank of Staff Sergeants of certain grades are permitted to marry, and also Sergeants of troops, batteries, or companies, &c., in a certain proportion, as laid down in the Regulations. Of the rank and file, 7 per cent. in England and 10 per cent. in India are allowed to marry, and are entered on the married roll; these numbers are calculated upon the establishment of the corps, except in the royal artillery, in which the calculation is made upon the establishment of each battery. No non-commissioned officer or soldier is entitled to have his name placed on the married roll without having obtained the consent of his Commanding Officer before marriage. In the case of a soldier below the rank of Sergeant wishing to marry, he must have completed 7 years' service and be in possession of at least one G. C. badge. If he has a balance in the savings-bank of £5 or upwards, it will be considered a desirable qualification. The fact of the name of a non-commissioned officer or soldier appearing on the married roll ensures him and his family certain privileges which are not accorded to men marrying without the consent of their Commanding Officer.

MARRONS.—Small cubic boxes, made of pasteboard, filled with powder, and wrapped with strong twine. They are used to give a loud report, or the effect of cannonading. To make a marron, cut the pasteboard into rectangles, whose sides shall be 3 and and 5 times, respectively, the length of the side of the marron required. Divide the rectangle into 15 equal squares; cut out the squares forming the four corners of the rectangle, and divide the three remaining squares on the long side from each other by a cut the length of their side and perpendicular to the long side of the rectangle. Form a small cubic box with the pasteboard thus cut out; paste the squares together which cover each other, and paste a band of paper around the box, leaving the cover open. When dry, fill the box with powder, paste down the cover, and envelop it with two or three layers of strong twine. Cover the marron with glue or kit, and prime it with quick-match inserted in a hole punched into the powder at the middle of one of the faces. See *Compositions* and *Fireworks*.

MARRUCINI.—An ancient people in central Italy, on a narrow tract of land along the right bank of the river Aternus. Their territory extended from the Apennines to the Adriatic: between the Vestini on the north and the Frentani on the south; and between the Peligni and the Adriatic on the east and west. They were an independent nation, said to be descended from the Sabines, and generally were in alliance with their neighbors, the Marsi and Peligni. They entered into alliance with the Romans in 304 B. C, but rebelled at the beginning of the Social War. Their only place of importance was Teste, now Chieti, on the right bank of the Aternus, now the Pescara.

MARS.—The Roman Mars, who as a war-god is surnamed *Gradivus* (=*grandis divus*, the great god), also bore the surname of *Silvanus*, and appears to have been originally an agricultural deity; the propitiatory offerings were presented to him as the guardian of fields and flocks; but as the fierce shepherds who founded the city of Rome were even more addicted to martial than to pastoral pursuits, one can easily understand how *Mars Silvanus* should have, in the course of time, become the "God of War." Mars, who was a perfect personification of the stern, relentless, and even cruel valor of the old Romans, was held in the highest honor. He ranked next to Jupiter; like him he bore the venerable epithet of *Father* (Mars-*piter*); he was one of the three Tutelary Divinities of the City, to each of whom Numa appointed a flamen; nay, he was said to be the father of Romulus himself (by Rhea Silvia, the Priestess of Vesta), and was thus believed to be the real progenitor of the Roman people. He had a sanctuary on the Quirinal; and the hill received its name from his surname, *Quirinus*, the most probable meaning of which is *the spear-armed*. It was under this designation that he was invoked as the protector of the *Quirites* (citizens) in other words, of the State. The principal animals sacred to him were the wolf and the horse. He had many Temples at Rome, the most celebrated of which was that outside the *Porta Capena*, on the Appian Road. The *Campus Martius*, where the Romans practiced athletic and military exercises, was named after him; so was the month of March (*Martius*), the first month of the Roman year. The *Ludi Martiales* (games held in his honor) were celebrated every year in the circus.

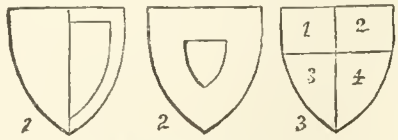
Ares, the Greek god of war, was the son of Zeus and Hera, and the favorite of Aphrodite, who bore him several children. He is represented in Greek poetry as a most sanguinary divinity, delighting in war for its own sake, and in the destruction of men. Before him into battle goes his sister *Eris* (Strife); along with him are his sons and companions, *Deimos* (Horror) and *Phobos* (Fear). He does not always adhere to the same side, like the great *Athena*, but inspires now the one, now the other. He is not always victorious. Diomede wounded him, and in his fall, says Homer, "he roared like nine or ten thousand warriors together." Such a representation would have been deemed blasphemous by the ancient Roman mind, imbued as it was with a solemn Hebrew-like reverence for its gods. The worship of Ares was never very prevalent in Greece; it is believed to have been imported from Thrace. There, and in Scythia, were its great seats, and there Ares was believed to have his chief home. He had, however, Temples or Shrines at Athens, Sparta, Olympia, and other places. On statues and reliefs, he is represented as a person of great muscular power, and either naked or clothed with the chlamys.

MARSEILLAISE.—The name by which the grand song of the first French Revolution is known. The circumstances which led to its composition are as follows: In the beginning of 1792, when a column of volunteers was about to leave Strasbourg, the Mayor of the city, who gave a banquet on the occasion, asked an officer of artillery named Rouget de Lisle, to compose a song in their honor. His request was complied with, and the result was the *Marseillaise*—both verse and music being the work of a single night. De Lisle entitled the piece *Chant de Guerre de l'Armée du Rhin*. Next day it was sung with rapturous enthusiasm that only Frenchmen can exhibit, and instead of 600 volunteers, 1000 marched out of Strasbourg. Soon from the whole army of the north resounded the thrilling and fiery words *aux armes aux armes*; nevertheless the song was still unknown at Paris, and was first introduced there by Barbaroux when he summoned the youth of Marseilles to the Capital in July, 1792. It was received with transports by the Parisians, who—ignorant of its real authorship—named it *Hymne des Marseillaise*, which name it has ever since borne.

MARSHAL.—A term which originally meant a groom or manager of the horse, though eventually the King's Marshal became one of the principal Officers of State in England. The Royal Farrier rose in dignity with the increasing importance of the *Chevalerie*, till he became, conjointly with the Constable, the judge in the *Curiæ Martiales*, or Courts of Chivalry. An Earldom is attached to the dignity, and the office of Earl-Marshal is now hereditary in the family of the Duke of Norfolk. When the King headed his army in feudal times, the assembled troops were inspected by the Constable and Marshal, who fixed the spot for the encampment of each noble, and examined the number, arms, and condition of his retainers. With these duties was naturally combined the regulation of all matters connected with armorial bearings, standards, and ensigns. The Constable's functions were virtually abolished in the time of Henry VIII., and the Marshal became thenceforth the sole judge in questions of honor and arms. The Earl-Marshal is president of the English college of arms, and appoints the Kings-at-Arms, Heralds, and Pursuivants. The Marshal's functions were formerly exercised in time of peace in the *Aula Regis* or King's Great Court, and on the division of the *Aula Regis*, he appointed deputies in the new courts; hence arose the offices of Marshal of the King's (Queen's) Bench, and of Exchequer, whose principal duty is to take charge of persons committed to their custody by the court. Besides the Earl-Marshal there is a Knight-Marshal, or Marshal of the King's (Queen's) household. The Marshal of the King's Bench held two different courts, which have been altogether discontinued since 1849. The Marshal, or Provost-Marshal, of the admiralty is an officer whose duty it is to act ministerially under the orders of the court of admiralty in securing prizes, executing warrants, arresting criminals, and attending their execution.

The dignity of Marshal existed formerly in Scotland, where a different orthography was adopted, and the office of Marischal was hereditary in the family of Keith. Sir Robert Keith, the Marischal, was one of the most distinguished warriors in the army of Robert the Bruce; and his descendant, the Marischal in 1456, had the dignity of Earl conferred on him with no other title but that of Earl-Marischal. There is little doubt that the Lyon King-at-Arms was, like the English Kings-at-Arms, originally subject to the Marischal, but his dependence ceased at a very early period, and the heraldic functions discharged by the Earl-Marshal in England devolved in Scotland on the Lord Lyon, who held office directly from the crown. Scotland had no Knight-Marischal till 1633, when Charles I., at his coronation, created the office. In 1716 George, tenth Earl-Marischal, was attainted in consequence of his share in the rebellion of the previous year, and the office has since been in abeyance. In France the highest military officer is called a Marshal, a dignity which originated early in the 13th century. There was at first only one *Maréchal de France*, and there were but two till the time of Francis I. Their number afterwards became unlimited. Originally the Marshal was the Esquire of the King, and commanded the vanguard in war; in later times the command became supreme, and the rank of the highest military importance. From the title of this class of general officers the Germans have borrowed their Feld-Marschall, and we our Field-Marshal, a dignity bestowed on commanders distinguished either by elevated rank or superior talents. In the United States the word is used in three significations: 1. To denote the Ministerial Officer of the United States Courts, there being one appointed to each judicial district. The duties of this officer resemble those of a Sheriff in the State Courts; he opens and closes the sessions of the District and Circuit Courts, serves warrants, and with his deputies enforces the execution of the internal revenue and other U. S. Statutes. 2. To denote a leader or director of ceremonies, festivities, or processions. 3. In many states of the south and west the Marshal is the head of the municipal police force, and is to be distinguished from the officers of the county called Sheriffs, and from the officers of the justice courts called Constables. In a few northern cities, formerly the name was applied with doubtful propriety to special police officers.

MARSHALLING OF ARMS.—The combining of different coats-of-arms in one escutcheon, for the purpose of indicating family alliance or office. In the earlier heraldry, it was not the practice to exhibit more than one coat in a shield, but the arms of husband and wife were sometimes placed *accollée*, or side by side, in separate escutcheons; or the principal shield was surrounded by smaller ones, containing the arms of maternal ancestors; and we not unfrequently find maternal descent or marriage indicated by the addition of some bearing from the wife's or mother's shield. Then followed *dimidiation*, where the shield was parted per pale, and the two coats placed side by side, half of each being shown. By the more modern custom of impaling (Fig. 1), the whole of each coat is exhibited, a reminiscence of the older practice being retained in the omission of bordures, orels, and tressures on the side bounded by the line of impalement. The most common case of impalement



Marshalling of Arms.

ment is where the coats of husband and wife are conjoined, the husband's arms occupying the dexter side of the shield, or place of honor, and the wife's the sinister side. Bishops, Deans, Heads of Colleges, and Kings-of-Arms, impale their arms of office with their family coat, giving the dexter side to the former. A man who marries an heiress (in heraldic sense) is entitled to place her arms on a small shield called an *escutcheon of pretence*, in the center of his achievement, instead of impaling (Fig. 2.). *Quartering* (Fig. 3), or the exhibiting different *coats* on a shield divided at once perpendicularly and horizontally, is the most common mode of marshalling arms, a practice which, however, was unknown till the middle of the 14th century. The divisions of the shield are called quarters, and are numbered horizontally, beginning at the dexter chief. The most common object of quartering is to indicate descent. The coats quartered in an escutcheon must all have been brought in by successive heiresses, who have intermarried into the family. In the case of a single quartering the paternal arms are placed in the first and fourth quarters, and the maternal in the second and third. The third and fourth quarters may, in after generations, be occupied by the arms of a second and third heiress. Sometimes an already quartered coat is placed in one of the four quarters of the escutcheon, then termed a grand quarter. We occasionally find the shield divided by perpendicular and horizontal lines into six, nine, or even more parts, each occupied by a coat brought in by an heiress; and in case of an odd number of coats, the last division is filled by a repetition of the first. In the course of generations, a shield may thus be inconveniently crowded by the accumulation of coats, including the several coats to which each heiress may, in a similar way, have become entitled, and in Germany, sometimes twenty or thirty coats are found marshalled in one escutcheon; but in British Heraldry, families entitled to a number of quarterings, generally select some of the most important. Quarterings, at least in Scotland, are not allowed to be added to the paternal coat without the sanction of the heraldic authorities. Sovereigns quarter the ensigns of their several States, giving precedence to the most ancient, unless it be inferior to the others in importance. In the royal escutcheon of the United Kingdom, England is placed in the first and fourth quarters, Scotland in the second, and Ireland in the third; the relative positions of Scotland and England being, however, reversed on the official seals of Scotland. Spain bears the arms of Leon in the first and fourth quarters, and Castile in the second and third. An elected King generally places his arms surtout on an escutcheon of pretence.

MARSI.—An ancient tribe of central Italy, inhabiting the district around the lake Fucinus (*Lago di Celano*). Their origin, like that of other Italian tribes, is involved in obscurity and fiction. They were probably of Sabine origin. They are worthy of notice chiefly on account of their warlike spirit. The Marsians were at one time allies of the Romans, but, in 308 B. C., they revolted and joined the Samnites. After being subdued they again, 301 B.C., shook off the alliance of Rome, but were beaten in the field, and lost several of their fortresses. From this time they continued the firm allies of Rome, contributing by their valor to her triumphs until the Italians were aroused in 91 B.C., to demand a redress of their wrongs and a share in the privileges of Roman citizens. A war ensued, generally known as the Social War, but frequently called the Marsic War, because the Marsi were prominent among the malcontents. Their leader was Silus Pompædius. Though often defeated, their perseverance gained the object for which they had taken up arms in 87 B.C. The Marsians, inhabiting a mountainous district were simple and temperate in their habits, but hardy, brave, and unyielding. So marked was their valor that there was a proverbial saying recorded by Appian, "That Rome had achieved no triumph *over* the Marsi, or *without* the Marsi." The ancient Marsi were represented as enchanters, able to tame serpents and to heal their bites; and it is worthy of note that the jugglers who now amuse the people by handling serpents are natives of the region in the vicinity of *Lago di Celano*. Their only important town was *Marruvium* (San Benedetto), the ruins of which are visible on the east shore of the lake.

MARTEAU D'ARMES.—An offensive weapon, so-called from its resemblance to a hammer.

MARTEL DE FER.—An offensive weapon in use at the beginning of the 13th century. It was in the shape of a pointed hammer or small pickaxe. It is stated to have made sad havoc in mail or armor, and left fatal openings for the passage of the sword or lance.

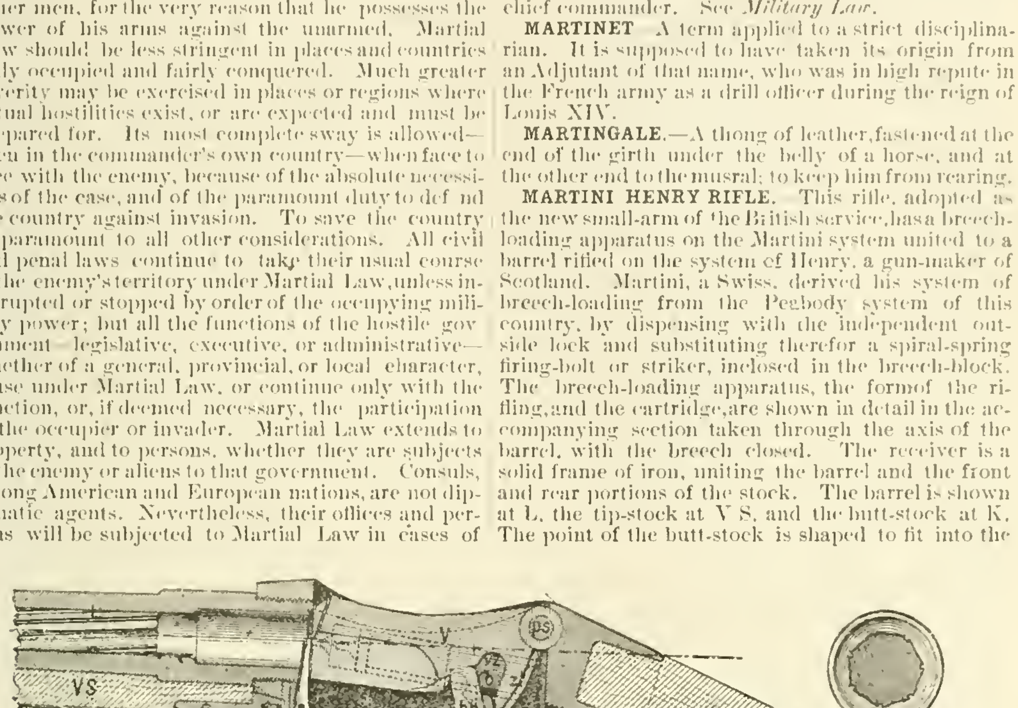
MARTELLO TOWERS—are round towers for coast defense, about 40 feet high, built most solidly, and situated on the beach. They occur in several places round the coast of the United Kingdom; but principally opposite to the French coast, along the southern shore of Kent and Sussex, where, for many miles, they are within easy range of each other. They were mostly erected during the French war as a defense against invasion. Each had walls of 5½ feet thickness, and was supposed to be bomb-proof. The base formed the magazine; above were two rooms for the garrison, and over the upper of these the flat roof, with a 4½ feet brick parapet all round. On this roof a swivel heavy gun was to be placed to command shipping, while howitzers on each side were to form a flanking defense in connection with the neighboring towers. Although the cost of these little forts was very great, they are generally considered to have been a failure; their armaments have mostly been removed. The name is said to be taken from Italian towers built near the sea, during the period when piracy was common in the Mediterranean, for the purpose of keeping watch and giving warning if a pirate-ship was seen approaching. This warning was given by striking on a bell with a hammer (Italian *Martello*), and hence these towers were called *torri da martello*.

MARTIAL LAW.—An arbitrary law, proceeding directly from the military power, and having no immediate constitutional or legislative sanction. A place, district, or country occupied by an enemy stands, in consequence of the occupation, under the Martial Law of the invading or occupying Army, whether any proclamation declaring Martial Law, or any public warning to the inhabitants, has been issued or not. Martial Law is the immediate and direct effect and consequence of occupation or conquest. The presence of a hostile army proclaims its Martial Law. Martial Law does not cease during the hostile occupation, except by special proclamation, ordered by the commander-in-chief; or by special mention in the treaty of peace concluding the war, when the occupation of a place or territory continues beyond the conclusion of peace as one of the conditions of the same. Martial Law in a hostile country consists in the suspension, by the occupying military authority, of the criminal and civil law, and of the domestic administration and government in the occupied place or territory, and in the substitution of military rule and force for the same, as well as in the dictation of general laws, as far as military necessity requires this suspension, substitution, or dictation. The commander of the forces may proclaim that the administration of all civil and penal law shall continue, either wholly or in part, as in times of peace, unless otherwise ordered by the military authority. Martial Law is simply military authority exercised in accordance with the laws and usages of war. Military oppression is not Martial Law; it is the abuse of the power which that law confers. As Martial Law is executed by military force, it is incumbent upon those who administer it to be strictly guided by the principles of justice, honor, and humanity—virtues adorning a soldier even more than other men, for the very reason that he possesses the power of his arms against the unarmed. Martial Law should be less stringent in places and countries fully occupied and fairly conquered. Much greater severity may be exercised in places or regions where actual hostilities exist, or are expected and must be prepared for. Its most complete sway is allowed—even in the commander's own country—when face to face with the enemy, because of the absolute necessities of the case, and of the paramount duty to defend the country against invasion. To save the country is paramount to all other considerations. All civil and penal laws continue to take their usual course in the enemy's territory under Martial Law, unless interrupted or stopped by order of the occupying military power; but all the functions of the hostile government—legislative, executive, or administrative—whether of a general, provincial, or local character, cease under Martial Law, or continue only with the sanction, or, if deemed necessary, the participation of the occupier or invader. Martial Law extends to property, and to persons, whether they are subjects of the enemy or aliens to that government. Consuls, among American and European nations, are not diplomatic agents. Nevertheless, their offices and persons will be subjected to Martial Law in cases of mainly to the support and efficiency of the Army, its safety, and the safety of its operations. The law of war does not only disclaim all cruelty and bad faith concerning engagements concluded with the enemy during the war, but also the breaking of stipulations solemnly contracted by the belligerents in time of peace, and avowedly intended to remain in force in case of war between the contracting powers. It disclaims all extortions and other transactions for individual gain; all acts of private revenge, or connivance at such acts. Offenses to the contrary shall be severely punished, and especially so if committed by officers. Whenever feasible, Martial Law is carried out in cases of individual offenders by Military Courts; but sentences of death shall be executed only with the approval of the chief executive, provided the urgency of the case does not require a speedier execution, and then only with the approval of the chief commander. See *Military Law*.

MARTINET A term applied to a strict disciplinarian. It is supposed to have taken its origin from an Adjutant of that name, who was in high repute in the French army as a drill officer during the reign of Louis XIV.

MARTINGALE.—A thong of leather, fastened at the end of the girth under the belly of a horse, and at the other end to the musrol; to keep him from rearing.

MARTINI HENRY RIFLE. This rifle, adopted as the new small-arm of the British service, has a breech-loading apparatus on the Martini system united to a barrel rifled on the system of Henry, a gun-maker of Scotland. Martini, a Swiss, derived his system of breech-loading from the Peabody system of this country, by dispensing with the independent outside lock and substituting therefor a spiral-spring firing-bolt or striker, inclosed in the breech-block. The breech-loading apparatus, the form of the rifling, and the cartridge, are shown in detail in the accompanying section taken through the axis of the barrel, with the breech closed. The receiver is a solid frame of iron, uniting the barrel and the front and rear portions of the stock. The barrel is shown at L, the tip-stock at V S, and the butt-stock at K. The point of the butt-stock is shaped to fit into the



urgent necessity only; their property and business are not exempted. Any delinquency they commit against the established military rule may be punished as in the case of any other inhabitant, and such punishment furnishes no reasonable ground for international complaint. The functions of Ambassadors, Ministers, or other diplomatic agents, accredited by neutral powers to the hostile government, cease, so far as regards the displaced government; but the conquering or occupying power usually recognizes them as temporarily accredited to itself. Martial Law affects chiefly the police and collection of public revenue and taxes, whether imposed by the expelled government or by the invader, and refers rear end of the receiver, which is cupped to receive it; it is fastened to the receiver by the longitudinal screw-bolt, K S, in the manner shown in the drawing. The several parts of the breech system may be divided into two groups, viz: 1. The falling breech-block and the firing apparatus contained in it; 2. The trigger and other parts attached to the trigger-plate, and the extractor. The breech-block is pivoted at its rear and upper portion, and in uncovering the chamber of the barrel for the purpose of loading, its front portion falls. The axis-pin, *p s*, around which the block turns is made of hard bronze. The portion of the collar surrounding this pin is embedded in the receiver and constitutes the principal recoil-bearing surface of the block. As this surface is above the axis of the bore, prolonged to the rear, there is a downward pressure of the block at the moment of explosion. This pressure is resisted by the short arm of the lever, *b h*, and the block thereby secured in its place. This lever, called the block-lever, is composed of two arms, and turns round the pin, *n w*. The short arm of the block-lever is divided into two branches. The long arm serves as a handle by which the block is worked, and when closed its point enters a countersink, and is held in place by a small catch-pin. The short arm of the block-lever works in a cut on the lower side of the breech-block. This cut is so shaped that the points of the branches of the short arm working against its sides raise and lower the block and lock it. The drawing shows the block in the locked position. The lever-pin passes through both cheeks of the receiver, and is secured to the left cheek by a small screw, the head of which enters a groove in the point of the pin.

The firing-bolt, or striker, lies in a hole extending nearly through the center of the breech-block. It is composed of its point, which projects through a corresponding opening in the head of the block; a collar, which serves as a shoulder for the spiral mainspring to press against, and the body enveloped by this spiral spring. The rear portion of the striker has a vertical slot, in which works the point of a lever to draw back the striker to the position of full cock. This lever is called the tumbler. The rear end of the striker has a slot in it, that it may be adjusted by a screw-driver to receive the point of the tumbler. The striker is kept in place by a nut screwed into the rear end of the breech-block. The tumbler is pivoted on the same axis-pin as the locking-lever, *n w*, and is placed between its two branches. To show when the striker is at full cock, the end of the lever-pin, *n w*, has an index-arm, which lies on the right side of the receiver and turns with the tumbler. It is for this purpose that the portion of the pin on which the tumbler fits is made square. The tumbler, when at full cock, is supported on a rocker, called the tumbler-rest. The nose of the trigger, in turn supports the tumbler-rest at *r*. The tail-piece of the tumbler-rest bears against the back of the trigger when the latter is pulled. The trigger-spring is shown in, *d f*. To prevent accidents when the piece is carried loaded, the trigger is secured in place by the trigger-bolt, which is slid back and forth by pressing on the finger-piece. When locked, the bolt fits into a notch, and is kept in place by a spring.

The extractor, *e*, is a bent lever pivoted at *e s*. Its vertical arm is composed of two branches with points which hook under the rim of the cartridge to extract the shell. The horizontal arm is shaped to receive the downward pressure of the breech-block on its point and start the shell from the chamber. As soon as the shell has moved slightly the point of the breech-block strikes the arm near the fulcrum, and ejects the shell with force from the piece. The form of the rifling is shown in the drawing. The number of grooves is seven; in shape they are flat at the bottom; the lands are narrow, having the appearance of sharp ribs, which are designed to take a firm hold of the bullet. It is understood that these grooves are made somewhat deeper at the breech than at the muzzle. Twist is one turn in 22 inches. There is a brass collar around the head of the ramrod to prevent injury to the bore in wiping out. The triangular bayonet is issued with all arms to private soldiers. The sword-bayonet is issued to non-commissioned officers.

The weight of the Martini-Henry rifle is 8½ pounds; of the present bayonet 13½ ounces; of the new bayonet, 14 ounces; of the old scabbard, 6 ounces; of the new scabbard, 4½ ounces. The weight of the rifle with a new bayonet attached is 9 pounds 11 ounces; with the old bayonet, 9 pounds 11½ ounces.

The cartridge adopted for the Martini-Henry rifle is made of wrapped metal, after what is known in England as the Boxer system. Each cartridge is composed of some fourteen distinct pieces, as shown in section. The body of the shell is made by wrapping a trapezoidal piece of thin sheet-brass around a cylindrical former, making a tube. One end of this tube is turned inward to form an interior flange for securing the shell to its head, the other end is reduced in diameter to fit the cylindrical portion of the bullet. A piece of thin paper is rolled up with the brass sheet for a lining to the shell to protect it against the action of the powder. The head of the shell is made of a perforated sheet-iron disk, *t*, two re-enforcing cups of thin sheet-brass, *k*, the anvil-pocket, *g*, made of copper, and a paper wad, *c*. The relative positions of these pieces are shown in the sectional figure, and they are held together by the anvil-pocket and the paper wad, which is pressed into its place with great force under the head of the anvil-pocket, while the open end of the pocket is riveted to the disk.

The shell is primed by inserting into the anvil-pocket from the outside a primer composed of a percussion-cap of copper, *z*, and containing an anvil, *a*, also of copper. The bottom of the anvil-pocket has a small hole for the passage of the flame from the fulminate of the primer when it is exploded.

The bullet, *c*, is of cylindro-conoidal form, made of lead hardened by an admixture of one-thirteenth part of tin. The bullet is slightly cupped at the base, and has around it a slight groove, *r*, *r*, or cannelure, into which the cartridge-shell is choked to hold the bullet in place. The bullet is enveloped in a patch of thin paper, similar to that used for bank-notes. The lubricating material is a bee's-wax wad, *w d*, lying between the powder and bullet. This wad is separated from the powder by a stout paper disk (jute), and from the bullet by two disks of the same material. The weight of the bullet is 480 grains, and the powder is similar in quantity to that known as No. 6, Curtis and Harvey's make, and weighs 85 grains. These cartridges can be reprimed and reloaded.

Since the Martini-Henry rifles have been placed in the hands of the troops certain defects have been developed, and the necessary alterations have been made to correct them. The most serious defect appears to have been the recoil, or "kick," of the arm, extending, according to the newspaper accounts, so far as to disable soldiers after firing a series of not more than one hundred shots. The cause of this severe recoil is attributed to the great weight of the charge (powder and bullet) in proportion to the weight of the arm. The prominence of the stock in rear of the breech-frame contributes to the inconvenience of the recoil by striking against the face of the firer, if care be not taken to hold the piece properly. The injurious effect of the recoil is found to be the greatest with soldiers not accustomed to the use of the new arm, and diminishes as they become more accustomed to it. To remedy the evil as far as practicable, it has been decided to lengthen the butt of the stock. Originally the distance from the trigger to the middle point of the butt-plate was 13 and 14 inches, and the two kinds of rifles were issued to the troops in the proportion of two of the former to one of the latter length. The corresponding distances now are about 14 inches and 14½ inches, and the change is said to have gone quite far toward remedying the evil. To protect the left hand from the heat of the barrel in rapid firing the portion of the barrel embraced by the hand is covered with a leather shield strapped and buckled on. The butt-plates were formerly roughed by cross-hatching with a file to give a firmer hold against the shoulder. This has been dispensed with as unnecessary, and the surface is now left smooth. The locking-bolt has also been dispensed with as unnecessary, and the block axis-pin is countersunk and made of steel instead of hard bronze. The strikers having been found to break, have been materially strengthened. The plan of screwing in the point of the ramrod to hold it in its place has been changed to a shoulder resting against a stop, which is strongly secured to the stock below the tip, somewhat after the American plan.

The carbines of the cavalry and artillery patterns have the same caliber as the Martini-Henry rifle, and have also the same twist and form of rifling, but the barrels are only 19 inches in length. The weight of the cavalry carbine is 7 pounds, 8 ounces, and that of the artillery carbine is 7 pounds, 10¾ ounces. Total length, 3 feet, 1¼ inches. See *Boxer Cartridge*, *Peabody-Martini Rifle*, and *Royal Small arms*.

MARTIN SHELL.—A very ingenious substitute for a red-hot shot, to which, as far as experience has gone, it is much superior. It is an ordinary shell furnished with an iron screw stopper. Molten iron is poured into the shell, the stopper screwed in, and the missile discharged for incendiary purposes.

Martlet.

MARTLET.—In Heraldry, a bird resembling a swallow, with long wings, very short beak and thighs, and no visible legs, given as a mark of cadency to the fourth son. It is also otherwise used as a charge. The martlet was originally meant for the martin, and in the earliest Heraldry, it is not deprived of its feet.

MASCLE.—In Heraldry, a lozenge-shaped figure perforated and showing a very narrow border. The term *mascally* is as a general thing applied to any field that is divided by diagonal lines into lozenge-shaped compartments of alternate tinctures, each having its center voided of the opposite tincture. *Lozengy-mascally* is a field composed of lozenges and mascles alternately. In the earlier Heraldry, mascally was used for what was afterwards callen lozengy. Crosses and other ordinaries may be formed of mascles, in which case they should begin with half a mascle. See *Heraldry*.

Mascle.

MASCLED ARMOR.—A kind of armor sometimes worn by the Norman soldiers, composed of small lozenge-shaped plates of metal fastened on a leathern or quilted under-coat.

MASK.—1. In a permanent fortification, a casemated redoubt, one or two stories high and 12 yards in

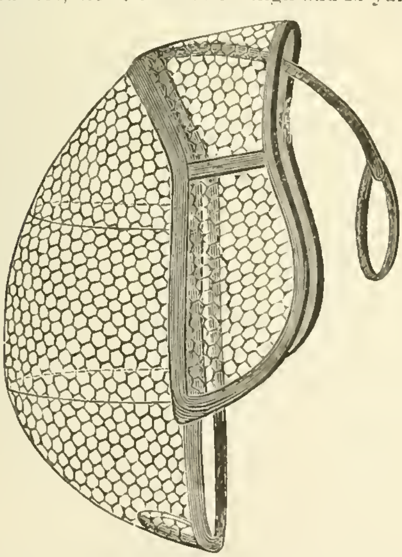


Fig. 1.

width at the capital, which is sometimes added in front of the caponier; a ditch 10 yards wide may be formed in front and rear of it. Its salients being made circular and loop holed, a close and powerful fire can be brought to bear upon the enemy if he succeeds in establishing himself in the ravelin. The name *mask* is given to this redoubt, as it acts as an efficient mask or counter-guard to the caponier. 2. A wire cage to protect the face in fencing. Fig. 1 represents the ordinary *fencing mask*, furnished with ears and fronts. Fig. 2, represents the *hau rapier mask* padded. 3. As a military expression, *mask*, is used in several senses. A *masked battery* is one so constructed, with a grassy glacis, etc., as to be hidden from the view of the enemy until, to his surprise, it suddenly opens fire upon him—on his flank, perhaps. The fire of a battery is *masked* when some

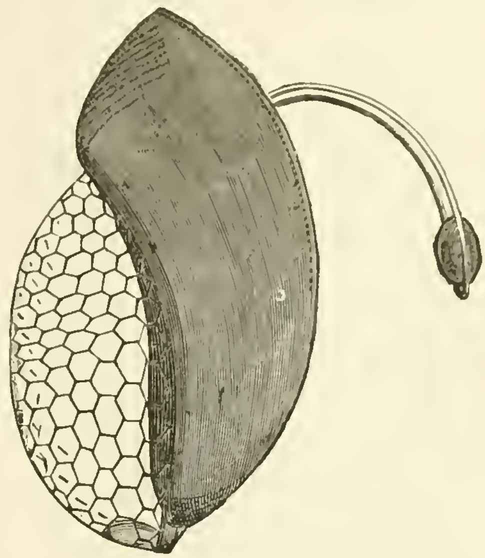


Fig. 2.

other work, or a body of friendly troops, intervenes in the line of fire, and precludes the use of the guns. A fortress or an army is *masked* when a superior force of the enemy holds it in check, while some hostile evolution is being carried out

MASON AND DIXON'S LINE.—This line originated in the difficulties which occurred in tracing the boundary line of a tract of land granted to William Penn in 1681. This land lay west of the Delaware and north of Maryland, and a part of its southern boundary was defined to be "a circle drawn at 12 miles distant from Newcastle northwards and westwards into the beginning of the 40° of northern latitude." Later, Penn received another grant, and, his agent being unable to agree with the authorities in America as to the just boundary, he came to this country himself in 1682 to establish his claim and take possession of his land. He was opposed by Lord Baltimore, the matter was referred to the Committee of Trade and Plantations, a change in the reigning monarch of England took place, and it was not until 1760 that the final deed was issued to the heirs of Penn, closing the controversy. But even then the question of surveying the disputed territory with a view of defining the boundary-line opened new disagreement; and it was to arrange this that Charles Mason and James Dixon, "Mathematicians and Surveyors," were mutually agreed upon by the contestants, Thomas and Richard Penn, on the one part, and Lord Baltimore, the great grand-son of Cecilius, the first patentee, on the other, "To mark, run out, settle, fix and determine all such parts of the circle, marks, lines, and boundaries as were mentioned in the several articles or commissions, and were not completed." The two surveyors commenced their work in 1764, and did not finish it until 1767; the delay being partly owing to Indian troubles, involving negotiations with the Six Nations in their settlement. The line as finally drawn, has been popularly supposed to have been the dividing line between the Free and the Slave States; but this is an error, as slavery existed throughout Delaware, which is both east and north of the line, until abolished by the 14th Amendment to the Constitution. To this line is owing the peculiar tract of land known as the Pan-handle," where a part of Virginia runs up between Pennsylvania and the Ohio River. Very little is known of the two "Surveyors of London," as they were styled. Mason was an assistant of Dr. Bradley at the Royal Observatory at Greenwich; both were members of the American Philosophical Society; both were sent by the Royal Society to the Cape of Good Hope to observe the transit of Venus in 1769. Dixon died in Durham, England, in 1777; and Mason died in Pennsylvania in 1787.

MASONED.—In Heraldry, a term used to describe the lines formed by the junction of the stones in building.

MASS.—1. In *Statics*, the amount of matter contained in a body. In *Dynamics*, that measure of the matter in a body which determines its relation to force. The accepted measure is the weight divided by the force of gravity. 2 The formation of troops in column at less than half distance. To *mass troops*, is to concentrate them by this arrangement on a certain point. A column is *closed in* mass when the sub-divisions have less than half distance.

MASSACRE.—The killing of human beings by indiscriminate slaughter, murder of numbers with cruelty or atrocity, or contrary to the usages of civilized people. As an example, we may cite the Mountain Meadows Massacre, an atrocity committed by the Indians in 1857, in Mountain Meadows, Santa Clara Co., Utah; as is supposed, under the instigation and direction of the Mormon leaders. A party of 120 emigrant settlers, on their way through Utah to California, had in some way aroused the suspicions of the Mormons, and at the place named were surrounded by Indians under Mormon control, and brutally massacred: only a few children of the party survived. In 1874 an investigation into the affair was ordered by the U. S. Government, and John D. Lee, a Mormon Bishop, and others, were indicted, tried, and condemned. Lee was executed on March 22, 1877, by being shot on the very spot where the massacre took place.

MASSAGETAE.—A nomadic people who inhabited the broad steppes on the northeast of the Caspian sea, to the northward of the river Araxes or Jaxartes. Herodotus says that they had a community of wives; that they sacrificed and devoured their aged people; that they worshipped the sun, and offered horses to him; that they lived on the milk and flesh of their herds, and on fish; and fought on horseback and on foot with the lance, bow, and double-edged axe. Cyrus is said to have lost his life in fighting against them, 530 B.C. Niebuhr and Böockh are of opinion that they belonged to the Mongolian, but Humboldt and others to the Indo-Germanic or Aryan family.

MASSE.—A species of stock-purse, which, during the French monarchy, was lodged in the hands of the Regimental Treasurer or Paymaster, for every Sergeant, Corporal, Drummer, and Soldier. The amount retained for each Sergeant was *vingt deniers* per day, and *dix deniers* for each of the other ranks, according to the establishment, not the effective number, of each battalion. Out of these stoppages a settled and regular *masse*, or stock-purse, was made up, and at the end of every month it was paid into the hands of the Major or Officer intrusted with the interior management of the corps, and was then appropriated to defray the expense of clothing the different regiments, and lodged in the hands of the Directors or Inspector-General of Clothing.

MASSE D'ARMES.—A warlike weapon, which was formerly used in France. It consisted of a long pole with a large iron head.

MASSELOTTE.—A French term used in the foundry to signify that superfluous metal which remains after a cannon or mortar has been cast, and which is sawed or filed off to give the piece its proper form.

MASSIE.—A short stick or rod, used by artificers in making cartridges.

MASSING GUNS.—The best mode of successfully silencing the enemy's artillery, or of destroying some special position of his, is by means of a number of guns brought to bear on that point. This system was first introduced by Napoleon at the battles of Wagram, the Moskwa, and Lützen, and subsequently was employed with great effect by the Germans during the war of 1870-71.

In the concentration of artillery in action it is not necessary that all the guns should be formed up into one gigantic battery. With pieces commanding a range of 3,000 yards, a hundred guns might generally direct their fire on to one spot, without being crowded together, and it is hardly likely so many guns would be required to concentrate their fire. It is further shown that it is important in massing guns, especially under the fire of an enemy, that the guns should come into action as nearly simultaneously as possible; otherwise each battery may be crushed in its turn as it comes up, from the enemy having got the exact range of the battery which first got into position.

MASTER GENERAL OF THE ORDNANCE.—An officer formerly at the head of the Board of Ordnance. Before the present regimental organization of the artillery, all details of the regiment came under the care and superintendence of the Master-General. The position of Master-General was introduced into the English Army as early as 1483; at all events, that seems to be the earliest date that the name of such a functionary can be traced. This officer was at the head of the Board of Ordnance, to which most important duties were assigned; and if any one would wish to learn what the Master-General had to do in the 17th century, let him go to the Tower and examine the correspondence of Lord Dartmouth, the faithful friend and servant of Charles II., a professional artilleryman, and James II., a skilled Master-General to the last. The last Master-General of the Ordnance was Lord Raglan, who died while in command of the British Army in the Crimea.

MASTER-GUNNER.—Formerly an ancient office under the crown, as far back as the reign of Henry VIII. The appointment is now filled by pensioned sergeants of artillery. A Master-Gunner, as understood nowadays, is a warrant officer selected from the Non-commissioned officers of artillery, whose duty is to take charge of guns, ammunition, stores etc., in a fortress. The Coast Brigade is composed of Master Gunners (pensioners), and there are 3 classes, 1st, 2d, and 3d, containing 16, 26, and 83 respectively.

MASTER OF THE BUCKHOUNDS.—An officer in the Master of the Horse Department of the Royal Household, who has the control of all matters relating to the royal hunts. A salary of £1,500 is attached to the office, which is regarded as one of considerable political importance. The Master of the Buckhounds goes out of office on a change of ministry.

MASTER OF THE CEREMONIES.—An office instituted at the Court of England in 1603, for the more honorable reception of Ambassadors and persons of distinction. The same term was afterwards extended beyond the Court, by being applied first to Beau Nash, the famous "Master of the Ceremonies," or President of the amusements at Bath, and then to other persons exercising the same function in ordinary assemblies.

MASTER OF THE HORSE.—The third great officer of the Court, who has the superintendence of the Royal Stables, and of all horses and breeds of horses belonging to the Queen. He exercises authority over all the Equerries and Pages, Grooms, Coachmen, Saddlers, and Farriers, and has the appointment and control of all artificers working for the Queen's stables. He is answerable for the disbursement of all revenues appropriated to defray the expenses of his Department; but his accounts are audited and examined by the Board of Green Cloth. He has the privilege of making use of the royal horses, pages, and servants, and rides next to her Majesty on all state occasions. The office is one of great antiquity, and is considered to be a position of great honor. The Master of the Horse is appointed during pleasure, by letter-patent; but his tenure of office depends on the existence of the political party in power. The salary is £2,500 a year.

MASTER OF THE SWORD. A citizen employed to instruct in the use of the small-sword, broad-sword, and bayonet, at the U. S. Military Academy. He is without rank, but wears a uniform of the following pattern:

Coat—Double-breasted frock, two rows of buttons of the General Staff of the Army, seven in each row. *Overcoat*.—Same as prescribed for a Second Lieutenant, dismounted. *Pantaloons*—Dark blue, plain. *Cap*—Chasseur pattern, with letters M. A. in silver, encircled by a wreath in gold on the front. *Sword and Sword-belt*—Same as prescribed for Lieutenants of Infantry. He is permitted to wear the dark-blue sack-coat prescribed for Army officers, with the buttons of the General Staff.

MASTER TAILOR.—A competent tailor, attached to each regiment, who has been, if a soldier, pronounced by a Board of Sergeant Master Tailors to be efficient and well up to his work, or who has been instructed in the art of tailoring at the Government Clothing Establishment, Pimlico. A civilian tailor may volunteer for the situation; and if so, he will have to pass an examination at the Royal Army Clothing Depot, and be enlisted as a Sergeant Master Tailor

MASTIC.—A species of gum-resin yielded by the mastic or lentisk tree (*pistacia lentiscus*, natural order *terebinthaceæ*). It oozes from cuts made in the bark, and hardens on the stem in small round tear-like lumps of a straw-color, or if not collected in time, it falls on the ground; in the latter state it acquires some impurities, and is consequently less valuable. The chief use of this gum-resin is in making the almost colorless varnish for varnishing prints, maps, drawings, etc. It is also used by dentists for stopping hollow teeth, and was formerly used in medicine. It is imported in small quantities, chiefly from the Morocco coast, but some is occasionally brought from the south of Europe. The name of mastic is also given to oleaginous cements, composed of about 7 parts of litharge and 93 of burned clay, reduced to fine powder, made into a paste with linseed oil.

MATADOR.—A long, narrow sword with a cross-bar. The toreador, on foot, fights with this sword and kills the bull.

MATAFUNDA.—An ancient machine of war, which was used for throwing stones, probably by means of a sling.

MATCH.—The name given to a material, such as cotton, hemp, tow, etc., which is rendered combustible by being dipped or soaked in some ignitible solution: There are two kinds of match familiar to the artilleryman, *quick-match* and *slow-match*. Quick-match is made of different-sized threads—vis: four-, six- and ten-thread—soaked in a solution of gunpowder, mixed with gum arabic and water in a boiling state, and of such consistency that the thread shall be thoroughly coated with it; it is then wound on reels, and gunpowder sifted on it. If it be stiff, and has the coating of powder perfect over the surface, it is serviceable. If it has been bruised or twisted and the coating of powder removed, it is unserviceable. It is largely used for priming fuses, etc. Slow-match is made of slightly twisted hempen rope, soaked in lime-water and saltpeter, and then dried, or it can be prepared by washing the hemp in a lye of water and wood ashes. It burns at the rate of one yard in eight hours, and is used for lighting port-fires, etc.

MATCHLOCK.—The name formerly given to a small-arm or musket. The earliest muskets were fired by means of a piece of slow-match applied by the hand to the touch-hole. An improvement on this mode of ignition was made at the end of the fourteenth century by a lock being attached to the musket which held the match, and by pressure applied to the trigger of the lock, it brought the lighted match down on the powder-pan and thus ignited the priming powder. This mode of ignition caused the musket to be called the *matchlock*. See *Lock*.

MATE-GRIFFON.—An ancient machine, the destroyer and terror of the Greeks, which projected both stones and darts.

MATERIEL.—The expression, "matériel of artillery," embraces all cannon, carriages, implements, ammunition, etc., necessary for artillery purposes, and is used in contradistinction to "*personnel of artillery*," which refers to the officers and men. The expression, "*system of artillery*," refers to the character and arrangement of the matériel of artillery, as adopted by a nation at any particular epoch. In the United States' service, the term "ordnance and ordnance stores," embraces not only all the *matériel* of artillery, but the swords, small-arms, and accoutrements used by infantry and mounted troops.

MATHEMATICAL INSTRUMEMTS.—Those instruments employed in the determination of the length of lines or the size of angles. Pairs of compasses, surveying-chains, etc., are examples of the former class; while the compass, sextant, theodolite, and the numerous list of astronomical instruments generally denominated telescopes, including the equatorial transit instrument, mural circle, etc., form the latter class. The more important of these instruments will be treated of under separate heads.

MATHEMATICS.—The science which has for its subject-matter the properties of magnitude and number. It is usually divided into *Pure* and *Mixed;* the first including all deductions from the abstract, self-evident relations of magnitude and number; the second, the results arrived at by applying the principle so established to certain relations found by observation to exist among the phenomena of nature. The branches of Pure Mathematics which were first developed were, naturally, *Arithmetic*, or the science of number, and *Geometry*, or the science of quantity (in extension). The latter of these was the only branch of mathematics cultivated by the Greeks, their cumbrous notation opposing a barrier to any effective progress in the former science. Algebra, or the science of numbers in its most general form, is of much later growth, and was at first merely a kind of universal arithmetic, general symbols taking the place of numbers; but its extraordinary development within the last two centuries has established for it a right to be considered as a distinct science, the *Science of Operations*. Combinations of these three have given rise to *Trigonometry* and *Analytical Geometry*. The Differential and Integral Calculus makes use of the operations or processes of geometry, algebra, and analysis indifferently; the *Calculus of Finite Differences* is in part included under algebra, and may be considered as an extension of that science; and the *Calculus of Variations* is based upon the Differential Calculus. The term "Mixed Mathematics" is calculated to lead to error; "Applied Mathematics" is a more appropriate name. This portion of mathematics includes all those sciences in which a few simple axioms are mathematically shown to be sufficient for the deduction of the most important natural phenomena. This definition includes those sciences which treat of pressure, motion, light heat, sound, electricity and magnetism—usually called *Physics*—and excludes chemistry, geology, political economy, and the other branches of science which, however, receive more or less aid from mathematics.

MATRAS.—An ancient bolt or arrow with a round disk or head, which killed without piercing. It was oftener used for the chase than in war, and was especially useful in bringing down such beasts as the hunter might wish to preserve with the skin uninjured.

MATRON.—A woman, generally the wife of some well-behaved soldier, who is employed to assist in the hospital, do the washing, etc. The matrons are under the direction of the Surgeon and are originally appointed by this officer.

MATROSS.—A name formerly given to an artilleryman. In the early organization of the British artillery, there were only two-trained artillerymen per gun; they consisted of a gunner and his *mate* or *matross*. It was in the year 1783 that the term *gunner* was substituted for that of *matross*. It would appear from this that the mate, or matross, was in fact a gunner. Another explanation of the word is as follows: A man whose business it is to be in the train of artillery, next the gunners, to assist them in loading, firing, and sponging the guns.

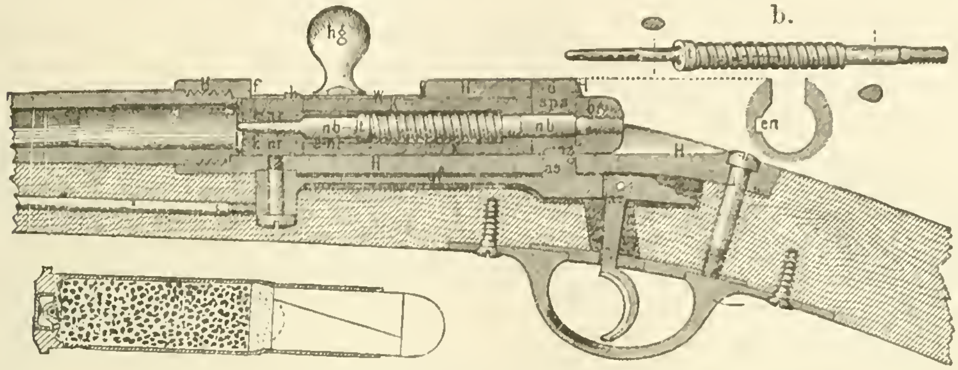
MATTER.—From a physical point of view, matter is anything that can affect the senses, or that can exert, or be acted on by force. The existence of matter, in the sense of *substance*, has been doubted by many Philosophers, including some of the greatest of Experimenters. Indeed, as we can know matter only by the forces it exerts, it is obvious that the supposition of mere geometric points, capable of exerting force (technically called *centers of force*), will as satisfactorily account for all observed phenomena as any other idea of the ultimate nature of matter. Here, however, we are dealing with a question confessedly beyond the reach of experiment, and belonging to the domain with which metaphysics professes to deal. Although experiment cannot lead to a knowledge of the ultimate nature of matter, it may lead to important discoveries as to the arrangement of the molecules of different bodies, and their similarity or dissimilarity. Some of the questions to which we may expect an answer, though not a speedy one, have already been mentioned in the article Force; but in order to render intelligible the short account which we intend to give of some very interesting ideas recently propounded by Graham, it will be necessary to repeat some of them. The old idea of the transmutation of metals implicitly contains the assumption that all kinds of matter are ultimately one. Far from being a startling assumption, this is the simplest and most easily conceived notion we can entertain on the subject; and it offers a remarkably simple explanation of that extraordinary property of matter which Newton proved by careful experiments, that the weight of a body depends only on the quantity, not on the quality of the matter that composes it. One idea, then, of matter is, that the atoms (or smallest parts, whatever these may be) of all bodies are identical, but that the molecules (each of which is a single atom, or a definitely arranged group of atoms) differ from one body to another. Thus (to take an instance merely for *explanation*, not as at all likely to be correct), if hydrogen be supposed to consist of the simple atoms of matter; oxygen, each molecule of which is 8 times as heavy as one of hydrogen, may have each molecule formed of 8 elementary atoms, arranged in a group such as the corners of a die; carbon, 6 times as heavy per molecule, might be composed of 6 simple atoms grouped as at the corners of an octohedron; and so on. It is obvious that here each atom must be supposed capable of exerting force on every other. This leads us naturally to speculations as to the medium through which this force, if it be exerted at a distance, is propagated; and then we have introduced matter of a more refined character than our supposed elementary atoms. This difficulty has suggested to various Philosophers the idea that there is no *actio in distans*, that all pressure, for instance, in a gas is due to incessant impacts of its particles upon each other and upon the containing vessel. But from various experimental results, we know that *this* species of motion is capable of being transferred from one body to another, of being increased or diminished by change of temperature, and is, in fact, *heat* itself, one form of kinetic energy. This, if there be no ultimate difference between kinds of matter, could never be the cause of their apparent difference. Hence, in Graham's view, though all ultimate atoms are identical in substance, they have special motions of their own, by which one is distinguished from another, these motions not being capable of transfer from one atom or group of atoms to another. It is difficult to conceive energy in such a form as not to be transferable, so that we refer the reader to Graham's own papers for the further development of his theory—remarking, in conclusion, that no theory of the nature of matter can be considered as at all complete till it account for the mutual action of separate atoms; for this the existence of a *continuous* material medium in space would seem to be necessary; and this, in its turn, would, if accepted, enable us to dispense with the idea of atoms. In connection with this, we may mention that Sir William Thomson has shown that mere heterogeneity (which we know exists in matter), together with gravitation, is sufficient to explain all the apparently discordant laws of molecular action; matter being supposed, in this theory, to be continuous but of varying density from point to point.

MATTOCK. A pioneer tool, resembling a pick-axe, but having two broad, sharp edges instead of points.

MATTUCASHLASH—An ancient Scotch weapon, sometimes called *Armpit Dagger*, which was worn under the armpit, ready to be used on coming to close quarters. This, with a broad-sword and shield, completely armed the Highlanders.

MAUL.—A heavy beater, or hammer, usually shod with iron, used in driving stakes, etc. That furnished from arsenals has a cylindrical head of wood, 6 inches in diameter and 8 inches long, with an iron band around each end. The handle is 24 inches long and 1.5 inch in diameter. Weight 10 lbs. This maul, as issued, owing to poor material and faulty construction, is of but little value. Where much service is required, it is better to make the head of tough, hard wood, with a handle considerably larger than the one of regulation pattern.

MAUSER RIFLE.—The Mauser is a modification of the Chassepôt system, by which it is adapted to the use of the metallic gas-check cartridge, and has been adopted by the Prussian Government as a substitute for the needle-gun. In the drawing, H represents the housing or receiver attached to the barrel by the usual form of screw at its forward end, and to the stock at its rear end by a tang-screw, which penetrates through the stock to the trigger-guard. The general form of the receiver is a tube cut away at different points for the reception of the parts that work in and are attached to it. The breech is closed by a bolt called the breech-bolt, which contains the firing-pin, and other parts necessary to the operation of locking and cocking. The principal part of the breech-bolt is the tube, K. The rib, *w*, on the exterior of this tube, known as the locking-tube, is for the purpose of locking into the space cut away in the receiver between *f* and *f*, to enable the breech-bolt to sustain the force of the discharge. The ends of this rib being made quite oblique to the axis of the bore, or rather of spiral form, and the ends of the cut being moreover made to correspond, the breech-bolt is screwed forward against the cartridge when it is locked in loading. By this arrangement the cartridge is not only forced into its place in the chamber, should there be undue resistance, but accidental explosions which might arise from striking the head of the cartridge directly when the bolt is shoved forward, are avoided. The thumb-piece, *h g*, is attached to this rib for the purpose of working the breech-bolt. The breech-bolt is terminated in the separate piece, *k n r*. By way of designation, this piece is called the bolt-head. The forward portion has a small round hole for the point of the firing-pin; the tennon which enters the locking-tube, has an oval hole, that being the shape of the cross-section of the firing-pin which passes through it. The extractor-hook is attached to the side of the bolt-head by means of a dovetail-tennon and works in a over the flange of the cartridge into its recess in the barrel. The screw motion of the locking-tube gives power to start the cartridge case should it adhere to the chamber. When withdrawn, the case falls out by slightly tipping over the barrel to the right. The following are some of the principal weights, dimensions, etc., of the Mauser rifle and cartridge as adopted for the Prussian military service: The bore is .433 inch (11 millimeters) diameter, and rifled with 4 flat grooves equal to the lands in width; the depth of the grooves is .01 inch and the twist is from right to left and one



corresponding groove cut in the left side of the well of the receiver. The stud, *h*, fits into the notch of the rib, and is the means of uniting these two parts longitudinally, at the same time their motions around their common axis are independent of each other.

The lower front corner of the cocking-piece, *s p s*, catches against the nose of the sear, *a s*, and holds the firing-pin at full-cock when the bolt is shoved forward and the breech is closed. It has also a groove, into which the nose of the sear projects when the firing-pin is pushed forward. The projection, *d*, works in a cut in the receiver, H, and thereby prevents the firing-pin from turning. A projection fits into a correspondingly shaped cut, in the locking-tube, K, and by the pressure produced by the firing-pin spring keeps the breech-bolt in the locked position.

The firing-pin nut, *b s*, secures the cocking-piece to the firing-pin. The projection, *g*, fits into a groove, and is thereby prevented from unscrewing. The parts marked, *a f*, and *a s*, are the sear-spring and sear combined in one piece. This piece is attached to the lower side of the receiver by a screw; the portion through which the screw passes serves as the ramrod-stop. The trigger, *a z*, is pivoted to the sear, and is composed of an arm and finger-piece. Fig. b, shows the firing-pin, and its spiral spring, made of square instead of round wire. The portions in front and rear of the spring are made oval in cross-section to prevent the pin from turning in locking. The re-enforce, *t*, forms a shoulder for the spring to press against. The main drawing represents the firing-pin in the position of resting on the head of the cartridge after firing. As the piece is brought to the position of full-cock in loading, an improvement has lately been introduced into this arm for locking the firing-pin in case it is not to be fired immediately, and thereby preventing accidental explosions. The motion of the breech-bolt to the rear is limited by the sear, *a s*, which works in a groove on the under side of the locking-tube, K. To remove the bolt entirely from the receiver it is only necessary to press on the trigger at the same time that the breech-bolt is pressed back. A recess serves to relieve the strain on the sear-spring by allowing the nose of the sear to penetrate it. The firing-pin screw, *b s*, is removed with the fingers (having a milled head) by pushing back the firing-pin and slipping forward the cocking-piece so as to free the projection, *g*, from its recess. The spring of the extractor allows the hook to pass turn in 33 inches. The length of the barrel is 33.65 inches; the total length of the rifle without bayonet is 53.15 inches; with bayonet, 71.65 inches; weight, without bayonet, 10 pounds; with bayonet, 11.6 pounds. The sight is arranged for a natural point-blank of 300 meters. The movable part is graduated up to 1,600 meters, some 500 yards farther than most military rifles. The initial velocity is about 1,400 feet. The cartridge-shell is drawn out in the usual way from a disk of sheet-brass, and is shown natural size. The head is solid, and has an exterior primer of the Berdan pattern. This distribution of the metal in the head is somewhat different from that in ordinary solid-head shells, and is such as to give it great strength to resist rupture under the pressure of the powder. The interior of the cartridge-shell is covered with a coating of varnish to prevent the metal from acting injuriously on the powder-charge. This varnish is applied by means of very ingenious machines devised and made by the Pratt and Whitney Company, of Hartford, Conn. The bullet is patched with bank-note paper, thin and strong, and there is a lubricating-wad between the powder and bullet. The powder-charge is 77 grains. The powder for the Mauser rifle differs from all other Prussian powder, inasmuch as red charcoal instead of black is employed in its manufacture, which is thought to give it greater strength. The size and shape of the grain are similar to that of the English musket-powder, known as Curtis and Harvey's No. 6. The bullet weighs 386 grains. See *Chassepôt Rifle*, and *Small-arms*.

MAXIMILIAN TOWERS.—Circular buildings 33 feet high, with a mean thickness of wall of $6\frac{1}{2}$ feet; the diameter of the base is 118 feet, and that of the top 110 feet. They are surrounded by a ditch 8 yards wide towards the exterior, and gradually becoming narrower towards the interior, where it is only four yards wide at the entrance gate. The deblais of the ditches have been employed to construct a glacis, that covers the masonry on the exterior, and gradually falls to the level of the ground in rear. 32 of these towers, from 500 to 600 yards apart, have been placed around Lintz. They are to be connected at the moment of need by a curtain, a ditch, and a palisaded covered-way the whole being flanked by the towers.

MAXIMILIENNE.—A German fluted armor of the Sixteenth century. Often written *Maximilian*. See *Milanaise*.

MAXIM MACHINE-GUN.—In other machine-guns, the feeding and firing and the traversing have to be performed by manual power, and, however beautifully carried out, the operator in any competition for speed is pretty severely tried; and one operator alone can hardly manipulate the machine at high speed, and in his breathless condition alter its direction to any purpose. Of course, the assistance of another man must be had when the particular magazine from which the rounds are entering the gun is exhausted. The inventor of this gun claims to have achieved a remarkable advance in making the recoil of his barrels work the feeding and firing gear; the operator kneels down quietly behind the breech and directs the barrel at his leisure exactly as he likes. There are clearly more advantages in this than appear at once. First, as noticed above, the heavy work of manipulation is saved; secondly, the danger of a jamb from a delay or hang fire is obviated, for the obvious reason that as it is the shock of discharge of each round that loads and fires the succeeding one, when a cartridge hangs fire the gun must wait for it, as without it there is no motive power to load the next round. This is clearly a very different condition of things from that in other machine-guns, when a man is driving the loading and firing-gear as hard as his strength permits, and when a jamb may be produced by delay; thirdly, a much greater rate of firing may be attained than by hand-driving gear, viz., 600 rounds per minute, instead of about 200; fourthly, the machine may be much lighter, and need not be clamped rigidly, as must be the case when a level handle has to be violently worked on one side of it.

The gun may be described as follows: It has a single barrel, arranged in such a way as to recoil slightly in its bearings, the force of recoil of each round acting on the feeding and firing-gear, so as to load and discharge the next round, and so on, round after round, in succession. That is, the force of recoil extracts and ejects the empty case, brings the next round into position, pushes it home, and cocks and liberates the striker. The barrel recoils 9-16 inch, with its breech held firmly closed. This gives the bullet time to escape and fly about a hundred feet, so that the gases have also abundant time to escape after it has left the muzzle. Then a locking-hook, which has held it close, is opened, and the barrel is stopped, while the breech and extractor run on, carrying the empty case with them. This is ejected, and the succeeding round brought into position by a feed-wheel, when the return stroke, given by a connecting rod, sends the charge home, closing the breech, pushing the barrel forward into a firing position, and finally releasing the striker which fires the round. The recoil of this round repeats the above movements, and so on, as long as filled cartridges are supplied and fired. The inventor has made his gun with a 0.45 inch bore to fire the service cartridges. He has a pattern of cartridge case which enables him to have a much simpler gun, because he is able to dispense with the recoil of the barrel proper, and work with the breech recoil alone; but he thinks it wiser to sacrifice what is necessary to enable him to meet all existing conditions. The gun without stand weighs about 60 pounds, a tripod for a man-of-war about 130 pounds, and a carriage for field service from about 60 pounds to 200 pounds, according to the requirements of the case. This tripod is about three feet high, and the piece from muzzle to rear of firing mechanism measures about 4 feet 9 inches. The gun can be left to move freely by hand for rapid change of position, as in the case of torpedo boats or cavalry at short distances; or it may be clamped and traversed or elevated by slow or quick movement screws. The cartridges are fed either from a belt or a drum. The belt is preferred by many. Each band or belt is about 7 feet long, and carries 333 cartridges, and one belt can be joined on to another, so that a stream of indefinite length can be used with care and attention in placing the boxes containing each belt in position. The drum fits on to the top, and is, we think, a more ordinary and less complete arrangement; it only holds 96 cartridges, also, and a man would be much more likely to be exposed in changing drums than in arranging the belts, and he would be kept constantly employed; in fact, one man does not appear to be at all sufficient for the work in rapid firing. When at full speed—600 per minute—allowing the bullets a velocity of 1,200 feet per second, it will be seen that a stream of bullets is formed, 150 feet from bullet to bullet. Should all the men near the piece be killed, the gun will go on firing as long as the supply of ammunition lasts. Under these conditions, the barrel must become very violently heated. Some of our readers are perhaps familiar with the spectacle of machine-gun barrels firing at a much lower rate of speed passing through the different tempering colors of steel. Mr. Maxim endeavors to provide for this by enclosing the barrel in an outer gun-metal case, which allows a large space between barrel and case to be filled with water. Finally he has devised a plan for carrying the smoke of from the muzzle.

The natural objections that appear to suggest themselves are—(1) That the opening of the breech by recoil is difficult to manage safely at so great a rate. It is thought, however, if it is clearly understood that the breech must remain completely closed—indeed no more opening than any breech-loading cannon during recoil—until it has reached a point when the bullet is 100 feet away, it will be seen that there is no danger of escape of gas. It would be interesting to see what would happen if a bullet lodged in the bore; but this is an awkward contingency for any machine-gun. (2) It may be objected that a miss-fire stops the firing for the moment, while in many machine-guns it merely involves the failure of one bullet, the cartridge being ejected and the firing going on without interruption. Perhaps the machine can be sent on by hand instantly; but we think cartridges for this gun ought to be as free from miss-fires as possible, as the loss of a number of rounds delivered in quick firing must be serious. Altogether, the gun is a wonderful design, and one which naturally attracts much greater interest than almost any piece in the same stage of development. The speed of firing, the ease of working, and saving of exposure of men promise great practical advantages, and the extreme neatness of the idea of the automatic system, by which each round fires itself and works the gear at exactly the speed that suits its own behavior, is very attractive. See *Machine-gun*.

MAXIMUM.—A term variously employed in Ordnance and Gunnery. In Mathematics, *maximum* is the greatest value of a variable quantity or magnitude, in opposition to *minimum*, the least. More strictly, a maximum is such a value as is greater than those immediately preceding and following it in a series; and a minimum is a value which is less than those immediately preceding and following it, so that a function may have many maxima and minima unequal among themselves, as in the case of a curve alternately approaching and receding from an axis. Traces of the doctrine of maxima and minima are to be found in the works of Apollonius on conic sections. The thorough investigation of them requires the aid of the differential calculus, and even of the calculus of variations. The brothers Bernouilli, Newton, Maclaurin, Euler, and Lagrange, have greatly distinguished themselves in this department of Mathematics. The Hindus have displayed great ingenuity in solving, by ordinary algebra, problems of maxima and minima, for which, in Europe, the calculus was considered to be necessary.

MAXIMUM CHARGE.—By increasing the charge of powder of a fire-arm, the greater and (in consequence of the wedging of the unburned grains among each other) the more difficult will be the mass to be set in motion; the space between the front of the charge and the muzzle will be diminished; and a larger number of grains will be thrown out unconsumed. It is evident, therefore, that the effect of a charge of powder on a projectile should not increase with the size of the charge; and experiment shows that beyond a certain point, an increase of charge is actually accompanied with a loss of velocity. The charge corresponding to this point is called the maximum charge. All experience proves that the longer a piece is, in terms of its caliber, the greater will be the maximum charge in proportion to the weight of the projectile. For heavy cannon, 19 to 20 calibers long, the maximum charge may be stated to be $\frac{1}{2}$ the weight of the projectile; and for light cannon of the same length, $\frac{1}{2}$ to $\frac{2}{3}$ of this weight; the increase of range for charges above the weight of the projectile, being very small. A charge of $\frac{1}{4}$ the weight of the projectile, and a bore of 18 calibers, is the most favorable combination that can be made in smooth-bored cannon, to obtain the greatest range with the least strain to the carriage. In the early days of artillery, when *dust* instead of grained powder was used in cannon, the weight of the charge was equal to that of the projectile; after the introduction of grained powder, it was reduced to $\frac{2}{3}$, and in 1740 to $\frac{1}{2}$, this weight.

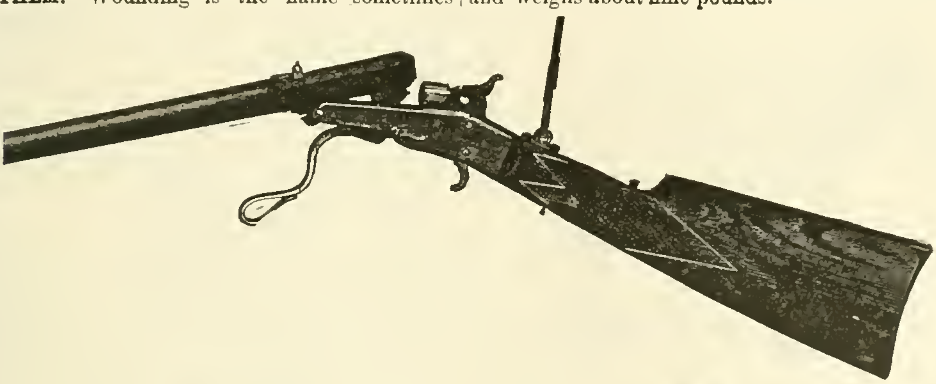
MAXIMUM RANGE.—In gunnery, the very extreme range of a projectile either *in vacuo* or in the air. In the former (were it possible), with a given velocity, the extreme range of a spherical projectile would be obtained at an angle of 45°; in the latter, with a velocity of 1600 feet per second, the maximum range would be obtained at an angle of about 32°; a 56-lb shot would, under these circumstances, at 32° elevation, range 5720 yards in the air, and 23,946 yards *in vacuo*, and at 45°, 26,666 yards *in vacuo*. The maximum range of rifled ordnance is much in excess of that of smooth-bore guns, the 9-inch gun having ranged over 11,000 yards.

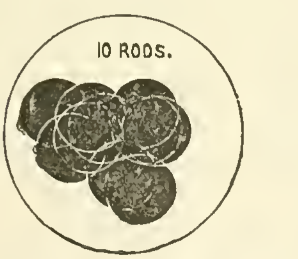
MAYHEM.—Wounding is the name sometimes found in law books for the offense of inflicting on another some dangerous hurt or wound; and it has been otherwise described as an aggravated species of battery. A still more aggravated and atrocious offense of this kind used to appear in the list of offenses against the criminal law of England under the term of MAYHEM, which was a violently depriving another of the use of a member proper for his defense, such as an arm, a leg, a finger, an eye, a fore-tooth, and some others; but it was laid down quaintly enough, that the loss of one of the jaw-teeth, the ear, or the nose, was no Mayhem in common law, because these members can be of no use in fighting.

MAYNARD PRIMER.—A primer made by indenting a sheet of paper at regular intervals, filling each indentation with a small charge of percussion powder, and covering the whole with another sheet of paper firmly pasted on. The sheet is then cut into strips, each strip containing 60 primers in a single row, and, to protect it from the moisture, it is covered with a thick coat of shellac varnish.—See *Friction Primers*.

MAYNARD RIFLE.—While special attention has been paid to the manufacture of superior sporting rifles, the interest in rifle shooting at long range, has led to the invention and introduction of what is known as the "New Creedmoor Rifle," in which the acknowledged and superior merits of the Maynard system are introduced, securing convenience, safety, accuracy, and efficiency, all made applicable to meet the present demand for long range practice. The Creedmoor rifle is a 32-inch, 44 caliber, specially adapted to the requirements of the Creedmoor range, and to which has been applied every facility and appendage which has been found by trial and experience best adapted to secure the most satisfactory results, including ammunition, vernier, and wind-gauge sights, spirit level, and all of superior models and workmanship. All the advantages comprised in the Creedmoor rifle, have also been applied to a new model mid-range target rifle, 32-inch, 40 caliber, designed and especially adapted for target practice and ordinary field-service.

This rifle is represented in the drawing, together with two models of targets selected from the large number in possession of the Massachusetts Arms Company, and representing a fair average result for the distance named. The rifle has an elevating peep, adjustable rear-leaf, and Black's combination-sights, and weighs about nine pounds.



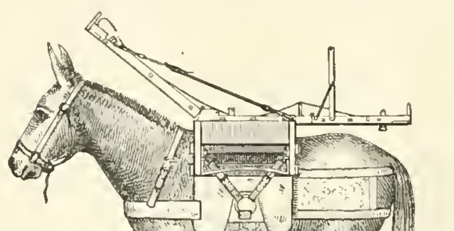


One valuable and special feature of the Maynard system is, that it admits of an interchange of barrels of any length or caliber. The manner of attaching the barrel to the stock is very simple and as follows: Push the arm of the lever axis-pin down and forward until it stops against the screw which holds it in place, then withdraw it as far as possible; hold the barrel in the left hand, pass the lever down through the breech-piece, hook the barrel on to the axis-screw at the front end, insert the lever axis-pin through the lever, then turn its arm back to its fastening position. No screw-driver required. To detach the barrel, place the barrel in position as for inserting the cartridge, then reverse the motions for attaching.

This is a capital gun in the field, and especially on marches through a game country, when it may be desirable to use the weapon either as a rifle or shot gun. Either barrel can be slipped into the same stock in a moment. The ammunition is peculiar. The strong brass cartridges are loaded at leisure, costing nothing but for the powder and lead, and may be used over and over again for any number of times. One can carry cartridges in his pocket, loaded with different sizes of shot, and slip in and fire any size wanted, for large or small game. The rifle in itself is confined to the central-fire ammunition in each and all of the calibers, excepting the .22, in which the rim-fire ammunition is used; but, by the application of a simple device rim-fire cartridges may also be used. See *Hadley Firing-pin.*

McCLELLAN SADDLE.—A saddle used by the United States cavalry prior to the advent of the *Whitman* saddle. This saddle was a great step in advance in its time, and was received with much favor. Its greatest faults were bad bearing surface, too wide in front, like the Mexican, allowing it to slip forward and embrace the tender points of the shoulder-blades; too short in the seat and too wide in front of seat, forcing the rider to an upright position, or the extreme "forked seat," throwing the weight of the rider too much over the fore-legs of the horse; a high, sharp, dangerous pommel, and heavy. See *Saddle.*

McELDERRY MULE-LITTER.—In the operations against the Modoc Indians, in the lava-beds of Oregon, the ordinary methods of transport were found unsuitable, and a form of mule-litter, devised by Assistant Surgeon H. McElderry, U. S. Army, proved serviceable and well adapted to the exigencies encountered.



The drawing shows the construction of the litter and the manner of using it. When not in use it can be folded compactly together, so as to permit a load of grain, provisions, etc., to be packed upon it. When the animal arrives at its destination, the load may be removed, the litter unfolded, and made available for the transportation of the wounded back to the base of supplies. By the use of the adjustable iron support, which raises up over the lower end of the litter, a wounded lower extremity can be suspended in the anterior or other splint, and the patient thus carried with much greater ease and comfort than when the wounded member is simply laid upon or fixed to the litter. It is used upon the *aparejo*, is well-balanced, and has no tendency to make the animal's back sore. It is firmly fixed in position by means of an extra-broad horse-hair girth, as shown in the drawing. The litter weighs, without a mattress, 54 pounds, and like the *Thistle* litter, has the advantage that its width does not much exceed the outer limits of the flanks of the pack-animal; a condition adapting it to the passage of narrow defiles or canyons, or of roads encumbered by vehicles. See *Litter.*

McINTYRE-FUSES.—The time-fuse, shown in Fig. 1, and inserted in the rear of the shell, consists of the brass stock, A; time-fuse B; a brass screw-plug, C; and a lead igniting cap, D. The fuse composition driven in a paper case is first inserted in the

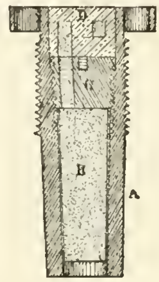


Fig. 1.

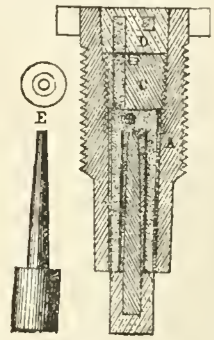
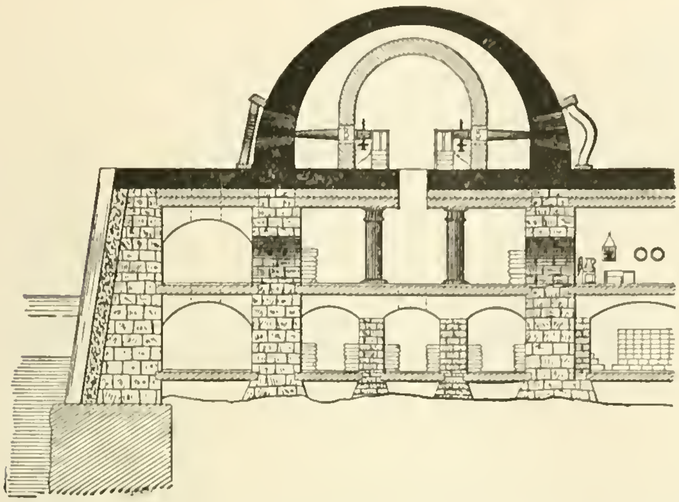


Fig. 2.

stock, the screw-plug with a vertical hole, to one side of its center is screwed to touch the top of the fuse. The igniting cap with its channel of pressed powder composition is then inserted so that the under opening of the channel shall communicate directly with the hole through the screw-cap, which is also filled with the composition. Directly under the projection which rises above the top of the igniting cap is the upper opening to the channel. Before firing, this projection is removed with a sharp knife and the composition thus exposed. The combination-fuse, shown in Fig. 2, is identical with the time-fuse, except that there is inserted in the fuse composition a plunger, whose head is of lead, and whose tapering stem is of brass; immediately surrounding the stem of the plunger is a column of plaster of Paris, between which and the composition is a tube of fusible metal. Should the projectile in which the fuse is inserted strike a resisting object before the fuse composition has burned out, the plunger is thrown forward into the shell, giving the flame from the burning composition direct access to powder in shell. See *Fuse.*

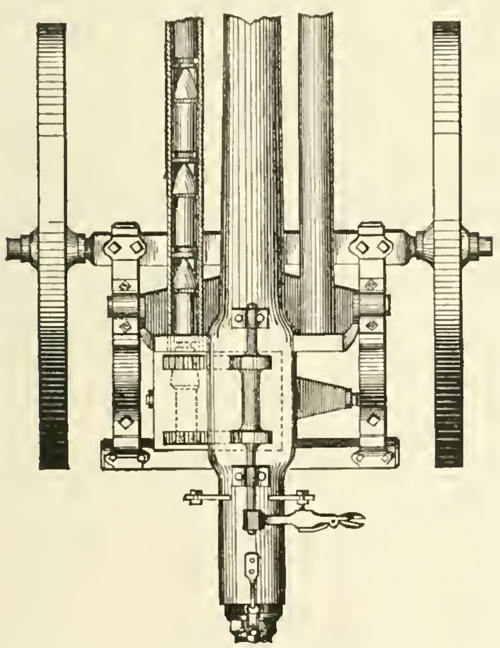
McKEEVER CARTRIDGE-BOX.—This box, invented by Captain Samuel McKeever, of the U.S. Army possesses all the requirements and advantages necessary for the military service, and is at present used by the United States troops. It is made of leather, is 6¾ inches long, 3¼ inches wide, and 1½ inches thick. It is carried on the waist-belt by two loops, opens from the top, the outside half working on a hinge formed by a brass rod running under the box and holding it together. The cartridges are held in webbing loops, ten in each section of the box, and are readily extracted from the box, a bellows arrangement allowing the tops of the cartridges to incline forward when the box is open. It has been improved by the addition of a brass escutcheon, and by making the bellows of russet leather, which is not so liable to corrode the cartridge. This box possesses all the merits of the thimble, or service belt, which has been highly recommended by many officers of the Army, with the additional advantages of protecting the cartridges from the danger of loss, or exposure to dust or moisture. No provision has been made in this box for a screw-driver, but, whenever necessary to carry one, a cartridge may be taken out and the screw-driver inserted in its place.

McLEAN FORTRESS.—This fortress, a section of which is shown in the drawing, is designed to be a permanent structure, or it may be a huge raft, with interior compartments for supplies of all kinds found necessary. The raft is to be towed from place to place, and when in position in shallow water will rest on the bottom, being held by ballast or piles, or by anchors. The fort or raft is to bear two turrets,



one within the other, the outside one being stationary, the inner one rotating, the guns firing through port-holes in the outer turret. The surface of the fort is to be heavily armored, and have quarters and storerooms below the armor.

McLEAN MACHINE-GUN.—This gun, illustrated in the drawing, is one in which every detail is made subordinate to the one of extreme rapidity of fire. The cartridges are in magazines at each side of the barrel, and are forced back by their spring followers into a sidewise reciprocating breech slide containing chambers for two cartridges. When one of the chambers is in line with the barrel the other is in line with



the magazine, and the loaded cartridge pushes out the old shell, the bullet being too large to pass into the slide further than its seat. The cartridge is fired in the slide, the force of the recoil serving to cock the firing-pin so that it is in position for the next shot. The same system is intended to be used with a magazine small arm. Dr. McLean has made more varieties of machine-guns than any other maker, but, in the opinion of the writer, he has sacrificed too much in other directions in order to secure rapidity of fire, and up to this time none of his working guns have met with more than a moderate degree of success. He has a number of improvements now in progress which are expected to overcome the difficulties hitherto experienced. See *Machine-guns*.

MEALED POWDER. Gunpowder pulverized by treating with alcohol. It causes compositions to burn readily and quickly. See *Gunpowder*.

MEAN. As a general term, the medium between two extremes, and is ordinarily understood to be what is known in mathematics as an arithmetic mean. An *arithmetic mean* between two numbers is found by adding them together and dividing by two. A *geometric mean* is found by dividing the larger number by the smaller, and taking the square root, which gives the common ratio; the smaller number multiplied by this ratio, or the greater number divided by it, gives the mean. A *harmonic mean* is found by adding the reciprocals of the numbers and dividing by two; the reciprocal of the result is the mean.

MEAN DEVIATION.—For the same trajectory, the *mean deviation* of a projectile, at a given distance, may be taken as an indirect measure of its accuracy at that distance. To obtain the mean deviation; let the piece be pointed at the center of a target stationed at the required distance, and fire a certain number of shots, say ten; and let the position of each shot-hole be measured in a horizontal and vertical direction from the origin of co-ordinates, taken at the lower left hand corner of the target. The sum of the distances in each direction divided by the number of shots, gives the corresponding co-ordinate of the *center of impact*, or the center of the cluster of shots fired. Multiply the horizontal co-ordinate thus obtained by the number of shots whose corresponding co-ordinates exceed that of the center of impact; take the difference between this product and the sum of the horizontal co-ordinates that exceed that of the center of impact; this difference divided by one-half the number of shots fired, will give the *mean horizontal deviation*. The *mean vertical deviation* is determined in a similar manner. Each of these results may be verified by making the same calculations upon the shots whose co-ordinates are less than the corresponding one of the center of impact. The *mean absolute deviation*, which is the average distance of the shots from the center of impact, will be the hypothenuse of a triangle whose sides are the mean horizontal and mean vertical deviations. The successive steps are explained by the following tabulated example:

The + signs are prefixed after the determination of the center of impact. The foregoing furnishes a measure for the accuracy of fire of the piece and projectile, but it does not afford a measure for marksmanship, the object of which is to direct a projectile so as to strike a given point or surface. In the U. S. Military Service ordinary target practice is recorded by the number of projectiles striking a target of a given size; and when firing for prizes, by the "string" or sum of the distances of the shots from the point aimed at, each miss counting twenty inches on the string. The shortest string is the one selected. The measure of "marksmanship" now most generally adopted is the "score," or sum of the numbers representing the value of shots placed within certain circles described about the center of a given target. The size of the target and the radii of the circles depend upon the distance, the number assigned to corresponding circles being the same for all distances.

SHOTS,	Co-ordinates.	
	Horizontal.	Vertical.
	Feet.	Feet.
1	+5.60	+5.80
2	+5.40	4.95
3	5.05	4.45
4	4.85	+5.25
5	+5.20	+6.00
6	4.75	+5.45
7	+5.35	4.50
8	4.65	+5.20
9	+5.18	4.30
10	+5.50	4.00
Sum	51.53	49.90
Sum divided by 10 gives center of impact	5.153	4.99
Preceding, multiplied; horizontal by 6; vertical by 5	30.918	24.95
Sum of the greater co-ordinates	32.23	27.70
Difference of two preceding lines	1.312	2.75
Divide by 5 for mean deviations	.262	.55
Center of impact; horizontal multiplied by 4; vertical by 5	20.612	24.95
Sum of lesser co-ordinates	19.30	22.20
Difference of two preceding lines	1.312	2.75
Divide by 5 for mean deviations	.262	.55
Mean absolute deviation	.609 feet.	

MEAN IMPACT.—The point of mean impact on a horizontal target is the intersection of the lines of mean range and mean lateral deviation; and on a vertical target, it is the intersection of the lines of mean vertical and lateral deviation.

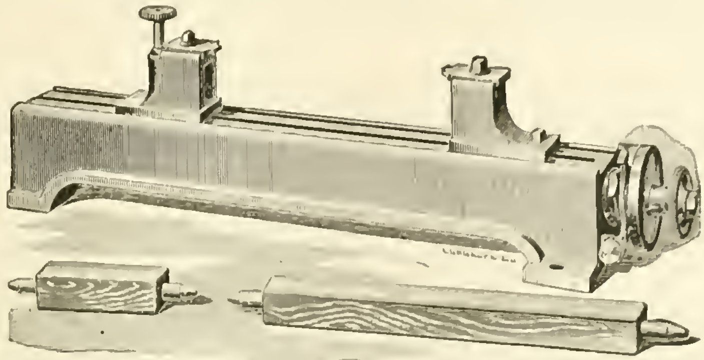
MEAN RADIAL DISTANCE.—The relative precision of small arms is decided by what is termed the *mean radial distance* of the shots from the center of the group on the target. To determine it, find the *point of mean impact*, and measure the absolute distance of each shot from it. Divide the sum of these distances by the number of shots on the target.

MEASURE OF UNIFORMITY.—In gunnery, the regularity in the velocity given by a number of consecutive rounds. It is calculated as follows: Take the mean observed velocity, and from this deduct the difference of each round, and divide the sum of the differences by the number of rounds fired.

MEASURING MACHINE.—The need of an instrument for the purpose of determining dimensions by difference from verified standards has been felt in all well-regulated engineering, tool, and machine shops. The screw operated by a wheel with graduated periphery, has been in use for many years, and was brought to a high degree of perfection by Whiteworth in England, and others. It may be said that, with proper safeguards in its use, it is sufficiently accurate for all practical purposes. It is doubtful if a screw of perfectly uniform pitch throughout any considerable length can be made. The attempt to compensate for this variability of pitch is frequently made by various devices.

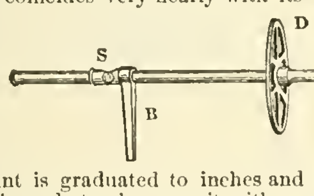
An interesting means of doing so is shown in the dividing engine at the Frankford Arsenal. A new screw having been made with great care by Wm. Sellers & Co., of Philadelphia, it was put into the engine and was found to give, for a certain number of turns, a greater length than the nominal pitch of its thread indicated. To counteract this an inclined plane was attached to the engine, upon which a weighted lever secured to the nut runs up or down as the nut traverses the screw in opposite directions. The effect, as it runs up the plane, is to back the nut a small fraction of the distance it would otherwise travel, and thereby compensate for the error of the pitch, and *vice versa*. If the pitch were absolutely uniform throughout the length of the screw this would leave nothing to be desired from a mechanical point of view, but when the pitch varies from inch to inch, as is nearly always the case, instead of an inclined plane, the corrective element of the engine would have to be a surface having a series of elevations and depressions to correspond to the variations of the pitch, a result only to be attained by a "cut and try" process, alike tedious and expensive, and of only approximate accuracy. It could not be depended upon for small fractional parts of the inch, say 0.0002 inch, or more or less, such as are daily brought into use. Short screws, or portions thereof, may be quite uniform, or so nearly so that the error can be safely disregarded, or an allowance made for it.

These considerations have led to the adoption at arsenals of the plan of obtaining certified standards of length, diameter, etc., in suitable forms and measuring, by difference from them, the object under examination as proposed by Mr. Richards. These standards differ by convenient fractions of an inch from one another, and by using the nearest one to the object whose dimensions are required, only a very short screw is necessary. The drawing shows the form of a Measuring Machine much used in arsenals. These machines are made of various sizes, are adjusted for absolute measurement of dimensions within their range, and are correct within a limit of one ten-thousandth of an inch. This is the usual limit of accuracy for cylindrical guages, and sufficiently precise for all practical purposes. These



machines will *indicate*, by means of vernier attachment, variations to one twenty-five-thousandth of an inch, or even less: but *measuring* and *indicating* are very different things, although generally confounded. See *Guage*.

MEASURING-STAFF.—An instrument employed in the inspection of cannon. It consists of a staff of steel or iron, in joints of suitable lengths, connected together by screws. Each joint is provided with a light brass disk, D, the diameter of which is .05 inches less than that of the bore. Through the center of the disk there is a hole which fits upon the shoulder at the joint; the whole is so arranged that when the joints are screwed together the disks between them are held firmly in place, while the length of the staff is not affected by them. A steel point is screwed on to the end. When pushed to the bottom of the bore, the staff coincides very nearly with its axis. The



outer joint is graduated to inches and tenths. A slide, S, is made to play upon it with a vernier scale, graduated to hundredths of an inch. On the inner end of the slide, a branch, B, projects at a right angle, sufficiently long to reach across the muzzle-face, and, when in contact with it, to indicate the precise length obtained from that point to the end of the measuring-point on the other end of the staff. The instrument is introduced until the point reaches the bottom of the bore, and the branch placed so that it takes across the muzzle-face, and the reading shows the length of the bore of the gun. See *Inspection of Ordnance*.

MEAT BISCUIT.—A preparation of the substance of meat combined with a certain quantity of flour, and made into the form of biscuits, by which process the nutritive qualities of the meat are preserved for any length of time. One way of preparing these biscuits is as follows: Large pieces of beef are placed in a quantity of water sufficient to cover them, and are subjected to slow ebullition. The fat being skimmed off, evaporation is allowed to take place, until the liquid is about the consistency of syrup, when it is mixed with fine wheaten flour, rolled out to the thickness of ordinary ship-biscuit, cut into any shape required, baked, and dried in the ordinary manner. One pound of biscuit usually contains the soluble parts of 5 lbs. of meat and half pound of flour. The meat biscuits can be eaten like ordinary biscuits; but boiled in about twenty times their own weight of water for half an hour, with the usual condiments, they make an excellent soup, and for this they are chiefly intended. Meat biscuits were first introduced into Britain from America by Mr. Borden, in the year 1851. They have been spoken highly of by medical men as food, and are still made to a limited extent; but one purpose they were first intended to serve—that of preserving the animal food of South America and Australia—has since been more effectually done by other and simple means.

MECHANICAL GUN-CARRIAGES.—The first of all considerations as to the mounting of a battery is, that it should admit of the utmost possible rapidity of fire, united with accuracy of aim. It is important to secure the greatest possible efficiency of the weapon under the conditions in which it is required to be employed. The duty of providing the most perfect means of working guns seems to be second only in importance to that of adopting the best material, form, and construction for the gun itself. Of two similar guns, that which can fire the greatest number of rounds in a given time is certainly more effective, and rapidity of fire depends more on the gun-carriage and conveniences for loading, than upon any peculiarity attaching only to the gun. Owing to the increase in the size and power of ordnance since the introduction of armor, gun-carriages have gradually become elaborate machines; and mechanical science, in the hands of experts, has produced carriages and slides which enable the heaviest guns to be easily, accurately, and safely worked in cramped positions. The great superiority of wrought-iron to timber as a material for gun-carriages is now universally acknowledged. The principal requirements of mechanical carriages are powerful moving-machinery so contrived as to be unaffected by the concussion of firing; self-acting controlling gear, almost independent of human carelessness; the gradual absorption of, rather than rigid resistance to shocks; the dispersion of concussions over large surfaces; and smoothness and ease of motion in every direction, and safety under all conditions. Guns mounted on the disappearing principle, are arranged to drop when fired into a position in which they can be loaded under cover, and from which they are only raised when required again to deliver their fire. In this system the gun must not only be loaded while lowered and under cover, but it is usually fitted to be trained and aimed while there, by indirect methods, such as by telescopic apparatus adapted to the gun's axis, and so arranged that it can enable an observer to look over and above the cover.

MECHANICAL MANEUVERS.—The mechanical maneuvers are the application of machines and of mechanical powers for mounting, dismounting, moving, and transporting artillery. The implements and machines required for the various operations depend upon the kind and weight of the piece and the nature of the maneuver to be performed. In every case the minimum number of each is used. When much work is to be done, due allowance must be made for wear and tear, which, with heavy material, is very considerable. Sound discretion should be exercised not to allow the wearing to go beyond the limit of safety. Those now used for siege-pieces are such as can be found in most localities; the rollers, chocks, and, if necessary, the hand-spikes being readily shaped from sections of trees. The following is a list of the implements generally used when maneuvering siege-pieces:

Implements.	Length.	Width.	Thickness.	Weight.		Remarks.
	Inch.	Inch.	Inch.	Lb.	Oz.	
Handspike	84	......	......	12	0	
Long roller.....	42	6	r'nd	25	0	Grooved ¼ inch deep in the middle.
Short roller.....	12	7	r'nd	12	0	
Gun-chock.....	3.6	2.75	3.5	0	6	Wedge-shape.
Wheel-chock...	7	6	3	2	4	Section a triangle. Top rounded ¼ of an inch.
Roller-chock...	7	5	2	1	0	
Shifting-plank.	67	12	2.25	48	0	Ends beveled on opposite sides.
Trace-rope......	360	r'nd	1.25	8	8	
Hammer wr'nch	......	......	......	2	4	Sometimes called monkey-wrench.
Sling-chain.....	156	......	......	55	0	Made of round iron 0.75 in. in diameter, with a stout hook at each end; length of links 5 inches.

In every case the wooden handspike is required, and the following general directions for its use are given. Six are the number generally used. When men on opposite sides of a piece apply themselves to a handspike, the handspike used is that of one of the even numbers; the man to whom it belongs is at the smaller end, the corresponding odd number at the butt end; those who assist place themselves inside of these two numbers; the lowest numbers nearest the ends. When two or more men work at the same end of a handspike, the man to whom it belongs is at the end, and the other men in the ascending order of their numbers from him. When several handspikes are crossed at the muzzle in order to raise or lower it, they are applied in the order of the numbers of the men to whom they belong, those of the highest numbers nearest to the trunnions. The handspikes used in the mechanical maneuvers are beveled on one side, as these will enter into places or under bodies where square handspikes could not be used. When a handspike rests on a fulcrum, and the weight on one end is to be raised by bearing down on the other, the weight should never rest on the beveled side, as the handspike would not then give a good hold, and would be liable to split. In this case the beveled side should be down. But if used for lifting, as when two handspikes are crossed under the breech or chase of a gun to heave it upward, their ends resting on the ground or platform, the beveled side should be up. Two or more men, lifting or hauling together, must wait for the command before exerting their strength. The gunner sees that all are ready before giving the command *heave*. Then all move with a prompt but steady effort, and apply their power increasingly until the weight responds to their effort. The gunner will repeat the command *heave* as often as it may be necessary. When the movement has been sufficiently made, the gunner commands: Ease Away. Those making the effort will then desist; but in doing so will be careful to avoid all sudden shocks or strains. Every operation should be done with spirit and animation, but without bustle or confusion. Vigilance should be constantly exercised to have the piece or rollers securely chocked. The limber of a siege-piece makes a powerful lever, and may be advantageously used in many cases. The pole is raised and the pintle engaged in a sling around the weight to be raised. The pole is hauled down by a trace-rope attached to the eye.

The machines and appliances usually employed for moving heavy artillery: Ropes, blocks and tackle, gins, hydraulic-jacks, sling-carts, casemate truck, truck-wagon, railway truck, cradle, gun-lift, capstan, derrick, shears, blocks and skids, hand-cart, blocks (whole, half, and quarter), way-planks, pinch-bars, mortar-wagon, collar. These, with the implements used in the mechanical maneuvers with siege pieces are sufficient to manage the heaviest pieces of artillery in all cases which ordinarily present themselves in service. All implements and machines, before being used, should be most carefully examined in every detail, to see that they are serviceable and suitable for the operation to be performed. None should be put to uses for which they are not intended, nor subjected to strains they are not constructed to bear. It must be borne in mind that the giving way of one part breaks and destroys other parts, frequently to an extent not readily repaired, and, furthermore, endangers those working at the maneuver. Heavy weights must never be allowed to *drop*, even for the

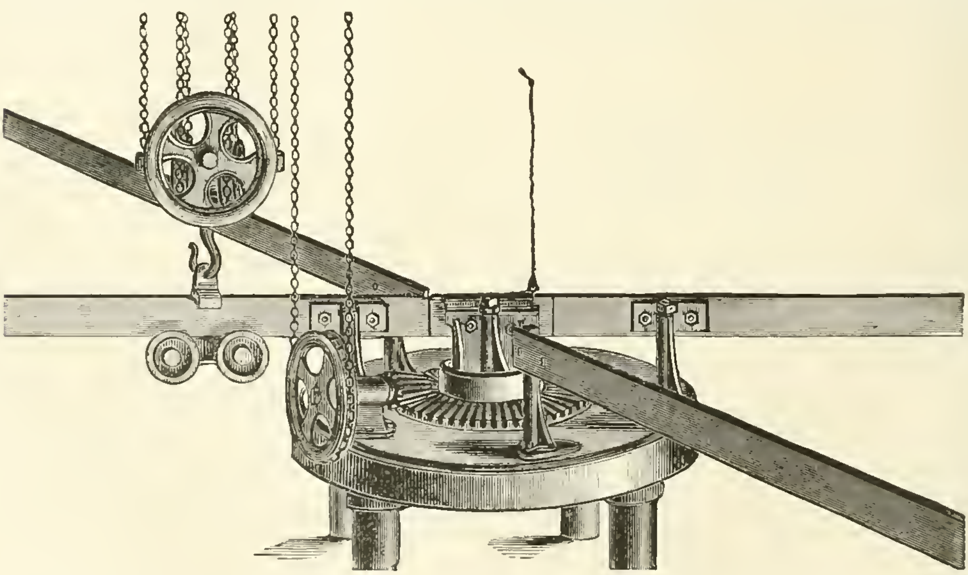


Fig. 1.

shortest distances; they must be lowered to rest with a gentle motion, and at the same time chocked to prevent rolling or sliding. In hoisting, they must, when practicable, be closely followed up with blocks and chocks to guard against any possible giving way. All motions with heavy bodies must be slow, so as not to generate momentum. Supports must have a firm base, and scaffolding a level foundation, and be built up vertically. All holdfasts must be secure beyond possibility of giving way.

The maneuver of the various service pieces are detailed in the Tactics. Within the limits of this article we will confine our descriptions to some general maneuvers and appliances, the details of which will cover the ground of the whole subject. 1. *To move a gun by rolling it.*—Place a skid under the rear of the trunnions, and another under the middle of the chase, and roll the gun over. By inclining the skids and cutting the muzzle it may be moved in different directions. In rolling heavy guns it is most

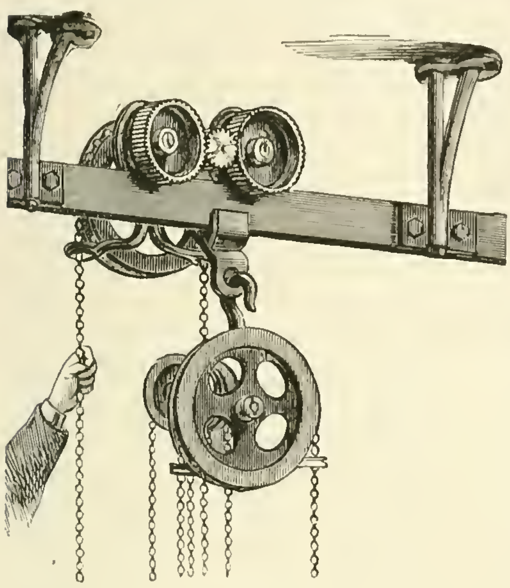


Fig. 2.

convenient to use two collars of wood or cast-iron of equal diameters (one on the breech, the other on the muzzle), large enough to allow the trunnions to turn without striking the ground. A rope used as a parbuckle is the best method of rolling a gun. To do this, place the gun on skids, and attach the rope by a bowline to one of the trunnions, passing it under and around up over the gun, and hauling on the end. If the gun is to be rolled up a slope, two ropes, of size suitable to the weight of the gun, are used. An end of each rope is made fast to some fixed object at the upper part of the slope; the other ends are carried under the chase and body respectively, and up over the gun; these ends are hauled upon by means of a capstan, or by attaching to them a fall and tackle. The muzzle is slued forward by pinching with bars, or by means of a rope and tackle attached to a roller or skid thrust into the muzzle. The piece is lowered by inverse means.

2. *To shift a gun from the trunnion-holes to its travelling-bed.*—Limber up; remove the cap-squares and chock the wheels front and rear; place the short roller under the reinforce; attach the trace-rope at its middle to the cascabel by two half-hitches; cross two handspikes under the one in the bore; lift and push at the muzzle, and haul on the rope until the trunnions are over their travelling position; raise the chase, bring forward the roller to the head of the stock and lower the chase upon it; raise the chase again; remove the roller, and lower the chase upon the stock; take off the rope; replace the cap-squares; insert the elevating screw from below, and lash it. If a lifting-jack can be used, place it under the swell of the muzzle; raise the chase; place a half-block on the head of the stock; take a second lift, and place two rollers on the stock, one just in rear of the trunnion, the other under the reinforce; chock the latter toward the muzzle, and remove the half-block; haul on the rope attached to the cascabel, and bring the breech over the bolster; chock the rear roller; place the jack under the muzzle, and remove the rollers. To shift the gun from its travelling-bed to the trunnion-holes, chock the wheels front and rear; remove the cap-squares; raise the chase and insert the short roller under the trunnions; attach the rope by its middle to the cascabel; bear down the muzzle, and, as the piece rolls forward, guide the trunnions into their holes by means of the rope; remove the short roller. A howitzer is shifted to and from its travelling-bed by the same means, except that the handspike in the bore is chocked above and below for raising the chase, the lower chock being placed about 18 inches in the bore. The vertical diameter of the short roller should be just forward of the rimbases.

3. *To move and handle heavy guns with a truck and tramway.*—The ease with which heavy loads are moved when loaded on an ordinary railway-car, on a smooth, rigid, unyielding track, as compared with other means of conveyance, has led to the adoption of this mode of transportation whenever the work to be done will justify the expense of preparing the roadway and laying down the track. It is thought that this means of transportation might be made available for the transportation of 15-inch guns and other heavy loads in and about our permanent works; that a temporary portable track might be provided capable of supporting as great a weight as that of a 15-inch gun, and could be laid down readily without much preparation of the road-bed, in many places none at all, and furnished at a small expense. A four-wheeled truck of simple construction, strong enough to sustain a weight of twenty-five tons, could be constructed at a cost not much greater than that of a cradle, but could be moved with far greater ease and much greater celerity. This idea elaborated, and proposed as the best, for transporting 15-inch guns over moderately even ground. For this purpose, under the above mentioned conditions, it will commend itself for its simplicity, efficiency, and economy.

In foundries, and special locations in permanent works, there are positive advantages attending the use of *overhead* tramways, within certain limits of weight and strain. The excellent machinery in this line made by Edwin Harrington & Son, and adopted by the United States Government, has demonstrated that there is an actual saving of 50 per cent. in the cost of labor, and little liability to accident, by the use of such a system. Two men can handle a large casting of 2,500 lbs. with great ease, and raising it clear of other heavier articles in the path or on the floor, avoid the necessity of moving or handling the latter. Fig. 1 shows a simple form of turn-table for an overhead track. The load is revolved by means of a hand-gear and pinion operated by a wheel and chain; the table can be adjusted to any required number of tracks that will allow the load, when once raised, to be transported to any desired point with safety and dispatch. The carrier truck cannot be run off from any track, except on to the turn-table, and when on the turn-table it cannot be run off except on to some one of the tracks. When connection is made with any track, the table is securely locked in position, thereby preventing all possibility of accident. Fig. 2 shows the construction of the most approved geared truck. The ordinary truck, when constructed of one or more wheels, and run by pushing or pulling the load at the lower end of the cage or sling, is very liable to lurch or jump, especially if running around a curve, often causing breakage of the chain or rope, as may be in use, besides being a source of great annoyance to persons that may be on the floor over the truck. The geared truck obviates all this, and one man can run the heaviest load required with ease on a straight rail or round a curve, stopping and starting at any desired point, the truck running with perfect smoothness and disturbing no one.

To mount a gun on the surface car, raise it by hydraulic jacks high enough to get the track and car under it; support it by blocks built up under the muzzle and breech; lay the track between the blocks, and place the truck on the track under the gun, the trunnions midway between the wheels; lower the gun on the truck; or place skidding, one end on blocks built up to the required height to reach the bolster, the other on the ground, and roll the gun up the inclined plane thus formed to its place on the truck. The bolsters are just high enough to permit the gun to be rolled into its place. Four men can lay down the track a distance of eighty yards in thirty minutes where no grading is required. Four men can transport a 15″ gun over level ground, using a capstan, twenty yards in five minutes after it has been mounted, the track has been laid down, and the capstan in position, or they can lay down the track and transport the gun twenty yards in fifteen minutes, all of the preparations having been first made. A horse with one double and one single block will move a 15″ gun as fast as the track can be laid and the tackle shifted, or a pair of oxen will pull a 15″ gun, a dead pull, without the intervention of pulley-blocks, the road being level. An increased force will be required if the track, instead of being in a level, is on an ascending grade, and proportionately greater as the angle of the slope increases. Horse-power is the only one recommended, except in very extraordinary cases, where there is a great amount of work to be done and done quickly.

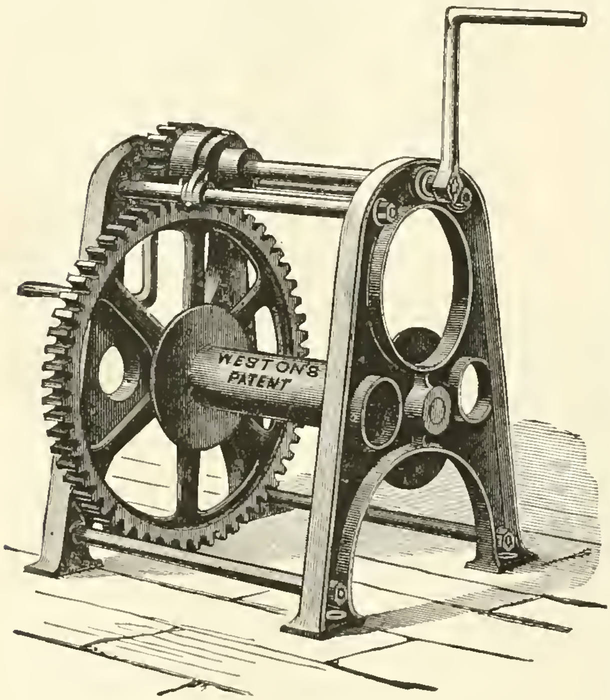


Fig. 3.

4. *To move and mount heavy guns, etc., with blocks, hydraulic jacks, capstan, or crab, cradles, etc.*—To move a heavy gun a short distance, raise it on skids, so that the trunnions will not touch the ground, roll it over by the pinch-bars, chocking the breech and cutting the muzzle when necessary. For longer distances, and through narrow entrances, mount it on the cradle, with rollers and shifting-plank underneath, and if on level ground move it along with pinch-bars or handspikes; if up a ramp, rig the fall and blocks to cradle, crab, and some fixed or well-secured object on top of ramp, and then work it up with the crab, changing the shifting-plank and rollers as required. Weston's hoisting crab, with automatic safety brake, should be used on every possible occasion. This excellent machine is shown in Fig. 3, and consists of the usual winding barrel, for common rope or chain, driven by manual power, applied to cranks, through two or more spur wheels, the ratio of the gearing being varied in the several sizes of machines, according to the load to be lifted. The lifting is accomplished in the usual manner. The lowering is done with the least possible exertion, by winding the handles backwards, and as long as this motion is continued the load will descend. The construction of the safety ratchet or brake is such that the load is always self-sustained and cannot run down. The handles cannot recoil on the operator, and if suddenly "let go" at any time, either in hoisting or lowering, the load will quietly come to rest and remain suspended. The smaller size has only a single speed or power; the larger size, two changes of speed. The capacity of either may be increased by the use of a running block in the usual manner.

For the purpose of thorough illustration, we will notice the process of mounting a fifteen-inch gun. The gun is supposed to be in its cradle, the cradle being blocked up to a level with the skidding that rests one end on the chassis-rail. Each skid is supported near the rail by a crib of heavy blocks piled one on top of the other, three in a crib, and brought to a level with the rail. The cribs, if placed obliquely to the skidding, will still be stable and support the skidding more in the direction of its length. The ends of the skidding remote from the chassis-rail are supported by two double cribs. Each crib is built of three tiers of blocks, alternate ends resting on the lower tier, each pair of blocks parallel to each other and 1′ 6″ apart. The cribs are brought to a level with a chassis-rail. To move the gun from the cradle on the skidding, a man with a chock stands by muzzle and breech, the rest of the men work at the bars. The muzzle is first cut and chocked from the cradle to the skidding; after the muzzle rests on the skidding the breech is cut on the skidding the same way as the muzzle. This operation is continued alternately with breech and muzzle as before, except the men with the chocks now chock on the side toward the chassis-rail until the gun rests on the skidding on the chassis-rail, under its position when mounted on the carriage. The gin or pumps are now set over the muzzle and breech or under them, as the case may be. The cribs to support the muzzle and breech are now respectively placed 3′ from the muzzle, and at the greater swell of the breech. In raising the gun, the breech is raised first by pump or gin 6″ full, a man standing on each side with chock, in case of slip, to prevent rolling. Care is taken to set the gin or pump vertical over or under the breech, and when lowering to ease up, without jerking, gradually. The muzzle can now be raised 12″ full, blocked and chocked in that position. The skidding is now removed. The breech 6″ additional, always having the men with chocks on either side ready, and following up the gun with the blocks, so that it cannot have a fall in case of accident. The blocks used come from the cribs for the skidding that are no longer required. The operation of alternate blocking at breech and muzzle is continued until the gun stands above the height of the trunnion-beds with the axis through the trunnion horizontal. The top-carriage is now put on the chassis and assembled with the trunnion-beds under the trunnions. The gun is then lowered in the trunnions, and the blocks and gin or pumps removed.

Another plan, when the top-carriage has not been taken apart, is as follows: Mount the chassis on platform and top-carriage on the chassis with gin, and then run the top-carriage into battery. Bring the gun upon cradle or skidding until it is parallel to a convenient position of chassis. Roll the gun over the chassis, having the breech projecting beyond the rear end of the chassis, raise it by blocking under the breech beyond the rails, and under the muzzle by blocks outside rails, with a skidding laid across them, until the muzzle is high enough for the top-carriage to be moved back under the trunnions; the muzzle is raised by gin and the breech by hydraulic pump. Run the top-carriage back under the trunnions, lower the gun into the trunnions, remove scaffolding. In building scaffolding of blocks, put the thickest at bottom, and as you gain in height in raising a gun, replace thin blocks by thicker ones. Derricks for raising and mounting ordnance as heavy as 15″ are to be avoided, if possible, as they are heavy and troublesome to move and set up—more difficult to handle than guns, and can only be used under favorable conditions of space; in other words, they consume labor and time that ought to be expended only on the guns. These objections apply to any machine of much weight and size beyond two or three cubic feet. Forts are often at comparatively inaccessible places, and are often in themselves very limited, and possess platforms for guns in angles and confined places hard to approach with guns as large as 15″, and, consequently, the *means* of handling—moving and mounting—must be small and powerful.

We will close this article with a description of the unloading and mounting of the 20-inch gun at the United States Centennial Exhibition. This gun, with a 13-inch sea-coast mortar of about 18,000 pounds, a cradle of about 4,000, with heavy yellow-pine skidding and a deck-load of lumber, in all about 80 tons, were shipped from Fort Monroe on a vessel rated at 94 tons. She nearly foundered in a gale on Chesapeake Bay on her way to the canal at Baltimore, but arrived at Philadelphia afloat but leaking badly, with her deck only about eight inches above the water-line and about four feet below the level of the wharf at high tide. The steam-crane on the wharf had been found by analysis to be insufficiently strong to lift the gun entire; it was consequently simply used as an auxiliary. A 14-inch spar was wedged very tightly into the muzzle of the gun, and served also as a fastening-point for the 11-inch hawser by which the gun was raised. The gun having been blocked up about 2 feet from the cascabel, the crane began to lift. It lifted the muzzle about 15 inches, besides stretching the hawser about 8 feet. Blocking was then placed just back of the center of gravity of the gun, and the muzzle lowered on this pile as a fulcrum until the breech was high enough to take a fresh pile of blocking beneath it. By this lift the gun was raised about 3 inches. The position of the three supports was as follows: 1st, 5 feet from the muzzle; 2d, immediately back of the trunnions; 3d, 2 feet from the breech. Owing to the position of the third point the crane was strained about 13 tons by this lift. Double piles of blocking were used at each bearing-point for safety, so as to limit any accidental fall in raising or lowering the gun to an inch or two at the utmost. Chocking-quoins were also used to follow up the gun closely in its movements. About 15 men were used throughout the maneuvers. One of these men, as ship-carpenter, with his adze and crosscut-saw, was particularly valuable, and also a rigger from the United States Navy-yard. Heavy 18-inch yellow-pine skidding was placed from under the gun to the wharf, inclining slightly upwards, and the hawser parbuckled around the gun and fastened to the crane. A purchase was taken from the muzzle by a locomotive standing on a neighboring track. The crane began to hoist at 6.44, the gun immediately rolling toward the wharf as the hawser uncoiled. The muzzle was cut meanwhile by the locomotive. At 7.04 p.m. the gun was landed, in 11 hours 6 minutes working-time.

As the vessel was relieved of the weight of the gun it rose, converting the inclined way of skidding into a declivity leading to the wharf. This feature permitted the pile of blocking on deck to be much lower than would otherwise have been necessary. On the second day the gun was rolled by the crane and locomotive together to a position parallel with the railroad track across which it had been necessarily landed. Toward the latter part of this operation the locomotive was dispensed with, it being found that by placing the crane in a favorable position, taking hold of the muzzle, and then topping the boom, the muzzle could be cut almost as well as with the locomotive. After about 4 hours of effective hoisting, the gun was placed on the car, on which it was transported safely the next morning to the exhibition grounds, and unloaded the same day. The advantages in this operation were as follows: I. The proximity of William C. Allison & Son's wharf and their large car-works, from which were obtained, readily, supplies of blocking, flat iron bars, heavy tools, men, and notably the use of their steam-crane and railroad-plant, and the 6-inch oak car-bolsters, especially valuable for blocking. II. The use of an extra heavy flat car procured from the Pennsylvania Railroad Company. The disadvantages were: I. The small size of the vessel, its breadth of 23 feet giving only 8 or 9 feet on each side of the bare gun to work in. The gun also occupied all the space between the masts. With the additional weight of the blocking upon her decks, used in raising the gun, the danger of breaking them in or of starting fresh leaks was greatly increased. II. The Captain of the schooner refused to permit hydraulic jacks to be used, for fear of breaking in his deck. III. The gun had to be raised so high, in order to roll it off upon the dock, that the stability of the vessel was considerably endangered. IV. The Captain of the schooner refused to lie alongside of the wharf, fearing, as he represented, shoal water; consequently the gun had to be rolled off from end of the wharf in a direction at right angles to the railroad track. V. Much of the work was done after dark, in the hope of getting the gun on the car by Sunday, the Pennsylvania Railroad wishing to move it to the grounds on that day, for fear of obstruction to the track and to avoid car-demurrage. VI. The men were unaccustomed to moving heavy weights, and shirked all they could, especially at night. In mounting the 20-inch gun, the Laidley gun-lift was used, assisted by blocking. The other guns were mounted with blocking only. The light auxiliary shears, provided with the gun-lift, proved of considerable value in placing in position heavy articles, such as the field-cannon, raising the ways of the drop-hammer, etc. A casemate-gin, mounted on three rollers, was also used. This was very useful in picking up heavy pieces, such as lumps of ore, drop-anvils, etc., and moving them to the pedestal or the foundation on which they were to be placed. Two of the rollers on the windlass-legs were joined together by a sleeve of heavy steam-pipe, fitting over the projecting limbs of the axles, to prevent the rollers from assuming their natural position at right angles to the line of the leg. See *Blocks, Capstan, Casemate-gin, Casemate-truck, Cordage, Crab, Cradle, Derrick, Gin, Gin-derrick, Knots, Lever-jack, Lifting-jack, Mounting Cannon, Piper Gin, Rope, Shears, Sling-cart, Sling-wagon,* and *Tackles.*

MECHANICAL MOTION.—Colonel A. R. Buffing ton, United States Army, has recently designed an interesting machine, which is serviceable as a practical illustration of the resolution of forces into components, and of the principle of mechanics that action and reaction are equal, simultaneous, and contrary. For a full description of this machine, reference is made to the Report of the Chief of Ordnance for 1882. In this connection we will be confined to an investigation of the theory of the contrivance. Suppose, in Fig. 1, the two circles *A* and *B* represent the pitch-lines of two gear-wheels, one, the larger, geared inside—a ring-gear— and twice the diameter of the other, each fixed at, but free to revolve on, its center. Any point, *d*, of the smaller will mark on the face and through the center of the other a right line, *a b*. Suppose a point *over* the point *d* be fixed to a slide on the face of smaller *A* [which slide can move only in the line *d e*], and compelled to move in a groove, *a b*, across the face and center of larger *B*. If a force whose direction is the same as in the direction of *e d* (Fig. 1). As it was shown above how the perpendicular component of the applied force is destroyed, it remains to show in what manner the parallel one is neutralized.

In Fig. 3 let *a b* represent the groove across the face and center of *B*, *d* the point of a slide on the face of *A*, and also of a block free to move in the groove *a b*, and the arrow *e d* represent the applied force and direction of it. It has been seen that under the action of this force the gear *A* would start to roll around inside of *B*, as indicated by the arrow, carrying the arm *h i* as indicated, which in its turn would carry the gear *C* and give it by means of fixed gear *D* the motion indicated by the arrow. But the two small gears engage at *c*, and examining them at this point it is seen that they have motion or, strictly, tendencies to motion, in opposite directions, consequently no motion can take place, although the system is free to move either by application of force to the arm or the *free* ring-gear. Thus the teeth of a

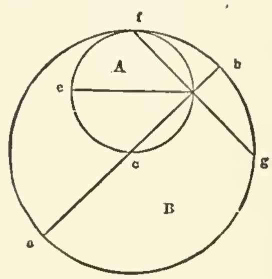


Fig. 1.

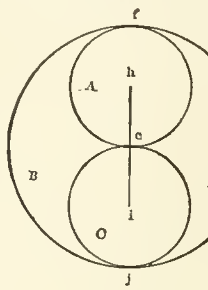


Fig. 2.

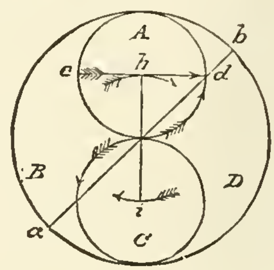
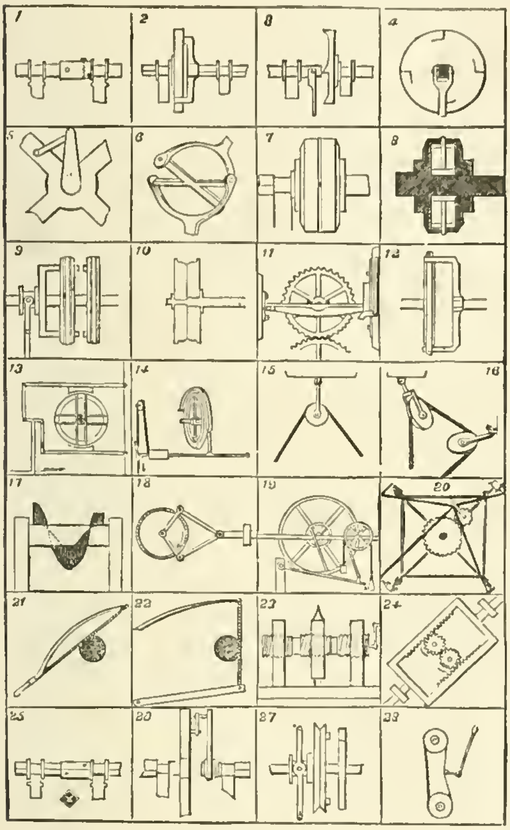


Fig. 3.

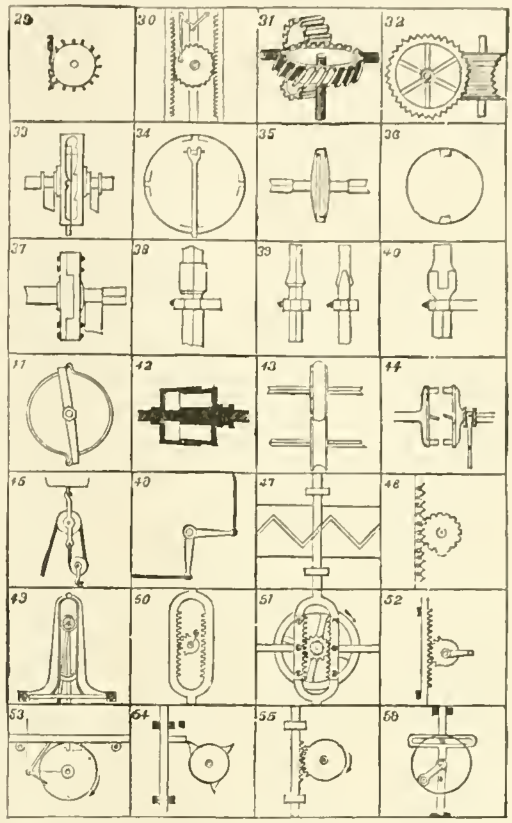
the line *d e* be applied to this point no motion of the system can take place; for the action against the larger would be in the line *f d g*, perpendicular to *a b* at *d*, and passing through *f*, the point of engagement of the two gears, and the *reaction* on smaller would be in the same line; these, action and reaction, being equal, no motion could take place. But suppose the center of smaller gear be free to move, motion would then take place—the smaller would roll around inside the other, the point referred to moving in the groove *a b*, the larger gear, although free to move around its center, remaining stationary—that is, the force applied would be resolved into two components, one perpendicular to and the other parallel with line *a b*, the former destroyed by action and reaction, the latter passing through the center of larger, producing motion only of smaller gear.

Suppose, now, two more gears precisely the same in size and gearing and having the same relation to each other be placed so that the small ones shall engage over the centers of large ones—these latter having no *direct* connection with each other—and that the centers of small ones be connected by an *arm* fixed so as to revolve at *c*, (Fig. 2); the two systems differing only in that the ring-gear (D, Fig. 2) shall be fixed—unable to move in any way. *A* and *B* of Fig. 2 being the two gears explained in Fig. 1, engaging at *f*; *C* and *D* (*D* and *B* coincident, showing but one circle), engaging at *j*, being the equal pair of last supposition; the smaller gears engaging at *c* and united by the arm *h i*, each free to revolve on journals of arm at *h* and *i*. If motion be given to the arm the small gear *C* will roll around inside the fixed ring-gear *D*, and revolve the other *A* about its center *h*, as it is carried around by the arm, and *A* will carry with it the movable ring-gear *B*, or if motion be given to this latter (*B*) it will carry *A* with it, which in turn will roll *C* around inside the fixed gear *D*. During this motion any point of *A* will describe a right line across the face and center of *B* as previously noted. But if *A* and *B* be arranged with slide and groove and a force applied, as above supposed, the system cannot be moved as long as the direction of this force crosses the center of *A* fixed ring-gear are interposed at every point of revolution to neutralize the parallel component. To always practically have the force applied, as described, to a crank arm whose center is at *c*, a link is attached and connects with the slide and block. To carry over the centers, the system of four gears above explained is doubled, the crank-arms being placed at right angles on the shaft to which they are attached. The point *d* describes during a revolution a double cusp.

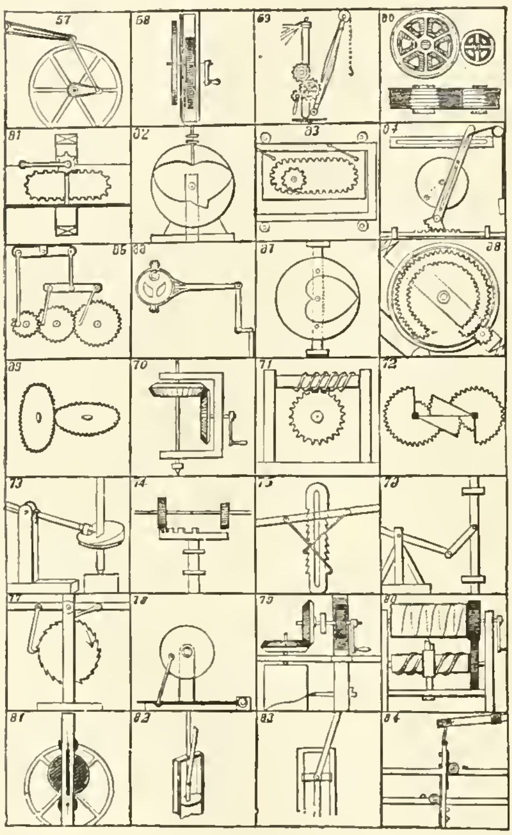
MECHANICAL MOVEMENTS.—In the construction of models or machinery, the skillful inventor and mechanic will study to avoid clumsiness in the arrangement of the parts, and will naturally select the simplest and best forms of mechanical movements. By the kind assistance of the proprietors of the *Scientific American* we are enabled to present a series of such movements, from among which the inventor may select at once that movement best suited for his purpose, and see at a glance the separate parts best adapted to any special combination of mechanism. The following is a brief description of the various movements as numbered: 1. Shaft coupling. 2. Claw coupling. 3, 4. Lever couplings. On the driving shaft, a disk with spurs is mounted, and to the shaft to be driven a lever is securely hinged. By causing this lever to catch in the spurs of the disk the coupling is readily effected, as in the figure 5. Knee or rose coupling, of which 26 gives a side view. 6. Universal joint. 7, 8. Disk and spur coupling. 9. Prong and spur lever coupling. 10. Fast and loose pulley. 11. Sliding gear, the journal-boxes of one of the wheels being movable. 12. Friction clutch. By tightening or releasing a steel band, encircling a pulley on the shaft, the machinery is thrown in or out of gear. 13, 14. Shoe and lever brakes. 15, 16. Change of motion by sheaves. 17. Spiral flanged shaft. 18. Connected with the rod are pawl links, catching into ratchet teeth in the wheel to which rotary motion is to be imparted. When the rod moves in one direction, one of the pawls acts; and when the rod moves in the opposite direction, the other pawl acts in the same direction as the first. 19. The reciprocating motion of a rod is converted into rotary motion of the fly-wheel by a weight suspended from a cord, which passes over a small pulley that connects with a treadle, from which the motion is transmitted to the fly-wheel. 20. "Flying horse." By pulling the cords radiating from the crank, the persons occupying the seats or horses on the ends of the arms are enabled to keep the apparatus in motion. 21, 22. Bow-string arrangements to convert reciprocating into rotary motion. 23. Same purpose by differential screw. 24. The same by double rack and wheels. 25. Coupling for square shafts. 26. Side view of Fig. 5. 27, Sliding-spur pulley coupling. 28. Lever with bearing roller to tighten pulley bands. 29. Chain wheel. 30. Reciprocating rectilinear into reciprocating rotary motion by two racks and cog-wheel, as shown. 31. Oblique-toothed wheels. 32. Worm and worm-wheel. 33, 34. Claw coupling with hinged lever.



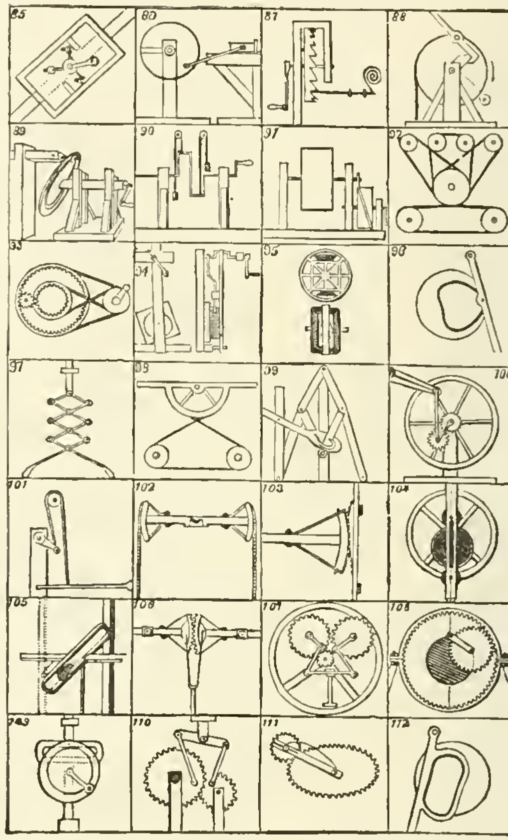
35, 36. Disk couplings with lugs and cavities. 37. Disk coupling with screw bolts. 38, 39, 40. Shaft couplings. 41. Face view of Fig. 12. 42. Friction cones. 43 Friction pulleys. 44. Self-releasing coupling. Disks with oblique teeth. If the resistance to the driven shaft increases beyond a certain point, the disks separate. 45. Hoisting blocks. 46. Elbow crank, for changing motion. 47. Reciprocating into rotary motion by zigzag groove on cylinder. 48 Another form of Fig. 29. 49. Reciprocating into rotary motion. 50. Same purpose. 51. Same purpose, by double rack and two ratchet pinions. When the double rack moves in one direction, one pinion is rigid with the shaft; when the rack moves in the opposite direction, the other pinion is rigid, and a continuous rotary motion is imparted to the fly-wheel shaft. 52. Reciprocating into oscillating. 53. Rotary into reciprocating. By the action of the wheel-pins the carriage is moved in one direction, and by the action of the same pins on an elbow-lever it is moved in the opposite direction. 54. Stamp rod and lifting cam. 55. For giving reciprocating motion to rack 56. Same motion to a bar, with slot, by means of an eccentric pin projecting from a revolving disk and catching in the slot. 57. Walking-beam and fly-wheel. 58. Reciprocating motion to pump or other rod by means of eccentric disk and friction rollers. (See 81 and 104). 59. Hoisting crane. 60. Friction gears. (See 43). 61. Rotary into reciprocating by rising and falling pinion acting on endless rack. 62. By the revolving cam a rising and falling or a reciprocating rectilinear motion is readily imparted to a drum. 63. Reciprocating mo-



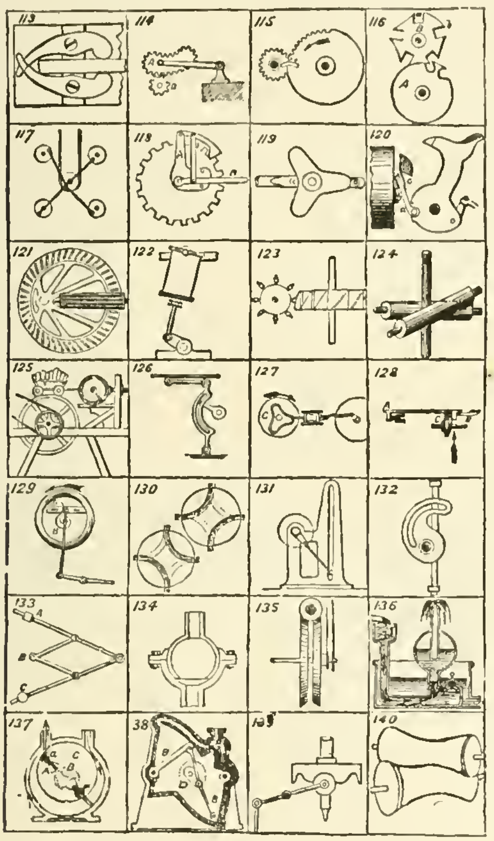
tion is communicated to a frame by means of the endless rack and pinion. 64. Reciprocating rectilinear motion to a toothed rack by a toothed segment on a lever-arm, which is subjected to the action of a weight, and of an eccentric wrist-pin, projecting from a revolving disk. 65. Reciprocating motion to a rod. The wheels are of different diameters, and consequently the rod has to rise and fall as the wheels revolve. (See 110). 66. Cam and elbow-lever. 67. Rod reciprocates by means of cam. 68. Revolving into reciprocating motion, by an endless segmental rack and pinion, the axle of which revolves and slides in a slot toward and from the rack. This rack is secured to a disk, and a rope round the disk extends to the body to which a reciprocating motion is to be imparted. 69. Elliptic gears. 70. Bevel gear. 71. Worm and worm-wheel. 72. Transmitting motion from one axle to another, with three different velocities, by means of toothed segments of unequal diameters. 73. Continuous revolving into reciprocating, by a cam-disc acting on an oscillating lever. 74. Intermittent revolving motion to a shaft with two pinions, and segment gear-wheel on end of shaft. 75. Oscillating lever, carrying pawls which engage teeth in the edges of a bar to which rectilinear motion is imparted. 76. Oscillating lever, connecting by a link with a rod to which a rectilinear motion is imparted. 77. Oscillating lever and pawls, which gear in the ratchet-wheel. 78. Common treadle. 79. Describing on a revolving cylinder a spiral line of a certain given pitch which depends upon the comparative sizes of the pinion and bevel-wheels. 80. Marking a spiral line, the graver moved by a screw. 81. (See Fig. 58). 82. Plunger and rods. 83. Cross-head and rods. 84. Reciprocating rod guided by friction rollers. 85. Revolving into reciprocating motion, by means of roller-arms extending from a revolving shaft and acting on lugs projecting from a reciprocating frame. 86. Crank motion. 87 Reciprocating motion communicated by toothed wheel and spring-bar. 88. The shaft carries a taper, which readily catches against a hook securely hinged to the drum,so as to carry the drum along and raise the weight on the rope. When the tappet has reached its highest position, the hook strikes a pin, the hook disengages from the tappet, and the weight drops. 89. Reciprocating motion to a rod by means of a groove in an oblique ring secured to a revolving shaft. 90. Double crank. 91. Cam groove in a drum. to produce reciprocating motion. 92. Belts and pulleys. 93. Pulleys, belts and internal gear. 94. As the rod moves up and down, the teeth of the cog-wheels come in contact with a pawl, and an intermittent rotary motion is imparted to said wheel. 95. By turning the horizontal axles with different velocities, the middle wheel is caused to revolve with the mean velocity. 96. Oscillating lever and cam groove in a disk. 97. Lazy tongs. 98l. Oscillating segment and belt over pulleys. 99. Converting oscillating into a reciprocating motion by a cam-slot in the end of the oscillating lever which catches over a pin projecting from one of the sides of a parallelogram which is connected to the rod to which reciprocating motion is imparted. 100. Oscillating motion of a beam into rotary motion. 101. Motion of a treadle into rotary motion.



102. Double-acting beam. 103. Single-acting beam. 104. (See Figures 58 and 81). 105. Device to steady a piston by a slotted guide-piece, operated by an eccentric on the driving shaft. 106. Rod operated by two toothed segments. 107. Two cog-wheels of equal diameter, provided with a crank of the same length, and connected by links with a cross-bar to which the piston-rod is secured. 108. Device for a rectilinear motion of a piston-rod based on the hypocycloidal motion of a pinion in a stationary wheel with internal gear. If the diameter of the pinion is exactly equal to one half the diameter of the internal gear, the hypocycloid becomes a sight line. 109. Same purpose as 56. 110. Action similar to 65. 111. Revolving motion by a circular sliding pinion gearing in an elliptical cog-wheel. 112. Similar to 96. 113. Carpenter's clamp. The jaws turn on the pivot-screws, and clamp the board. 114. An irregular vibratory motion is given to the arm carrying the wheel A by the rotation of the pinion B. as shown. 115. Intermittent rotary motion of the pinion-shaft, by the continuous rotary motion of the large wheel. The part of the pinion shown next the wheel is cut on the same curve as the plain portion of the circumference, and therefore serves as a lock whilst the wheel makes part of a revolution, and until the pin upon the wheel strikes the guide-piece upon the pinion, when the pinion-shaft commences another revolution. 116. Stop-motion used in watches to limit the number of revolutions in winding up. The convex curved part, *a b*, of the wheel B serving as the stop. 117. Several wheels, by connecting-rods, driven from one pulley. 118. Intermittent circular motion is imparted to the toothed wheel by vibrating the arm B. When the arm B is lifted, the pawl is raised from between the teeth of the wheel, and traveling backward over the circumference again, drops between two teeth on lowering the arm, and draws



with it the wheel. 119. Reciprocating rectilinear motion is given to the bar by the continuous motion of the cam. The cam is of equal diameter in every direction measured across the center. 120. Mechanism for revolving the cylinder in Colt's firearms. When the hammer is drawn back, the dog, *a*, attached to the tumbler acts on the ratchet, *b*, on the back of the cylinder, and is held up to the ratchet by a spring, *c*. 121. Alternate increasing and diminishing motion, by means of eccentric toothed wheel and toothed cylinder. 122. Oscillating or pendulum engine. The cylinder swings between trunnions like a pendulum. The piston-rod connects directly with crank. 123. Intermittent rotary motion. The small wheel is driven, and the friction rollers on its studs move the larger wheel by working against the faces of oblique grooves or projections across the face thereof. 124. Longitudinal and rotary motion of the rod is produced by its arrangement between two rotating rollers, the axles of which are oblique to each other. 125. Friction indicator of Roberts. Upon the periphery of the belt-pulley a loaded carriage is placed, its tongue connected with an indicator.



tor. With a given load the indicating pointer remains in a given position, no matter what velocity is imparted to the pulley. When the load is changed the indicator changes, thus proving that the friction of wheels is in proportion to load, not velocity. 126. Circular intermittent rectilinear reciprocating motion. Used on sewing-machines for driving the shuttle; also on three-revolution cylinder printing-presses. 127. Continuous circular into intermittent circular motion. The cam is the driver. 128. Sewing-machine, four-motion feed. The bar, B, carries the feeding-points or spurs, and is pivoted to slide, A. B is lifted by a radial projection on cam, C, which at the same time also carries A and B forward. A spring produces the return stroke, and the bar, B, drops by gravity. 129. Patent crank motion to obviate dead centers. Pressure on the treadle moves the slotted slide, A, forward until the wrist passes the center, when the spring, B, forces the slide against the stops until next forward movement. 130. Four-way cock. 131. One stroke of the piston gives a complete revolution to the crank. 132. Rectilinear motion of variable velocity is given to the vertical bar by rotation of the shaft of the curved arm. 133. Pantagraph for copying, enlarging and reducing plans, etc. C, fixed point. B, ivory tracing point. A, pencil. Trace the lines to be copied with B, and the pencil will reproduce them double size. Shift the slide to which C is attached, also the pencil slide, and size of the copy will be varied. 134. Ball-and-socket joint for tubing. 135. Numerical registering device. The teeth of the worm-shaft gear with a pair of worm-wheels of equal diameter, one having one tooth more than the other. If the first wheel has 100 teeth and the second 101, the pointers will indicate respectively 101 and 10,100 revolutions. 136. Montgolfier's hydraulic ram. The right-hand valve being kept open by a weight or spring, the current flowing through the pipe in the direction of the arrow escapes thereby. When the pressure of the water current overcomes the weight of the right valve, the momentum of the water opens the other valve, and the water passes into the air-chamber. One equilibrium taking place, the left valve shuts and the right valve opens. By this alternate action of the valves, water is raised into the air-chamber at every stroke. 137. Rotary engine. Shaft B and hub, C are arranged eccentric to the case. Sliding radial pistons, *a*, *a*, move in and out of hub C. The pistons slide through rolling packings in the hub C. 138. Quadrant engine. Two single-acting pistons, B, B, connect with crank D. Steam is admitted to act on the outer sides of the pistons alternately through valve *a*, and the exhaust is between the pistons. 139. Circular into rectilinear motion. The scalloped wheel communicates motion to the horizontal oscillating rod, and imparts rectilinear movement to the upright bar. 140. Rotary motion transmitted by rolling contact between two obliquely arranged shafts.

MECHANICAL POWERS. — Machines are instruments interposed between the moving power and the resistance, with a view of changing the direction of the force, or otherwise modifying it. Machines are of various degrees of complexity; but the simple parts, or elements of which they are all composed, are reducible to a very few. These elementary machines are called the Mechanical Powers, and are usually reckoned as six in number, three being primary—viz., the *lever*, *inclined plane*, and *pulley;* and three secondary, or derived from the others—viz., the *wheel-and-axle* (derived from the lever), the *wedge*, and the *screw* (both derived from the inclined plane). To these some add toothed wheels. What is special to each machine will be found under its name; a few observations applicable to all may appropriately be made here. 1. In treating of the theory of the lever and other mechanical powers, the question really examined is, not what power is necessary to move a certain weight, but what power is necessary to balance it. This once done, it is obvious that the least additional force to P will suffice to begin motion. 2. In pure theoretical mechanics, it is assumed that the machines are without weight. A lever, for instance, is supposed to be a mere rigid line; it is also supposed to be *perfectly* rigid, not bending or altering its form under any pressure. The motion of the machine is also supposed to be without friction. In practical mechanics, the weight of the machine, the yielding of its parts, and the resistance of friction, have to be taken into account. 3. When the effect of a machine is to make a force overcome a resistance greater than itself, it is said to give a *mechanical advantage*. A machine, however, never actually increases power—for that would be to create work or energy, a thing now known to be as impossible as to create matter. What is gained in one way by a machine is always lost in another. One pound at the long end of a lever will lift 10 pounds at the short end, if the arms are rightly proportioned; but to lift the 10 pounds through one foot, it must descend 10 feet. The two weights, when thus in motion, have equal momenta; the moving mass multiplied into its velocity, is equal to the resisting mass multiplied into its velocity. When the lever seems to multiply force, it only concentrates or accumulates the exertions of the force. The descending one pound weight, in the case above supposed, may be conceived as making 10 distinct exertions of its force, each through a space of a foot; and all these are concentrated in the raising of the 10 pound weight through one foot. The principle thus illustrated in the case of the lever holds good of all the mechanical powers. 4. The object of a machine is not always to increase force or pressure; it is as often to gain velocity at the expense of force. In a spinning factory, e. g., the object of the train of machinery is to distribute the slowly working force of a powerful water-wheel or other prime mover, among a multitude of terminal parts moving rapidly, but having little resistance to overcome. 5. The mechanical advantage of a compound machine is theoretically equal to the product of the separate mechanical advantages of the simple machines composing it; but in applying machines to do work, allowance must be made for the inertia of the materials composing them, the flexure of parts subjected to strains, and the friction, which increases rapidly with the complexity of the parts; and these considerations make it desirable that a machine should consist of as few parts as are consistent with the work it has to do. 6. The forces, or "moving powers," by which machines are driven are the muscular strength of men and animals, wind, water, electrical and magnetic attractions, steam, etc.; and the grand object in the construction of machines is, how, with a given amount of impelling power, to get the greatest amount of work of the kind required. This gives rise to a multitude of problems, some more or less general, others relating more especially to particular cases—problems, the investigation of which constitutes the science of applied mechanics. One of the questions of most general application is the following: If the resistance to a machine were gradually reduced to zero, its velocity would be constantly accelerated until it attained a maximum, which would be when the point to which the impelling force is applied was moving at the same rate as the impelling force itself would move if unresisted. If, on the other hand, the resistance were increased to a certain point, the machine would come to a stand. Now, the problem is, between these two extremes to find the rate at which the greatest effect or amount of work is got from the same amount of driving power. The investigation would be out of place here, but the result is that the greatest effect is produced when the velocity of the point of application is one-third of the maximum velocity above spoken of. The moving force and the resistance should therefore be so adjusted as to produce this velocity.

It will be our endeavor in this article to find the relation between the power and the weight when they balance each other in each of the simple machines; friction and the weight of the machine not being taken into account. For the sake of convenience, the power will be denoted by P, and the weight by W. A *lever* is an inflexible rod, straight or bent, turning on a point called the *fulcrum*. It is much used in the form of an iron bar for moving heavy bodies, through small distances. Fig. 1 shows a lever used for that purpose, in which F is the fulcrum, P is the power exerted by the hand, and W is the weight to be moved. Take a straight inflexible bar, A B, Fig. 2,and place it on a prop, F. On the end, B, hang a weight, W, and balance it with the power, P, hung on the end, A; F A is the power-arm, and F B the weight-arm. Now if F A is equal to F B, then W is equal to P; if F A is three times the length of the arm, F B, then W is double the length of F B,then W is double of P; if F A is three times P;and so on. The *weight* always bears

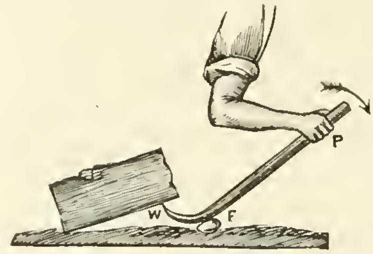


Fig. 1.

the same proportion to the *power* as the *power-arm* bears to the *weight-arm*. The same thing may be expressed by saying that the power multiplied by the length of the power-arm is always equal to the

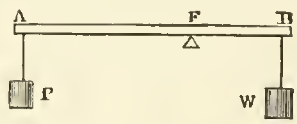


Fig 2.

weight multiplied by the length of the weight-arm. This rule holds for all levers; but if the lever be bent as in Fig. 3 we must not take the bent arms of the lever, E M and F N, for the power and weight arms; but for the power-arm we must take, F A the perpendicular drawn from the fulcrum to the direction

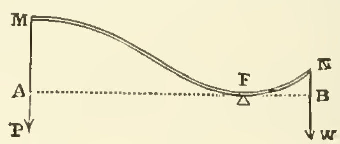


Fig. 3.

in which the power acts, and for the weight-arm we must take F B, the perpendicular drawn from the fulcrum to the direction in which the weight acts. The same precaution must be observed if the power and weight do not act in directions parallel to each other, as shown in Fig. 4.

In Figs. 2, 3, 4, the power multiplied by the length

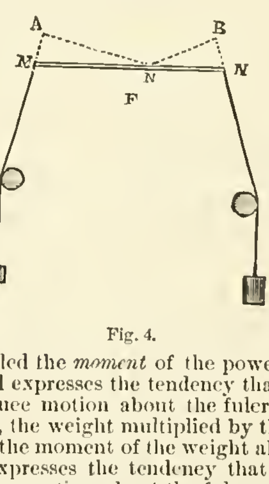


Fig. 4.

of F A is called the *moment* of the power about the fulcrum, and expresses the tendency that the power has to produce motion about the fulcrum; in the same figures, the weight multiplied by the length of F B is called the moment of the weight about the fulcrum, and expresses the tendency that the weight has to produce motion about the fulcrum in the opposite direction. We see that when a lever is at rest the moments of the power and weight about the fulcrum are equal. Levers are generally divided into three kinds, according to the position of the power and weight with regard to the fulcrum. In levers of the first kind the power and weight act on different sides of the fulcrum, as shown in Fig. 5. It is evi-

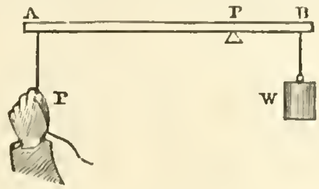


Fig. 5.

dent that with levers of this kind we may either have a *mechanical advantage* or a *mechanical disadvantage*, according as the fulcrum is placed nearer the weight or the power. Examples of this kind of lever are numerous: the crowbar, used as seen in Fig. 1; the poker used in stirring the fire; and the claw-hammer used in drawing a nail, are familiar illustrations. In these, as well as in the examples to be given of the other two kinds of levers, the reader should satisfy himself as to what constitutes the *fulcrum*, *power*, and *weight* in each case. In levers of the second kind, the power and weight act on the

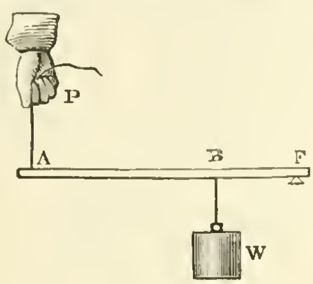


Fig. 6.

same side of the fulcrum, the weight being nearer the fulcrum, as shown in Fig. 6. Here, it is evident, that we have always a *mechanical advantage*, whether great or small, for the power-arm must be always somewhat longer than the weight-arm. Nut-crackers, a chipping-knife, an oar used in propelling a boat, and a door taken by the handle and opened on its hinges, are levers of the second kind. In levers of the third kind, the power and weight also act upon the same side of the fulcrum, the power being nearer the ful-

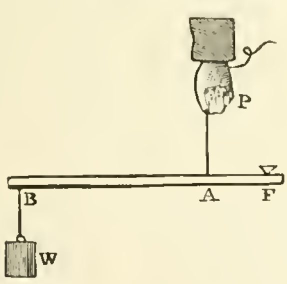


Fig. 7.

crum, as in Fig. 7. In this kind of lever there is always a *mechanical disadvantage*, for in it the power-arm is always shorter than the weight-arm, so that to support a weight with it a greater power is required than if the power were applied directly and without the intervention of a machine at all. This kind of lever is only used when velocity rather than power is wanted: the human arm, Fig. 8, is an example. The fulcrum is at the elbow, the weight is the body resting on the hand, and the contractile

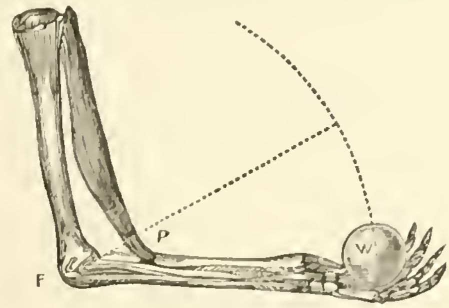


Fig. 8.

force of the muscle furnishes the power which acts at P. When the muscle contracts, the hand describes a much longer curve than P does, and this

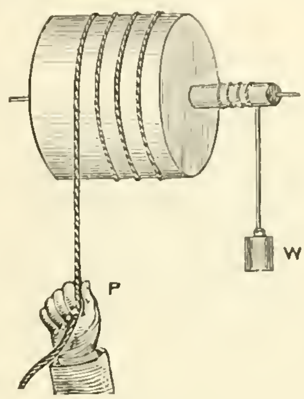


Fig. 9.

is convenient. The *Wheel-and-Axle*, as represented in Fig. 9, consists of two cylinders of different sizes, having a common axis to which they are rigidly attached: the larger cylinder is called the wheel, because a wheel having a groove in its circumference for carrying a rope is sometimes used instead of it; the smaller cylinder is called the axle; their common axis is firmly supported on a strong frame. The weight is attached to the end of a long rope which is coiled round the axle, and the power acts at the end of another rope which is coiled round the wheel in an opposite direction, so that when the

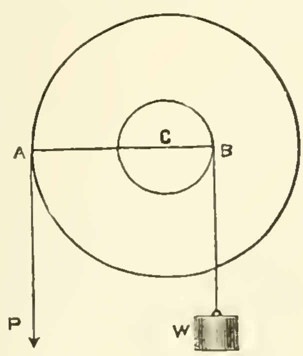


Fig. 10.

rope is pulled down the weight is raised. Fig. 10 represents a vertical section of the wheel-and-axle, from which it is manifest that it is merely a modification of the lever, in which C, the center of the axle, is the fulcrum. C A, the radius of the wheel, is the power-arm. and C B, the radius of the axle is the weight-arm.

It clearly follows, from the law of the lever, that the wheel-and-axle is in equilibrium when the power multiplied by the radius of the wheel equals the weight multiplied by the radius of the axle; so that if the radius of the wheel were eighteen inches and the radius of the axle two inches, then a power of

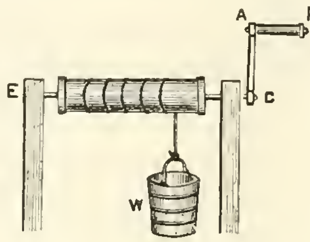


Fig. 11.

one pound would balance a weight of nine pounds. In the windlass, shown in Fig. 11, the arm, A C, is used instead of a wheel. Examples of the practical application of the wheel-and-axle are seen in the capstan. crane, water-wheel, and toothed wheels.

Fig 12 shows a *Pulley* in use. It is a small disk or wheel, of wood or metal, having a groove in its circumference for carrying a string, and turns on an axis passing through the center of its faces, the axis being supported by a frame called a block. Pulleys are designated as either fixed or movable; a pulley is said to be *fixed* when it does not ascend or descend according as the weight is raised or lowered. It is manifest from Fig. 12 that a fixed pulley has no mechanical advantage, for the power, P, must be equal to the weight, W, in order to support it. This machine is only used to change the direction in which a force acts. When force is transmitted through a string, as it is in the case of pulleys, it gets the name of *tension*, and a string possesses the property of transmitting a force without changing its amount; thus the tension at every point of the string in Fig.

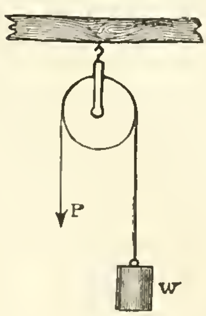


Fig. 12.

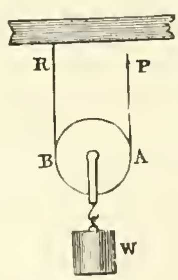


Fig 13.

12 is the weight, W. Pulleys are called *movable* when they ascend or descend according as the weight is raised or lowered. We have a movable pulley in Fig.13. When one movable pulley is used, the strings being parallel, the weight is equal to twice the power. For W is supported by the tension in B R and the tension in A P; and since the tension in each of these is the power, P, acting upward, these two tensions would support a weight of 2 P: therefore W must be equal to 2 P. It is generally found to be convenient to use a fixed pulley along with a movable one when we wish to change the direction of the force, as in Fig. 14. There are three systems of arranging pulleys—or reeving them, as it is called. In the first system, which is shown in Fig. 15, each pulley hangs by a separate string, and all the strings are parallel. When three movable pulleys are ar-

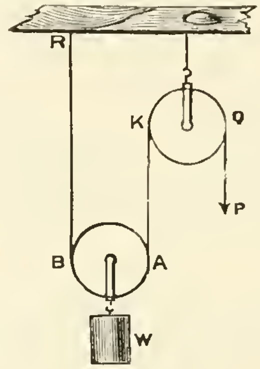


Fig. 14.

ranged thus, the weight is equal to eight times the power; for the tension in the string passing under the first movable pulley at the top is the power, P;

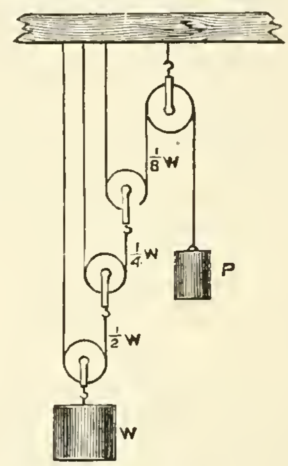


Fig. 15.

the tension in the string passing under the second movable pulley is 2 P; the tension in the string passing under the third movable pulley is 4 P; and the tension in the string hanging from this pulley is 8 P. But this last tension supports the weight, W, therefore W = 8 P. It will be observed that in this system each movable pulley that is added doubles the mechanical advantage. In the second system the string passes round all the pulleys, and the folds of this string are parallel, as represented in Fig. 16. Here the weight, W, is supported by the tensions in the folds of the string; and as there are four folds, each having the tension of the power, P, the weight must be four times the power. In this system the weight is always as many times the power as there are folds in the string, the folds being counted between the two blocks. In the third system Fig. 17, each pulley hangs by a separate string, and the end of each string is attached to the weight, the whole being suspended from a fixed support. The tension in the string passing over the first pulley at the bottom is the power, P; the tension in the string passing over the next pulley is 2 P; the tension in the string passing over the third pulley from the bottom is 4 P; and so on. Thus it is when three pulleys are arranged in this manner, W is supported by P + 2 P + 4 P, that is, by 7 P, and therefore the weight is exactly equal to seven times the power. The effect of any other number may be calculated similarly. The first thing that strikes one on experimenting with the pulleys is the

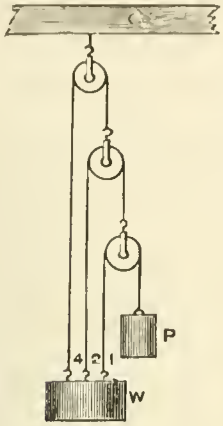


Fig. 16.

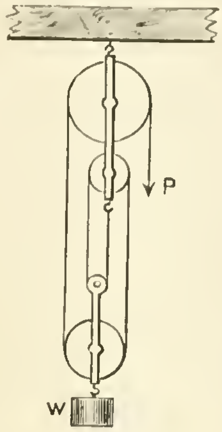


Fig. 17.

principle of virtual velocities. Let us make an experiment with the first system, shown in Fig. 15. Here we have three movable pulleys, and we find that a power of 1 oz. balances a weight of 8 oz. True: but on putting the machine in action, we also find that when the weight is raised 1 ft. the power has to move through 8 ft., so that what is gained in power is lost in speed, and, as we said before, this is true of every machine.

We now come to consider the inclined plane. Here

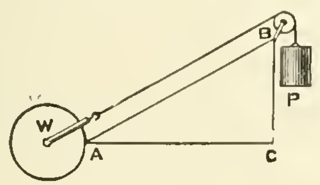


Fig. 18.

is one in Fig. 18. We shall perform an experiment on it, and then draw a conclusion. Let the weight, W, be drawn from the bottom to the top of the inclined plane by the power, P, which acts on the

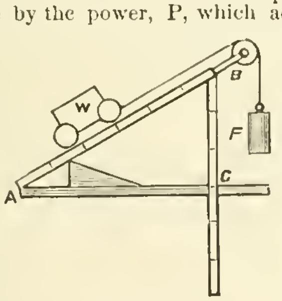


Fig. 19.

weight in a direction parallel to the length of the plane A B; W will be thus raised through a vertical distance equal to B C, the height of the plane; but during this time P will have descended through a vertical distance equal to A B, the length of the plane. Now, from the principle of virtual velocities it follows at once that there is equilibrium here, when P multiplied by A B is equal to W multiplied by B C; that is, on the inclined plane, when the power acts parallel to the length of the plane, there is equilibrium when the power multiplied by the length is equal to the weight multiplied by the height. In Fig. 19, an experiment is shown which verifies the rule we have just drawn from the principle of virtual velocities. A B and A C are two boards, hinged together at A. A C rests for convenience on a table, and A B can be made to rise from it at any angle by inserting a wedge, properly prepared as seen in the figure. From B hangs a bar graduated in inches, by which the height of the plane can be at once measured. The carriage, W, constitutes the weight, and the power, P, acts on it in a direction parallel to the length of the plane. Now make P balance W, and then measure the height and length of the plane; it will be found that P is to W as the height of the plane is to its length; that is, the power multiplied by the number of inches in the length will be equal to the weight multiplied by the number of inches in the height. By varying the experiment, so that the power might act in a direction parallel to the base, we would find that there would be equilibrium when the power multiplied by the base equals the weight multiplied by the height. Two inclined planes placed base to base form a *Wedge*. It is much used in splitting wood, as in Fig. 20; it is also used for raising great

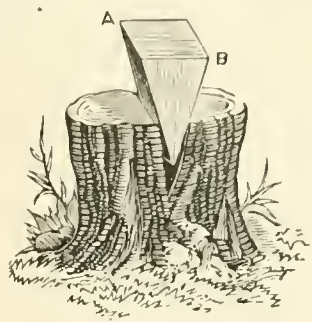


Fig. 20.

weights through small distances. In dockyards, ships are raised on the stocks by wedges driven under their keels. Theoretically considered, the mechanical advantage of the isosceles wedge is the side of the wedge divided by half the back. But this gives us no idea of the real advantage of the machine: this arises from its enormous friction, and also because the force which urges it is derived from the blow of a hammer or a mallet, etc.; a force so very different in its nature from the resistance that it has to overcome, which is the pressure of some weight or the cohesion of the particles of a body, that it admits of no numerical comparison. One part of the theory is true: that the smaller the back the greater is the advantage of the wedge. If a flexible inclined plane, A—one made of paper, for example—be wrapped round a cylinder, B, as in Fig. 21, a *screw* is formed. By means of the apparatus in Fig. 22 we can determine the mechanical advantage of the screw. The resistance here is the bar, W, which is to be moved forward; the power acts at the handle A P. When

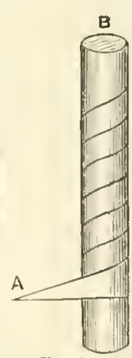


Fig. 21.

the machine is put in action by turning the handle, the power moves through the circumference of the circle described by the handle, while the weight is only moved from *a* to *b*, the distance between two threads; so that in the screw the power is to the weight as the distance between two threads is to the circumference of the circle described by the power. Thus, suppose A P sweeps a circle of 30 in., and that the distance between two threads is ½ in.: then the mechanical advantage of the machine is 30 divided by ½, that is 60; so that if a power of 50 lbs. is exerted on the handle, A P, the bar, W, is urged forward with a force of 60 times 50 lbs., that is 3,000 lbs.

The screw is much used to exert a great pressure through small distances. Fig. 23 shows a common screw-press. To apply the screw here, in an expeditious way, a hollow screw is cut in the nut, N,

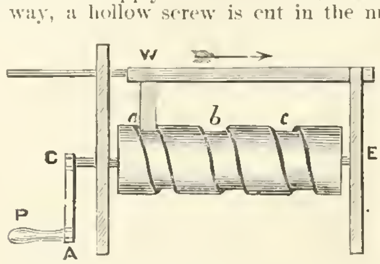


Fig. 22.

into the groves of which the threads of the solid screw fit exactly. The solid screw, S, is fixed to the press-board, B B, so that it cannot turn round, but can be made to move up and down; on the other hand, the nut, N, is fixed, so that it cannot be moved up and down, but can be made to turn round by means of the bar, P, which is inserted in a hole in its side. When the power makes one revolution, the solid screw, with the press-board attached to it, is raised through the distance between two threads; so that if the power, P, sweeps a circle of 20 ft., that is, 240 in., and the

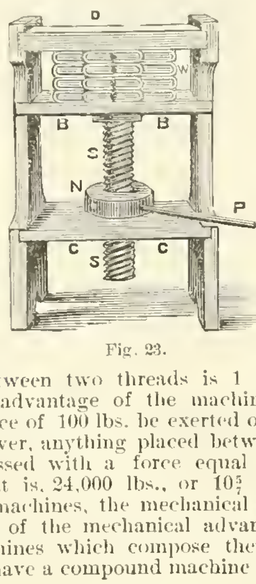


Fig. 23.

distance between two threads is 1 in., then the mechanical advantage of the machine is 240; so that if a force of 100 lbs. be exerted on the extremity of the lever, anything placed between B and D will be pressed with a force equal to 240 times 100 lbs., that is, 24,000 lbs., or $10\frac{5}{7}$ tons. In the compound machines, the mechanical advantage is the product of the mechanical advantages of the simple machines which compose them. Thus, in Fig. 24 we have a compound machine consisting of

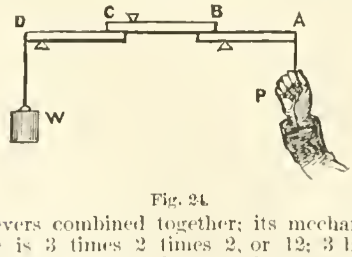


Fig. 24.

three levers combined together; its mechanical advantage is 3 times 2 times 2, or 12; 3 being the mechanical advantage of the first lever, 2 that of the second, and 2 that of the third. A power of 1 lb. applied at A. would balance a weight of 12 lbs. at D.

MECHANICS.—The science which treats of the nature of forces and of their action on bodies, either directly or by the agency of machinery. The nature of force will be found treated of under FORCE. The action of forces on bodies may be in the form of pressure or of impulse, and may or may not produce motion. When the forces are so balanced as to preserve the body affected by them in a state of equilibrium, their actions are investigated in that branch of mechanics called STATICS; when motion is produced, they are considered under the head of DYNAMICS, or *Kynetics*. The equilibrium and motion of fluids (including liquids and gases) is treated in the subordinate branches of HYDROSTATICS and HYDRODYNAMICS; though the special terms AEROSTATICS and AERODYNAMICS (for which the comprehensive term PNEUMATICS is often used) are sometimes employed to designate those portions of the science of mechanics in which the action of gaseous bodies is treated of. The science of mechanics owes very little to the ancient philosophers. They were acquainted with the conditions of equilibrium on the lever—discovered by Archimedes—and had reduced the theory of all the mechanical powers, except the pulley and the inclined plane and its derivatives, to that of the lever, but this was nearly all. Archimedes, starting from the principle of equilibrium on the lever, struck out the idea of a center of gravity for every body, and investigated the position of that point for the triangle, parabola, and paraboloid. Till the 16th century, the science remained stationary. Cardan, the Marquis Ubaldi, and Stevinus—the first to give the correct theory of equilibrium on the inclined plane—then gave it a slight impetus, and the labors of Galileo, who introduced the expression of mechanical propositions in mathematical formulas, discovered the laws regulating the motion of falling bodies, and originated investigations concerning the strength of materials, placed the science on a broad and substantial basis. Torricelli, Descartes, Pascal, Fermat, Roberval, and Huyghens, on the continent, and Wallis and Wren in England—the last three of whom simultaneously discovered the laws which regulate the collision of bodies—added each his quota to the *New Science*, as Mechanics was then called. In 1687, appeared Newton's *Principia*, in which the complete experimental basis of the subject was first laid down in a satisfactory manner, and the mechanical principles which had before been considered to act only at the surface of the earth, were shown to rule and direct the motions of the planets. Contemporary with Newton were Leibnitz, and the two elder Bernouillis, James and John, who, besides contributing greatly to the advancement of the science, applied to it the newly-invented differential calculus, which was found to be a weapon of immense power. From this time, a constant succession of illustrious men have prosecuted the study of theoretical mechanics, or of subjects connected with it. The chief names are Daniel Bernouilli, Euler, D'Alembert, Clairaut, Lagrange, Laplace. Lagrange's *Mécanique Analytique* not only systematised the subject, but enormously increased its power and the range of its applications. The last great additions to the science are those made by Sir W. R. Hamilton, under the name of the principle of *Varying Action*. The developments which this has received from Jacobi, Boole, Cayley, Liouville, Donkin, Bour, etc., form an extensive and difficult branch of applied mathematics, chiefly of the theory of simultaneous differential equations.

MEDAL.—A piece of metal in the form of a coin, not issued or circulated as money, but stamped with a figure or device to preserve the portrait of some eminent person, or the memory of some illustrious action or event. The study of medals, interesting in an historical and antiquarian point of view, is also important as illustrating the contemporary state of art. Like coins, medals belong to two periods, ancient and modern, separated by a wide interval. To the former belong those pieces issuing from the mint of ancient Rome, known as *Medallions*, of the size of the aureus in gold, of the denarius in silver, and of the first or large brass in copper. They are generally supposed to have been struck on occasions similar to those on which medals are coined in modern times, on the accession of an Emperor, on the achievement of an important victory, or as specimens of workmanship; but there are circumstances which countenance the belief that they were circulated as money. Medallions prior to the time of Hadrian are rare and of great value; one of the most beautiful and most famous being a gold medallion of Augustus Cæsar; from Hadrian to the close of the Empire they are comparatively common. Of the Roman medallions, some were struck by order of the Emperors, some by the Senate; the latter may be known by being inscribed with the letters S. C. The larger bronze medallions are of admirable workmanship. In some of them a ring of bronze surrounds a center of copper, and the inscription extends over both metals. No portrait of a person not princely occurs on any ancient medal, a remarkable circumstance, considering the numerous contemporary statues of poets, historians, and philosophers. The *Contorniati* are bronze medals marked with furrows *(contorni)*, distributed at the public games and apparently also in use as money, Numerous medals and medallions were struck in the Greek provinces of the Roman Empire, of less substance and thickness, for the most part, than those of Rome. The Sicilian medals are of very fine workmanship, particularly one with a head of Ceres, and on the reverse a Victory crowning a figure in a car.

Medals in the present day are conferred by the Sovereign as marks of distinction for eminent worth or noble conduct, more particularly for naval and military services. Such medals of honor are seldom of great intrinsic value, their worth depending merely on the associations connected with them. They have ribbons attached, with clasps or small bars, each of which bears the name of a particular action. The Waterloo medal is of silver, with the head of George IV (Prince Regent), a winged Victory, and the words "Waterloo," "Wellington;" it hangs from a crimson ribbon, with a narrow stripe of blue near each edge. The Crimean medal, also of silver, is attached to a blue ribbon with yellow edges when worn for service in the Crimea, and to a yellow ribbon with blue edges when for service in the Baltic. Good-service medals of silver were instituted in 1830 and 1831, and rules formed for their distribution among meritorious sailors, soldiers, and marines. The Naval medal is worn suspended from a blue, and the Military from a crimson ribbon. There are also various British medals which have been conferred for services in the Peninsula, India, etc. On every medal is engraved the name, rank, etc., regiment or ship of the recipient of it. Medals and decorations do not seem to have been ever conferred as rewards in the Army or Navy prior to the Commonwealth. The French military medal and the Sardinian War Medal were some time ago bestowed to a large extent on British officers, soldiers, seamen, and marines. The former exhibits the effigy of Napoleon III., surmounted by an eagle, and is worn from a yellow ribbon with green borders; the latter is charged with the Cross of Savoy, and suspended from a sky-blue ribbon.

MEDAILLE MILITAIRE.—A French military medal instituted by Napoleon III. It is conferred principally on privates and non-commissioned officers for gallantry in the field, and carries with it a pension of £5 a year. The *médaille militaire* is, however, also conferred on Field Marshals and Generals when they have attained to the highest rank of military honors, that of Grand-Croix of the Legion of Honor. It exhibits the effigy of the founder, surmounted by an eagle, and is attached to a yellow ribbon with a green border. It was, after the Crimean War, bestowed, to a large extent, on British soldiers.

MEDICAL BOARD.—A Board consisting of three or more officers of the Medical Department, convened by an order through the Secretary of War, for the inspection of wounded officers in order to secure them a provision for life, in accordance with the regulations regarding pensions, etc.

MEDICAL DEPARTMENT.—This Department of an army, next to the Commissariat, is the most important of all the non-combatant sections. The surgical treatment of the wounded in actual fighting, and still more the combat with disease engendered by crowding, unhealthy stations, and the reckless habits of the soldiery, necessitate a large Medical Staff; for, on an average of the whole army, it is found that the rate of sickness is at least triple that for the civil population.

In the British army every battalion, when at home or in the temperate zone, has a Surgeon and an Assistant Surgeon; when in India or the tropics, another Assistant Surgeon is added. In addition to these officers, there are numerous Staff Medical Officers at all stations, who have charge of detachments, hospitals, etc. The active list of the Medical Officers comprised, in 1879-80, 530 Surgeons-General, Deputy Surgeons General, Surgeons Major, and Surgeons. Besides these, there are between 400 and 500 Medical Officers employed with the army in India. The total estimate for medical establishments and services in 1879-80 was £266,200. The Medical Department is governed by a Director-General, who is a member of the War Office, and has charge of the surgical, medical, and sanitary arrangements of the army.

In the United States, the Surgeon General is charged, under the Secretary of War, with the administrative duties of the Medical Department. The Chief Medical Purveyor is the chief purchasing and disbursing officer of the Medical Department. He has, under the direction of the Surgeon General, the supervision of the purchase and distribution of all medical and hospital supplies. Every military post has at least one medical officer and sometimes two, as the nature of the climate or the strength of the garrison demands; all of whom are under the command of the Surgeon General.

The Medical Department is, at present, organized as follows:—One Surgeon General, with the rank of Brigadier General; one Assistant Surgeon General, with the rank of Colonel; one Chief Medical Purveyor, with the rank of Colonel; four Surgeons, with the rank of Colonel; eight Surgeons, with the rank of Lieutenant-colonel; two Assistant Medical Purveyors, with the rank of Lieutenant-colonel; fifty Surgeons, with the rank of Major; eighty-eight Assistant Surgeons, with the rank of Captain; and thirty-seven Assistant Surgeons, with the rank of First Lieutenant. There are also in the Medical Department, four Medical Storekeepers, and one hundred and fifty Hospital Stewards. Assistant Surgeons have the rank, pay, and emoluments of First Lieutenant of Cavalry for the first *five* years' service, and the rank, pay, and emoluments of the grade of Captain after *five* years' service.

MEDICAL DIRECTOR.—In the United States service, an officer who is assigned to duty at the Headquarters of a Military Geographical Division or Department, and who, under the supervision of the Surgeon General, has control of the Medical Department within the limits of the command in which he is serving. Medical Directors are assigned by order of the Secretary of War, and are required to make such special reports to the Surgeon General as shall at all times keep him fully informed as to the sanitary condition of his Department.

MEDICAL SCHOOL.—An establishment for the technical education of medical officers for the British and Indian military service. Candidates are examined competitively in the ordinary subjects of professional knowledge; and, passing satisfactorily through that ordeal, are then required to attend, for six months, at the Military Medical School, where they go through practical courses of military hygiene, military and clinical-military surgery and medicine, and pathology with morbid anatomy. As the School is attached to the Royal Victoria Hospital, which is the great invalid depot for the whole army, the students have ample opportunity of seeing theory exemplified in practice. The School comprises 4 Professors with £850 a year each, 4 Assistant Professors having £450 each, and usually about 40 medical candidates, who receive each 5 shillings a day and lodging-money. The annual cost of the whole establishment is about £7,900.

MEDICAL STAFF.—A branch of the British Army, under the control of some experienced officer, stationed at headquarters and denominated Director General. Immediately under his command are a number of Inspectors General, Deputy Inspectors General, and a Corps of Staff Surgeons. The locality of all the officers subordinate to the Director General is determined by the force to which they may be attached. All the Regimental Surgeons and Assistant Surgeons make their reports to and consult the Staff Officer who is placed in their district. The Director General is paid from the civil department of the Government. A Deputy Inspector General of Hospitals must have served five years at home, or three years abroad in this rank, before he shall be eligible to the highest rank of Inspector General.

MEDICAL STOREKEEPERS.—Medical Storekeepers are charged, under the direction of the Surgeon General and the Chief and Assistant Medical Purveyors, with the storing and safe-keeping of Medical supplies, and with the duties of receiving, issuing, and accounting for the same, according to regulations. If a Medical Storekeeper be assigned to the same depot with an Assistant Medical Purveyor, he prepares all requisitions under his direction and subject to his approval. Medical supplies transferred to Medical Storekeepers by the Chief or Assistant Medical Purveyors are receipted for as invoiced, without breaking packages, provided that the number of packages corresponds with the invoice, that they be in good shipping condition, and that there be no reason to suppose the contents broken or defective. Medical Storekeepers cause the Medical supplies issued or transferred by them to be well packed, each article designated by the name of the maker or vender, and each package legibly and correctly marked with the address of the officer for whom it may be intended, and with its weight and contents, whether medicines, hospital stores, instruments, dressings, books and stationery, bedding, clothing, or furniture and appliances. There are four Medical Storekeepers in the United States army, with the rank, pay and emoluments of a Captain of Cavalry.

MEDICAL SUPPLIES.—The Medical supplies for an army are prescribed in the Standard Supply Tables furnished by the Surgeons General, and issues are governed by it, except as to the size of packages, which may be regulated by circumstances and quantities required. When any requisition is not according to the Supply Table, the reason therefore is explained, as in the prevalence of epidemics, unhealthy location of troops, or other cause making a deviation desirable. In the United States service, Acting Assistant Medical Purveyors at field depots, and the senior Medical Officer of every hospital, regiment, post, or detached command, forward their requisitions for Medical supplies to the Medical Director under whom they may be serving. The Medical Director approves or modifies the requisition at his discretion and transmits them to the nearest purveying depot for issue. If the Assistant Medical Purveyor or officer in charge of the depot deems necessary, on account of the character of the supplies, he forwards the requisition through the Chief Medical Purveyor to the Surgeon General for instructions. If the quantity required be large, and there is time, the Medical Director transmits the requisitions, with his recommendations indorsed thereon, to the Surgeon General.

Requisitions to replenish Medical supplies are made in detail, in duplicate, and transmitted by different mails, on the 30th June and 31st December They are made only for articles that are, or probably will be, deficient. They exhibit the quantity of every article on hand, whether more be wanted or not. At remote posts, requisitions are made at such times and for such periods as may be specially authorized by the Surgeon General. Special requisitions are only permissible in cases of emergency. A duplicate of every special requisition, giving the name of the officer upon whom it is made, is immediately forwarded to the Surgeon General for his information. Requisitions for articles not on the Standard Supply Table is, in all cases, forwarded to the Surgeon General for his action. When it is necessary to obtain Medical supplies, and recourse cannot be had to a purveying depot, they may be purchased by the Medical Officer, and bills in duplicate therefor sent through the Medical Director to the Surgeon General for examination and payment. The purchasing officer shall prepare, in triplicate, an invoice of all the articles bought—one copy to be forwarded to the Surgeon General, with the bill; one, as a voucher, to accompany his next property return, on which he accounts for the articles purchased; and one to be filed with his retained set of vouchers. In all official lists of Medical supplies the nomenclature, order, and classification of the Standard Supply Table is strictly followed. The whole table is not transcribed in all instances, but the names of the articles mentioned follow the official arrangement.

I.—REGULAR LIST

MEDICINES.

Acid, acetic.
Acid, carbolic, for disinfection.
Acid, carbolic, pure, crystallized.
Acid, citric.
Acid, muriatic.
Acid, nitric.
Acid, sulphuric.
Acid, sulphuric, aromatic.
Acid, tannic.
Acid, tartaric, powdered.
Alcohol.
Aloes, powdered.
Alumina and potassa, sulphate of.
Ammonia, aromatic spirits of.
Ammonia, carbonate of.
Ammonia, muriate of.
Ammonia, solution of.
Antimony and potassa, tartrate of.
Arsenic, pills of.
Arsenite of potassa, solution of.
Belladonna, alcoholic extract of.
Bismuth, subnitrate of.
Borax, powdered.
Camphor.
Castor oil.
Cerate, blistering.
Cerate, resin.
Cerate, simple.
Chalk, prepared.
Chloral, hydrate of.
Chloroform, purified.
Cinchona, fluid extract of.
Cinnamon, oil of.
Cod liver oil.
Colchicum seed, fluid extract of.
Colocynth, compound extract of.
Copper, sulphate of.
Croton oil.
Digitalis, tincture of.
Ergot, fluid extract of.
Ether, compound spirits of.
Ether, stronger, for anæsthesia.
Ether, spirits of nitrous.
Flaxseed.
Flaxseed meal.
Ginger, fluid extract of.
Glycerine, pure.
Gum arabic, powdered.
Hyoscyamus, alcoholic extract of.
Iodine.
Ipecacuanha, powdered.
Iron, solution of the sulphate of.
Iron, sulphate of.
Iron, tincture of the chloride of.
Iron and quinia, citrate of.
Jalap, powdered.
Lavender, compound spirits of.
Lead, acetate of.
Liquorice, extract of.
Liquorice root, powdered.
Magnesia, heavy calcined.
Magnesia, sulphate of.
Mercurial ointment.
Mercury, corrosive chloride of.

Mercury with chalk.
Mercury, mild chloride of.
Mercury, ointment of the nitrate of.
Mercury, pill of.
Mercury, red oxide of.
Morphia, sulphate of.
Mustard seed, black, ground.
Nux vomica, alcoholic extract of.
Olive oil.
Opium, camphorated tincture of.
Opium, compound powder of.
Opium, deodorized tincture of.
Opium, powdered.
Opium, tincture of.
Pepper, Cayenne, ground.
Peppermint, spirits of.
Pills, camphor and opium, in bottles.
Pills, compound cathartic, in bottles.
Pills, opium, in bottles.
Podophyllum, resin of.
Potassa, caustic.
Potassa, acetate of.
Potassa, bicarbonate of.
Potassa, bitartrate of.
Potassa, chlorate of.
Potassa, nitrate of.
Potassa, permanganate of.
Potassium, bromide of.
Potassium, iodide of.
Quinia, sulphate of.
Rhubarb, powdered.
Rochelle salt.
Santonin.
Seneka, fluid extract of.
Silver, nitrate of, in crystals.
Silver, nitrate of, fused.
Soap, castile.
Soap, common.
Soda, bicarbonate of.
Soda, chlorinated solution of.
Squill, powdered.
Squill, syrup of.
Strychnia.
Sulphur, washed.
Turpentine, oil of.
Vaccine virus.
Wax, white.
Zinc, acetate of.
Zinc, oxide of.
Zinc, solution of chloride of.
Zinc, sulphate of.

II.—SUPPLEMENTARY LIST.

MEDICINES.

Acid, arsenious.
Acid, benzoic.
Acid, chromic.
Acid, gallic.
Acid phosphoric, diluted.
Acid, hydrocyanic, diluted.
Aconite root, fluid extract of.
Aconite root, tincture of.
Ammonia, phosphate of
Anise, oil of.
Arnica, fluid extract of
Arsenic and mercury, solution of iodide of.
Assafetida.
Atropia, sulphate of.
Bismuth, subcarbonate of.
Bismuth, tannate of.
Blistering, liquid.
Bromine.
Buchu, fluid extract of.
Cacao, butter of.
Calabar bean, extract of.
Cantharides, tincture of.
Cantharides, cerate of the extract of.
Catechu.
Chamomile flowers.
Cinchona bark, powdered,
Cloves, oil of.
Collodion.
Copabia.
Creosote.
Cubeb, oleo-resin of.
Gentian, fluid extract of.
Gum arabic.
Guaiac, resin of.
Indian hemp, purified extract of.
Ipecacuanha, fluid extract of.
Iron, dried sulphate of.
Iron, by hydrogen.
Iron, hypophosphate of.
Iron, syrup of the iodide of.
Iron, oxalate of.
Iron and potassa, tartrate of.
Iron, pyrophosphate of.
Mercury, green iodide of.
Mercury, yellow subsulphate of.
Morphia, acetate of.
Myrrh.
Origanum, oil of.
Potassium, cyanide of.
Sarsaparilla, fluid extract of.
Senna, confection of.
Sinapism paper.
Soda, phosphate of, exsiccated.
Soda, sulphite of, exsiccated.
Sulphur, in roll.
Tar, wood.
Taraxacum, fluid extract of.
Tolu, balsam of.
Valerian, fluid extract of.
Veratrum viride, fluid extract of.
Veratrum viride, tincture of.
Wax, yellow.
Wild-cherry bark, fluid extract of.

HOSPITAL STORES.

Arrow-root.
Barley.
Beef, extract of, Liebigs.
Brandy.
Candles.
Candles, wax.
Cinnamon,
Cocoa or chocolate.
Corn starch.
Farina.
Gelatin, shred.
Ginger.
Milk, concentrated.
Nutmegs.
Pepper, black.
Sugar, white.
Tapioca.
Tea, black.
Whiskey.
Wine.

III.—ARTICLES EXPENDABLE.

INSTRUMENTS.

Nipple shields.
Probangs.
Syringes, glass.
Syringes, rubber.
Trusses, single.
Trusses, double.

DRESSINGS.

Bandages.
Bandages, suspensory.
Binder's boards, small.
Binder's boards, large.
Cotton bats.
Cotton wadding.
Flannel, red, all wool.
Gutta-percha cloth.
Lint, patent.
Lint, picked.
Muslin.
Needles, cotton, thimble in case.
Needles, assorted.
Needles, upholsterer's.
Oakum.
Oiled muslin.
Oiled silk.
Plaster of Paris.
Pencils, hair.
Pins.
Plaster, adhesive.
Plaster, isinglass.
Silk, gray.
Silk, ligature.
Splints.
Splints, Smith's anterior.
Splints, material for making, felt.
Sponge.
Tape, cotton.
Thread, linen.
Thread, cotton, spools.
Tow.
Towels.
Towels, roller.
Twine.

IV.—ARTICLES NOT EXPENDABLE.

INSTRUMENTS.

Atomizers, steam.
Cupping glasses.
Cupping tins.
Electric apparatus.
Field case.
Irrigators.
Lancet, thumb.
Leech, artificial.
Obstetrical case.
Pocket case.
Post-mortem case.
Scarificators,
Scissors.
Speculum for the rectum.
Speculum for the vagina.
Spongeholders.
Spray apparatus.
Stethoscope.
Stomach-pump and tube, in case.
Syringes, hard rubber, 8-ounce.
Syringes, hypodermic.
Syringes, rubber, self-injecting.
Syringes, rubber, self-injecting, with colpeurynter in each case.
Syringes, universal, hard rubber.
Syringes, vagina, glass.
Syringes, vagina, hard rubber.
Tooth-extracting case, Army pattern.
Thermometer, clinical.
Tongue depressors.
Tourniquets, field.
Tourniquets, screw, with pad.
Urinometers.
Amputating case.
Trephining case.
General operating case.
Exsecting case.
Capital operation case.
Minor operation case.
Trunks, leather.
Barometer, aneroid.
Barometer, mercurial.
Hygrometer.
Rain-gauge.
Rain-gauge glasses.

Thermometer, maximum.
Thermometer, minimum.
Thermometer, standard.

BOOKS.

Anatomy, Grays.
Bumstead on Venereal.
Chemistry, Fowne's.
Children, Diseases of, Meigs Treatise.
Children, Diseases of, Vogel.
Craig on the Decimal System.
Diagnosis, Da Costa's.
Dictionary, English, Worcester's.
Dictionary Medical, Dunglison's.
Diseases of Women, Thomas.
Dispensatory.
Ear, Tröltsch on.
Eye, Stellwag on.
Histology, Stricker's.
Hygiene, Parke's.
Jurisprudence, Taylor's.
Jurisprudence, Stillé & Wharton's.
Meteorology, Loomis'.
Midwifery, Hodges.
Midwifery, Cazeaux'.
Ophthalmoscope, Zander.
Pathology, Surgical, Billroth's.
Physics, Ganot's.
Physiology, Flint's.
Practice of Medicine, Flint's.
Practice of Medicine, Wood's.
Practice of Medicine, Reynolds'.
Practice of Medicine, Aitken's.
Practice of Medicine, Niemeyer's.
Recruits, Examination of, Tripler's.
Skin, Diseases of, Tilbury Fox's.
Surgery, Erichsen's.
Surgery, Gross'.
Surgery, Holmes'.
Surgery, Guthrie's Commentaries.
Therapeutics, Stillé's.
Therapeutics, Waring's.
Therapeutics, Mechanical, Wales'.
Woodward on "Camp Diseases."
Woodward's Hospital Steward's Manual.
Case, Diet and Prescription Book.
Morning Report Book.
Order and Letter Book.
Record of Deaths.
Register, Meterological.
Register of Patients.
Register, Surgical Operations.

BEDDING.

Bed sacks.
Beds, water.
Blankets.
Blanket cases.
Counterpanes.
Cushions, rubber, small.
Cushions, rubber, with open center.
Gutta-percha bed covers.
Mattresses, hair.
Mosquito bars.
Pillows, hair.
Pillows, feathers.
Pillow cases, white.
Pillow ticks.
Sheets.

The above Table is ample and sufficiently varied for ordinary practice, but in order to provide for the necessities of unusual emergencies, and to indulge, as far as practicable, individual preference and treatment, special requisitions for numerous miscellaneous articles, not on the Table.may be made to the Surgeon General at any time.

MEDICINE CHEST.—A pannier filled with a variety of medicines necessary for a campaign, together with such chirurgical instruments as are useful. These chests are usually provided by the Government, and are fitted up with a view to being transported on pack animals. Before taking the field for a long or indefinite period, Commanding Officers, or Surgeons-in-Charge, should provide a sufficient number of *Medicine Chests*, each supplied with the following articles: A case of pocket surgical instruments, consisting of, at least, a lancet, scalpel, small knife, forceps, and scissors; a few rolls of sticking and adhesive plaster; some silk, needles and waxed thread; an assortment of bandages, splints, sponges and some red flannel; some lint, oil-silk and tow; a flask of wine or brandy; a hypodermic injection syringe; a tourniquet and small cup; blue mass, quinine, opium and cathartic, put up in usual doses; a little chloroform, laudanum, hartshorn, camphor, solution of morphia, iodine, tincture of chloride of iron, chloride of lime, tincture of myrrh and aloes, tincture of arnica (excellent for strains and contusions), spirits of nitre, ammonia and turpentine; sulphates of iron, zinc and copper; pulverized indigo, carron oil, saltpeter, tartar emetic, nitrate of potash, prepared chalk, tincture of opium and catechu, cantharides (in powder), sugar of lead, acetic acid, and powdered mustard; emetics and aperients (mild and powerful); nitrate of silver, in a holder; cold cream or glycerine (cooling for irritated surfaces); a cordial for diarrhœa, a sudorific (Dover's powders excellent), and some simple cerate or a mixture of wax and lard; some alum, Jamaica ginger, castor oil, linseed oil and meal, flaxseed, and an assortment of cathartic, diuretic, sedative, febrifuge and alterative "balls"; also some astringent ointment (one part acetate of lead and three parts of lard), hoof ointment (equal parts of tar and lard), and a strong liniment. See *Field Remedies*, *Medical Supplies* and *Military Surgery*.

MEDJIDIE.—A Turkish Order, instituted in 1852, and conferred after the Crimean Campaign, to a considerable extent, on British officers. It has five classes; and the decoration, which differs in size for the different classes, is a silver sun of seven triple rays, with the device of the crescent and star alternating with the rays. On a circle of red enamel, in the center of the decoration, is the legend in Turkish, whose signification is "Zeal, Honor, and Loyalty," and the date 1268, the Mohammedan year corresponding to 1852; the Sultan's name is inscribed on a gold field within this circle. The first three classes suspend the badge around the neck from a red ribbon having green borders, and the fourth and fifth classes wear it attached to a similar ribbon on the left breast. A star, in design closely resembling the badge, is worn on the left breast by the first class, and on the right breast by the second class.

MEDIUM CAVALRY.—An appellation given to some of the regiments of the British army which are neither *heavy* nor *light*. There are 11 regiments of medium cavalry, 5 of which are Lancers (5th, 9th, 12th, 16th, and 17th), five Dragoon Guards (1st, 2d, 3d, 6th, 7th), and one (6th) Dragoons. The latter 6 regiments wear brass helmets. The average weight carried by the horses of the medium cavalry is about 18 stone 10 lbs.

MEER BUKSHY.—A Chief Paymaster in the East Indies.

MEER TOZUK.—In the East Indies, a Marshal whose business is to preserve order in a procession or line of march, and to report absentees.

MEGGHETERIARQUE.—The Commanding Officer of a body of men called *Heteriennes*, who formerly did duty at Constantinople. They were composed of soldiers who were enlisted in the Allied Nations.

MEGRIMS.—Megrims and vertigo are the terms usually applied when a horse at work reels, and then either stands for a minute dull and stupid, or falls to the ground, lying for a time partially insensible. These attacks come on suddenly, are often periodical, are most frequent during hot weather, and when the animal is drawing up a hill, or exposed during heavy work to the full rays of a hot sun. Liability to megrims constitutes unsoundness, and usually depends upon the circulation through the brain being temporarily disturbed by the presence of tumors. Horses subject to megrims are always dangerous; if driven at all, they should be used with a breastplate or pipe-collar, so as to prevent, as much as possible, pressure on the veins carrying the blood from the head. They should be moderately and carefully fed, and during hot weather have an occasional laxative.

MEIGS GUN.—An early magazine-gun carrying a great number of cartridges. Some patterns carried as many as forty or fifty rounds. This system, like many of its contemporaries, did not meet with any considerable success. See *Magazine-gun*.

MELDER SYSTEM OF FORTIFICATION.—This system very much resembles that of Freytag, but there is an absence of ravelins on the salients of bastions.

MELEE.—A military term which is used among the French to express the hurry and confusion of a battle. Melée corresponds with the English expression "Thick of the fight."

MEMBERED.—A term in Heraldry; when a bird has its legs of a different color from its body, it is said to be membered of that color.

MEMBERS.—Officers are so called who are detailed by orders to sit on General or Garrison Courts-Martial. In case supernumerary members are detailed for a court-martial, they are sworn, and it is right that they should sit and be present at all deliberations even when the court is cleared, in order to be prepared to take the place of any absent member. Until then they have no voice.

MEMOIR.—The title given by military officers to those plans which they offer to their government or commanders on subjects relating to war or Military economy. *Memoirs* is a species of history, written by persons who had some share in the transactions they relate, answering in some measure to what the Romans' call Commentarii. Cæsar's Commentaries are the Memoirs of his Campaigns.

MEMORIAL.—An address in the form of a petition to a Sovereign or other authority, able to redress the grievance of the memorialist. Memorials or petitions of the nature above adverted to may be addressed by officers to government; they must be written, not printed, and signed by the writer.

MENACE.—A hostile threat. A Court-Martial may punish, at discretion, any person who uses any menacing words, signs or gestures in its presence, or who disturbs its proceedings by any riot or disorder.

MENAGE.—All military men should have a thorough knowledge of the structure and powers of endurance of horses; should be familiar with the rules for their management under all circumstances; should understand in detail the method of shoeing them, and be able to treat all ordinary cases of injury or disease. In the field, or on the march, an ignorant or careless commander will always have many broken down and unserviceable animals, while the animals of other commands, performing the same duties, but judiciously handled, remain in good condition.

To make the horse tractable and steady in mounting. - Go up to the horse, and pat him on the neck, and speak to him; then take the reins from the horse's neck, and hold them at a few inches from the rings of the bit with the left hand; take such position as to offer as much resistance as possible to the horse, should he attempt to break away; hold the whip in the right hand, with the point down; raise the whip quietly and tap the horse on the breast; the horse naturally tries to move back to avoid the whip, follow the horse, pulling at the same time against him, and continuing the use of the whip; be careful to show no sign of anger nor any symptom of yielding. The horse, tired of trying ineffectually to avoid the whip, soon ceases to pull, and moves forward; then drop the point of the whip and make much of him. This repeated once or twice, usually proves sufficient; the horse having found how to avoid the punishment, no longer waits for the application of the whip, but anticipates it, by moving up at the slightest gesture; this is of great assistance in the bending-lessons, as also in mounting and dismounting, and accelerates the training of the horse.

To bend the horse's neck and to rein in, dismounted.—The balance of the horse's body, and his lightness in hand, depend on the proper carriage of his head and neck. A young horse usually tries to resist the bit, either by bending his neck to one side, by setting his jaw against the bit, or by carrying his nose too high or too low. The bending-lessons serve to make a horse manageable by teaching him to conform to the movements of the reins and to yield to the pressure of the bit. During the lessons the horse must never be hurried. *To bend the neck to the right* for instance, take a position on the near side of the horse, in front of his shoulder and facing toward his neck; take the off rein close up to the bit with the right hand, the near rein in the same way with the left hand, the thumbs toward each other, the little fingers outward, bring the right hand toward the body, and at the same time extend the left arm so as to turn the horse's head to the right. The force employed must be gradual, and proportioned to the resistance met with, and care must be taken not to bring the horse's nose too close to his chest. If the horse back, continue the pressure until, finding it impossible to avoid the restraint imposed by the bit, he stands still and yields to it. When the bend is complete, the horse holds his head there without any restraint, and champs the bit; then make much of him, and let him resume his natural position by degrees, without throwing his head round hurriedly. A horse, as a rule, champs the bit when he ceases to resist. The horse's neck is bent to the *left* in a similar manner, the man standing on the off side. *To rein in*, cross the reins behind the horse's jaw, taking the near rein in the right hand, and the off rein in the left, at about six inches from the rings; draw them across each other till the horse gives way to the pressure and brings his nose in. Prevent the horse from raising his head by lowering the hands. When the horse gives way to the cross-pressure of the reins, ease the hand, and make much of him.

To bend the horse's neck and to rein in, mounted.—The horse should be equipped with the curb-bridle. *To bend the neck to the right*, for instance, adjust the reins in the left hand; seize the right rein with the right hand well down; draw it quietly toward you until the horse's head is brought completely around to the right, in the same position as in the bend dismounted. When the horse champs the bit, make much of him, and allow him to resume his natural position. *To rein in*, lower the bridle-hand as much as possible, turning the back uppermost; with the right hand, nails down, take hold of the curb-reins above and close to the left hand and shorten them by degrees, drawing them through the left hand, which closes on the reins each time they are shortened. When the horse resists much, and holds his nose up, keep the reins steady; do not shorten or lengthen them; close the legs to prevent the horse from backing; after remaining perhaps a minute or more with his nose up, and his jaw set against the bit, he will yeld, bring his nose in, and champ the bit; make much of him, loosen the reins, and, after a few seconds, *rein in* again. This exercise gives the horse confidence, and teaches him to arch his neck, and bring his head in proper position whenever he feels the bit. Most young horses are afraid of the bit, and they must never be frightened by sudden jerks on the reins, lest they should afterward refuse to stand the requisite pressure of the bit. A certain amount of bearing is necessary to induce the horse to work boldly and well, as well as to apprise the rider of what the horse is going to do. In reining in, some horses rest the lower jaw against the breast: to counteract this press both legs equally and force the horse forward to the bit. Some horses will not work up to the hand, that is, will not bear on the bit at all. Such horses are unfit for the service.

To teach the horse to obey the pressure of the leg.—If it is desired to *turn to the right on the fore-feet*, for instance, apply the right leg well behind the girth, very quietly, and without touching the horse's side with the spur; press against him till he makes a step to the left with his hind-legs; then cease the pressure of the leg and make much of him; then repeat the same until the horse takes another step, and so on until he has turned about, always pausing when he takes a step in turning. The horse should not be reined back; his fore-legs remain in place, and his hind-quarters move around in a circle. Both legs are kept close to the horse, the pressure of either leg being increased as the occasion requires. *Turning to the left on the fore-feet* is executed in a similar manner.

To break the horse of bad habits.—Should the horse *rear*, the rider must yield the hand when the horse is up, and urge him vigorously forward when he is coming down; if the horse be punished while up, he may spring and fall backward. *Kicking* can be prevented by holding the horse's head well up, and closing the legs; if necessary, they are closed so much as to force the horse forward. *Shying* sometimes results from defect of sight, and sometimes from fear. If from fear, the horse must be taken up to the object with great patience and gentleness, and be allowed to touch the object with his nose. *In no case should a horse be punished for timidity.* The dread of chastisement will increase his restiveness.

To accustom horses to firing. Station a few men at a little distance from, and on both sides of, the stable-door, and cause them to fire pistols as the horses are led into the stable to be fed; for the same object, a gun may be fired during the hour of feeding.

To teach horses to jump—Horses should be first taught to leap the ditch and then the bar. They are equipped with the watering-bridle, and follow a steady horse who is accustomed to jumping. The horses are taken in the open field and practiced at jumping shallow ditches, fallen logs, very low fences, etc. Great discretion must be used in applying the whip, and the horses will not be required to leap repeatedly over the same thing or at the same place. See *Horse* and *Horsemanship*.

MEN'S HARNESS.—An arrangement by which men are attached to a gun-carriage which is to be moved but a short distance, or where animal power cannot be employed. It consists of a rope 18 feet long and 4 inches in circumference, having a thimble at one end and a thimble and hook at the other. Ten leather loops are fixed in pairs to the rope, 5 on each side. These are of sufficient size to allow a man to pass his body through them, the strain of the draft coming on the chest.

MENSURATION.—That branch of the application of arithmetic to geometry which teaches, from the actual measurement of certain lines of a figure, how to find, by calculation, the length of other lines, the area of surfaces, and the volume of solids. The determination of lines is, however, generally treated of under trigonometry, and surfaces and solids are now understood to form the sole subjects of mensuration. As the length of a line is expressed by comparing it with some well-known *unit* of length, such as a yard, a foot, an inch, and saying how many such units it contains, so the extent of a surface is expressed by saying how often it contains a corresponding superficial unit, that is, a square whose side is a yard, a foot, an inch; and the contents of solid bodies are similarly expressed in cubes or rectangular solids having their length, breadth and depth a yard, a foot, an inch. To find the length of a line (except in cases where the length may be calculated from other known lines, as in trigonometry) we have to apply the unit (in the shape of a foot-rule, a yard measure, a chain), and discover by actual trial how many units it contains. But in measuring a surface or a solid we do not require to apply an actual square board, or a cubic block, or even to divide it into such squares or blocks; we have only to measure certain of its boundary-lines or *dimensions;* and from them we can calculate or infer the contents. To illustrate how this is done, suppose that it is required to determine the area of a rectangular figure ABCD, of which the side AB is 7 inches, and the side AC 3 inches. If AC be divided at the points F and E into 3 portions, each 1 inch long, and parallels be drawn from F and E to AB or CD; and if AB be similarly divided into 7 parts, of 1 inch each, and parallels be drawn to AC or BD through the points of section, then the figure will be divided into a number of equal squares or rectangular figures, whose length and breadth are each 1 inch; and as there are 3 rows of squares, and 7 squares in each row, there must be in all 7×3, or 21 squares. In general terms, if a and b be the lengths of two adjacent sides, there are a rows of little squares, and b squares in each row. Hence the *area of a rectangle = the product of two adjacent sides.*

The areas of other figures are found from this, by the aid of certain relations or properties of those figures demonstrated by pure geometry; for instance, the area of a parallelogram is the same as the area of a rectangle having the same base and altitude, and is therefore equal to the base multiplied by the height. As a triangle is half of a parallelogram, the rule for its area can be at once deduced. Irregular quadrilaterals and polygons are measured by dividing them into triangles, the area of each of which is separately calculated. By reasoning similar to what has been employed in the case of areas, it is shown that the volume of a rectangular parallelopiped or prism is found in cubic inches by multiplying together the length, breadth, and depth in inches; and the oblique paralellopiped, prism, or cylinder, by multiplying the area of the base by the height.

MENTONIERE.—The bearer of a helmet, sometimes called *Baviere.* Also written *Mentonniere.*

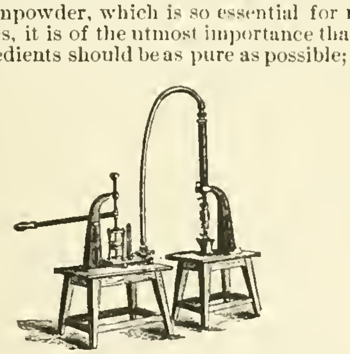
MERCENARIES.—Soldiers serving for pay in any foreign service.

MERCURY.—One of the so-called noble metals, remarkable as being the only metal that is fluid at ordinary temperatures. It is of a silvery white color, with a striking metallic luster. When pure, it runs in small spherical drops over smooth surfaces; but when not perfectly pure, the drops assume an elongated or *tailed* form, and often leave a gray stain on the surface of glass or porcelain. Moreover, the pure metal, when shaken with air, presents no change upon its surface; while, if impure, it becomes covered with a gray film. It is slightly volatile at ordinary temperatures, and at 662° it boils, and forms a colorless vapor of specific gravity 6.976. Hence it is capable of being distilled; and the fact of its being somewhat volatile at ordinary temperatures, helps to explain its pernicious effects upon those whose trades require them to come much in contact with it—as, for example, the makers of barometers, looking-glasses, etc. At a temperature of —39°, it freezes, when it contracts considerably, and becomes malleable. In consequence of the uniform rate at which it expands when heated, from considerably below 0° to above 300°, it is employed in the construction of the mercurial thermometer. All mercurial compounds are either volatilized or decomposed by heat; and when heated with carbonate of soda, they yield metallic mercury. Native or virgin quicksilver only occurs in small quantity, usually in cavities of mercurial ores. Of these ores, by far the most important is *cinnabar.* There are two means of obtaining the metal from the cinnabar: the ore may be burned in a furnace, in which case the sulphur is given off as sulphurous acid, and the mercury is collected in a condensing chamber; or the ore may be distilled with some substance capable of combining with the sulphur—as, for example, with slaked lime or iron filings. The mercury imported into this country is usually almost chemically pure. If the presence of other metals is suspected, it may be pressed through leather, re-distilled, and then digested for a few days in dilute cold nitric acid, which exerts little action on the mercury, if more oxidizable metals are present. The mercury, after being freed from the nitric acid by washing with water, is chemically pure.

There are two oxides of mercury, the black suboxide (Hg_2O) and the red oxide (HgO). Both of these lose all their oxygen when heated, and form salts with acids. The *black suboxide,* although a powerful base, is very unstable when isolated, being readily converted by gentle warmth, or even by mere exposure to light, into red oxide and the metal ($Hg_2O=HgO+Hg$). The most important of its salts is the nitrate (Hg_2O,NO_5+2Aq), from whose watery solution ammonia throws down a black precipitate known in pharmacy as *mercurius solubilis Hahnemanni*, from its discoverer, and consisting essentially of the black suboxide with some ammonia and nitric acid, which are apparently in combination. Of the *red oxide*, the most important salts are the nitrate (HgO,NO_5+8Aq); the sulphate (HgO,SO_3), which is employed in the manufacture of corrosive sublimate; and the basic sulphate ($3HgO,SO_3$) which is of a yellow color,and is known as *turpeth mineral*. Sulphur forms two compounds with mercury—viz., a sulphide (Hg_2S), a black powder of little importance and a sulphide (HgS), which occurs naturally as cinnabar. *Sulphide of mercury* is thrown down as a black precipitate by passing sulphureted hydrogen through a solution of a persalt of mercury (corrosive sublimate, for example). When dried and sublimed in vessels from which air is excluded, it assumes its ordinary red color. The well-known pigment *vermillion* is sulphide of mercury, and is sometimes obtained from pure cinnabar, but is more frequently an artificial product. Mercury unites with most metals to form amalgams, several of which are employed in the laboratory.

Of the numerous organic compounds of mercury, it is unnecessary to mention more than the fulminate and the cyanide ($HgCy$), which may be prepared by dissolving the red oxide of mercury in hydrocyanic acid, and is the best source from which to obtain cyanogen. The uses of mercury are so numerous that a very brief allusion to the most important of these must suffice. It is employed extensively in the extraction of gold and silver from their ores by the process of amalgamation. Its amalgams are largely employed in the processes of silvering and gilding, and some (as those of copper and cadmium) are employed by the dentist for stopping teeth. It is indispensable in the construction of philosophical instruments, and in the laboratory in the form of the mercurial bath, etc. It is the source of the valuable pigment vermillion. It is constantly used for percussion caps, and in taking the density of gunpowder. Spherical projectiles are floated in mercury to ascertain whether they are homogeneous.

MERCURY DENSIMETER.—In order to secure a first-class gunpowder, which is so essential for military purposes, it is of the utmost importance that the several ingredients should be as pure as possible; this

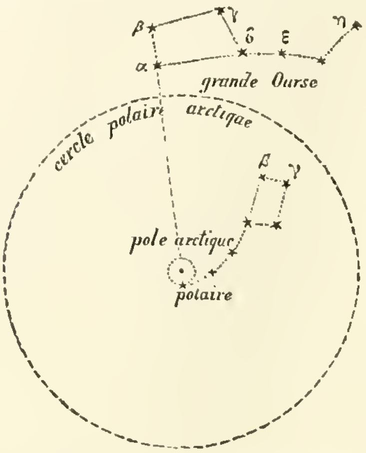


being secured,it then becomes very necessary that the density or specific gravity of the powder should at all times be as nearly as possible the same,as any variation however slight, affects its quality and force to an immense extent. To ascertain its density,therefore, is a matter of considerable importance and for this delicate operation a very ingenious instrument has been devised called a "densimeter"; it may be described as follows: On a small table a kind of barometer is fitted, but instead of the glass tube being closed at the upper end and all in one piece, as is usual, it is in this case made in two pieces and open at the top. The upper part is about 24 inches in length, and is connected to the lower, which is 10 inches in length, by means of a closely fitting and perfectly air-tight screwed metal joint; the lower part, instead of being a plain parallel tube of the same diameter throughout as the upper, is made in the form of a globe or bulb, and on the neck at each end of it a metal union and stop-cock are secured, both of which are made perfectly air-tight. By means of one of these unions this glass globe or lower half of the instrument is attached to the upper, while the other union, into which is screwed an open nozzle or metal tube, dips into a cup fastened to the table filled with mercury. On another table standing by the side of the first one an ordinary air-pump is fixed, with vacuum gauge, etc. It will readily be seen that if the upper part of the glass tube of the densimeter be connected with the air-pump, and the air be extracted from the glass tube whilst the lower tap is closed, a vacuum will be formed, and that upon opening the lower tap so as to afford a free passage for the mercury in the cup, it will rise and fill the glass globe and upper portion of the tube to such a height as will balance the pressure of the atmosphere, thus giving a column of mercury of precisely the same total height as that in an ordinary barometer.

To use the instrument, two tables are placed side by side, the open upper end of the glass tube of the densimeter is connected with the air-pump by means of a flexible tube, the tap on the upper union of the densimeter is opened, the lower one is closed. The air-pump is worked; as soon as all the air is exhausted, shown by a vacuum gauge attached to the air-pump, the lower tap on the glass tube immediately below the globe is opened, and the mercury rushes into the tube; when it ceases to rise, the two metal taps are closed, and the globe part,with the mercury contained therein,is removed and carefully weighed. All the mercury is now emptied back again into the cup,and the globe, nearly filled with a known weight of gunpowder, say 100 grammes, is then reconnected to the densimeter under the same conditions as before, and the air again exhausted until a vacuum is formed. The lower tap is now opened, and the mercury allowed to find its way in and rise in the tube; the mercury rises to precisely the same height in the tube as before; but the globe having been nearly filled with gunpowder will contain less mercury. The taps on the lower portion of the instrument are closed, the globe part removed and again weighed. This weight, as well as that previously ascertained when the globe was entirely filled with mercury,is recorded, and from these two ascertained weights the density of the powder can readily be obtained by the following rule: *To find the density of the gunpowder, we have only to multiply the specific gravity of the mercury by the weight of the gunpowder placed in the globe of the densimeter, and divide by the difference in weight of the globe when filled with mercury only and when filled with gunpowder and mercury, plus the weight of the powder placed in the globe*; the result will show the density of the gunpowder under test. See *Densimeter, Dupont de Nemour's Densimeter, Inspection of Powder*, and *Mercury Densimeter.*

MERIDIAN.—The name given to the great circle of the celestial sphere which passes through both poles of the heavens, and also through the zenith and nadir of any place on the earth's surface. Every place on the earth's surface has consequently its own meridian. The meridian is divided by the polar axis into two equal portions, which stretch from pole to pole, one on each side of the earth. It is midday at any place on the earth's surface, when the centre of the sun comes upon the meridian of that place; at the same instant it is midday at all places under the same half of that meridian, and midnight at all places under the opposite half. All places under the same meridian have, therefore, the same longitude. Stars attain their greatest altitude when they come upon the meridian; the same thing is true approximately of the sun and planets; and, as at this point the effect of refraction upon these bodies is at a minimum, and their apparent motion is also more uniform, astronomers prefer to make their observations when the body is on the meridian. The instruments used for this purpose are called *meridian circles*.

The meridian may be determined at night by passing a plane through a plumb-line and the north star. The trace of this plane on a horizontal plane will be the projection of the meridian sought, the north star



being only $\frac{1}{12}°$ from the true pole. It is easy to recognize the north star—it is the seventh star of the little bear and is found precisely in the prolongation of the two first stars of the great bear (*grande ourse*), a constellation disposed in symmetrical order as in the drawing.

To practically determine the variation of the compass, erect a pole, and at a distance of 200 yards set up another, so that the two are in a line with the true north; the variation of the compass may be ascertained the next morning by taking the bearing of one pole from the other.

MERIDIAN MEASUREMENT.—The determination of the form and size of the earth from the measurement of an arc of a meridian has been a favorite problem with mathematicians from the earliest times, but up to the middle of last century their operations were not carried on with exactness sufficient to render their conclusions of much value. Since that time, however, geodesy has so rapidly progressed, owing to the invention of more accurate instruments and the discovery of new methods, that the measurement of the meridian can now be performed with the utmost accuracy imaginable. The *modus operandi* is as follows: Two stations, having nearly the same longitude, are chosen; their latitude and longitude are accurately determined (the error of a second in latitude introduces a considerable error into the result), and the direction of the meridian to be measured ascertained; then a base line is measured with the greatest accuracy, as an error here generally becomes increased at every subsequent step; and then, by the method known as triangulation, the length of the arc of the meridian contained between the parallels of latitude of the two stations is ascertained. As the previously found latitudes of its two extremities give the number of degrees it contains, the average length of a degree of this arc can be at once determined; and also—on the supposition that the length of a degree is uniform—the length of the whole meridional circumference of the earth. This operation of meridian measurement has been performed at different times on a great many arcs lying between 68° north latitude and 38° south latitude., and the results show a steady though irregular increase in the length of the degree of latitude as the latitude increases. On the supposition that this law of increase holds good to the poles, the length of every tenth degree of latitude in English feet is as in the following table:

Degree of Latitude.	Length of Degree in English feet.	Degree of Latitude.	Length of Degree in English feet.
0°	362,732	50°	364,862
10°	362,843	60°	365,454
20°	363,158	70°	365,937
30°	363,641	80°	366,252
40°	364,233	90°	366,361

This result shows that the earth is not spherical, as in that case the length of all degrees of latitude would be alike, but of a more or less spheroidal form—that is having its curvature becoming less and less as we go from the extremity of its greater or equatorial diameter to the lesser or polar axis. It was by the measurement of a meridional arc that, in 1792–99, the length of a quadrant of the earth's circumference was determined, in order to form the basis of the French metrical system. See *Metrical Measures*.

MERIT ROLLS.—Rolls prepared by the Academic Board, at each examination, in which the merit of each Cadet (at the United States Military Academy) in each branch of study upon which he has been examined, is denoted by a number proportional to his proficiency and to the importance of the subject; and in which the names of the Cadets are arranged, in their respective classes, in the order of aggregate merit, as determined for each, by the addition of the numbers expressing his merit in each particular branch, and in discipline. The table on page 315 shows the manner of forming the general *Merit Roll*.

MERKIN.—A mop used for cleaning cannon. Also written *Malkin*.

MERLON—In fortification, the position of the parapet between two embrasures. Its length is usually from fifteen to eighteen feet. The term is also applied to the projection on the top of a crenellated wall.

MERRILL BAYONET HANDLE—The essential feature of this device is a slide in the side of the handle, which being withdrawn, allows the bayonet-stud to pass aside into the square notch prepared for it at the farther extremity of its L-shaped groove. It is securely kept there by pushing back the slide into its former position. In a modification of this invention, the bayonet is held on the gun by the engaging of the bayonet-stud with a corresponding notch in the spring-catch swinging in a slot in the end of the handle. By pressing down the outer end of the spring-catch the shoulder on its forward extremity is passed above the bayonet-stud, and the bayonet is still further secured on the gun by the muzzle passing through a corresponding hole formed in the guard.

MERRILL GUN.—A breech-loading rifle having a fixed chamber closed by a movable breech-block, which slides in the line of the barrel by direct action. It is opened by raising the handle of the breech-bolt to a vertical position and drawing it back to its full extent. In raising the handle, the firing-pin is retracted by a lug near its head engaging with a spiral cam-recess in the receiver; it is held back by the lug entering a circumferential groove in the bolt. In withdrawing the bolt, it passes over the hammer and presses it back to the full-cock. The piece is closed by reversing the movement of the bolt. At the end of the forward stroke, the point of the extractor engages with a recess in a ring which sur-

Number.	Class Rank.	Mathematics.	French.	Spanish.	Natural and Experimental Philosophy.	Chemical Physics and Chemistry.	Tactics.	Drawing.	Civil and Military Engineering.	Law.	Ordnance and Gunnery.	Mineralogy and Geology.	Discipline.	General Merit.
	Maximum in each branch.	300.0	100.0	75.0	300.0	150.0	100.0	100.0	300.0	150.0	100.0	75.0	200.0	1950
1	A. B	293.5	82.8	66.9	292.8	146.6	95.4	81.9	300.0	144.6	98.8	75.0	170.0	1848.3
2	C. D	296.7	98.9	74.2	285.7	144.9	89.6	95.4	289.2	135.7	100.0	72.3	156.0	1838.6
3	E. F	300.0	95.9	67.6	289.2	139.8	85.0	87.5	292.8	146.4	96.4	68.7	138.6	1807.9
4	G. H	290.3	75.7	59.5	282.1	136.4	87.3	85.3	285.7	133.9	89.2	66.0	172.3	1783.7
5	I. J	287.0	86.8	70.6	296.4	143.2	73.5	84.1	296.4	139.3	97.6	69.6	103.3	1747.8
6	K. L	283.8	94.9	71.3	257.1	133.0	91.9	79.6	260.7	141.1	92.8	66.9	172.0	1745.1
7	M. N	277.4	96.9	69.8	300.0	148.3	100.0	92.0	274.9	128.6	90.4	73.2	183.3	1734.8
8	O. P	270.9	92.9	73.5	264.2	138.1	79.3	100.0	253.5	130.4	91.6	74.1	162.3	1730.8
9	Q. R	274.1	90.9	63.9	278.5	134.7	64.3	93.2	257.1	142.9	88.0	62.5	167.0	1717.1
10	S. T	258.0	76.7	58.1	267.8	141.5	97.7	59.3	264.2	132.1	95.2	67.8	191.6	1710.0
11	U. V	261.2	64.6	43.4	274.9	150.0	96.5	96.6	278.5	148.2	94.0	71.4	160.6	1639.9
12	W. A	264.5	88.8	72.3	242.8	129.6	67.8	88.7	221.4	126.8	86.9	64.2	149.0	1602.8
13	B. C	238.7	77.7	58.8	271.4	131.3	68.9	94.3	282.1	117.9	85.7	70.5	102.3	1599.6
14	D. E	225.8	89.8	69.1	224.9	127.9	88.5	49.1	271.4	137.5	84.5	65.1	148.3	1581.9
15	F. G	251.6	83.8	72.0	185.7	121.1	94.2	77.4	196.4	114.6	70.2	60.7	166.3	1494.0

See *United States Military Academy.*

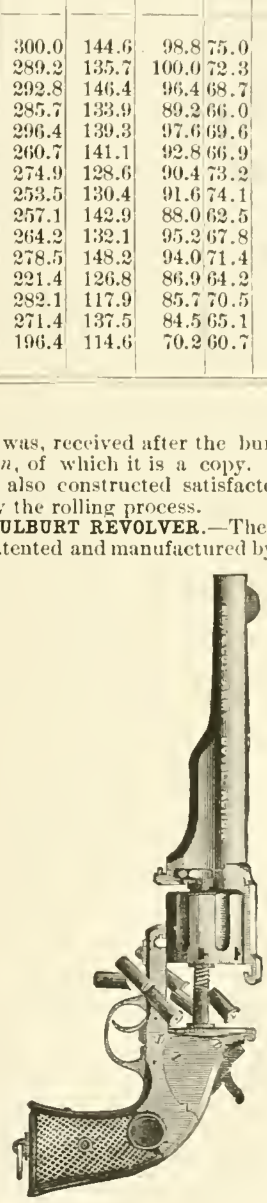
rounds the mouth of the chamber, and against which the bolt is pressed, and turns the ring with it; so that the rotation of the bolt in locking will not cause it to grind against the head of the cartridge. In turning down the handle, the piece is locked by the engaging of a sectional collar on the bolt with a corresponding groove in the receiver. When this is accomplished, the lug on the firing-pin is opposite the deepest part of the spiral recess and is free to move forward when the piece is fired (by means of a center-lock moved by a double mainspring.) Extraction is accomplished by a spring-hook lying on top of the breech-bolt; and in drawing back the bolt, the natural spring of the extractor presses down the rim of the cartridge upon the bottom of the receiver, until it is checked by striking against a notch left there for that purpose, and is thereby thrown upward around the hook of the extractor and clear of the gun.

MERRILL LOCK.—A lock intended to dispense with the tumbler and adjacent parts, and to be hermetically imbedded in the stock. In a modification of the lock the motion of the mainspring is arrested by a stop-pin after the hammer, in falling, has passed the half-cock notch. When applied to the Springfield system the act of raising the firing-pin guard in turning the cam-latch to open the block would be sufficient to easily overcome the friction and weight of the hammer and to bring it to the half-cock. In this lock there is no swivel, the mainspring pressing directly on the hammer.

MERRILL MAGAZINE.—In this device, the comb of the butt-stock is cut out in a groove deep enough to receive one cartridge, on end, and long enough to accomodate four or five of them side by side. A movable back for this groove is formed by a follower-block, which is pressed forward by a spiral-spring, carrying the cartridges ahead of it to the mouth of the magazine, from which they are to be picked out one by one. The magazine has a sliding cover by which, in traveling, the cartridges are to be kept from falling out.

MERSEY GUN.—The 12-inch wrought-iron gun, in the Brooklyn Navy Yard, was forged like the *Horsfall Gun*, by the Mersey Iron Works, in 1845. Its dimensions are: total length, 169 inches; diameter over the chamber, 28 inches; length of bore, 144 inches; diameter of bore, 12 inches; weight, 16,700 pounds. It was received after the bursting of the *Stockton Gun*, of which it is a copy. The Mersey Works have also constructed satisfactory wrought-iron guns by the rolling process.

MERWIN HULBURT REVOLVER.—The new Army Revolver, patented and manufactured by the Messrs.



Merwin, Hulbert and Company, is rapidly becoming a favorite with the military organizations throughout the United States. The details of its construction may be readily understood by a reference to the illustration which we present herewith. This revolver makes the following claims for superiority :—Compactness, symmetrical, easy outline, and general neat appearance; no salient points to prevent its ready and easy insertion into or withdrawal from the holster. In handling, not liable to injure the hand; all the projecting parts being rounded and smooth; cleaning being thereby facilitated. The circular form of cylinder front gives a continuous cover to breech of barrel; prevents sand or dirt entering therein. Accidental unlocking of the parts prevented, as hammer must first be set at half-cock. The front sight forged solid with the barrel; not liable to be separated therefrom or injured. The extractor ring prevents the interior of the lock and ratchet from fouling by escape of gas about the primer when using outside primed ammunition. The hood and collar at front of cylinder covering base-pin and base-pin hole prevents fouling. The flanged recoil plate here covers and protects the heads of the cartridges; prevents sand or dirt entering between face of recoil plate and cylinder, which might clog it and prevent rotation. The cylinder and barrel can be dismounted from the frame and re-assembled thereto without the use of screw-driver or any tool. The construction is not intricate nor fragile, and the extractor is a solid part of the base pin. Strength, durability and endurance. Simultaneous, positive, and easy extraction of shells; great power obtained for starting the shells before final extraction by the incline screw action on the base-pin. Less lateral escape gas is deflected downward into the works, as no top strap is used. The face of the collar on cylinder takes against the bracket, prevents forward movement of cylinder when pressed by the ball in rotating; gives a central bearing; prevents abrasion of cylinder face against rear of barrel; gives easy rotation; permits a close joint without friction, reducing the escape of gas; the cylinder is not forced backward on firing, but is held forward by the hood-clutch taking into the recess of the cylinder collars. The lines of recoil and resistance are close together, lessening upward inclination of barrel when fired.

The following are the directions for manipulating the arm:

To load—Place the hammer at half-cock, press the gate downward and insert the cartridges.

To eject the shells—Push back the thumb-bolt under the frame, turn the barrel outward, and draw forward, when the shells will fall out.

To take the arm apart—When the barrel and cylinder are drawn forward, press the small pin in the barrel-catch even with the frame, *then* press the catch down and draw forward.

Complimentary letters have been received as regards these arms from all parts of the world. Col. George T. Denison, author of the Russian Imperial Report on Arms and Cavalry Tactics, for which he received the government reward of five thousand dollars and gold medals, as well as medals from other governments, says: "This army revolver is, in my opinion, the most perfect cavalry pistol in the world."

MESAIL.—That portion of a helmet which closes on the open front, more generally known in England as the *Ventaill.* Also written *Mezail.*

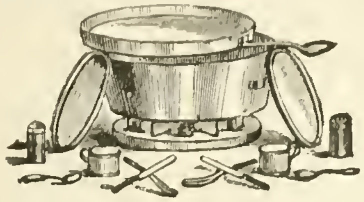
MESNE PROCESS.—Any writ issued in the course of a suit between the original process and execution. By this term is also meant the writ of proceedings in an action to summon or bring the Defendant into court, or compel him to appear or put in bail, and then to hear and answer the plaintiff's claim.

MESS.—A term at present used in the sense of a number or association of officers or of men taking their meals together. In societies consisting entirely of the male sex, and of one set of men continually thrown together, it is a very important social point that the Mess should be well regulated. There are consequently stringent rules—both of the service and of mutual etiquette—laid down for its government. One officer acts as caterer, receives subscriptions from the several members, charges the wine to those who drink it, etc.; a steward has charge of the more menial department, arranging for the cooking, purchase of viands, servants, rations, etc. In the British army, the Mess is a regimental institution for the maintenance of a common table for all the officers in a regiment, who are bound to subscribe an annual subscription, whether present or absent. Married men pay one half if they do not regularly attend the mess, but they pay all contributions to the mess fund. The introduction of messes into the British Army has been attended with the happiest results. Officers of all ranks meet together on an equal social footing, and the youngest officer in the regiment is able to enjoy the society of his senior and brother officers without reserve. The advantages of a mess are manifold, and are seen not only in its social value, but also in the means it offers to all ranks of living well and comfortably. A small government allowance is granted in aid of the expenses of the officer's mess. Messes are extended also to the non-commissioned officers and men of a regiment, who have their several messes under the superintendence of the officer commanding the regiment and the captains of companies. In France, the several grades mess separately; lieutenants and sub-lieutenants forming two tables; captains another, and field officers of different grades generally eating separately also.

MESSAGES. — Communications passing between officials whether in peace or war time. In the former, messages are generally sent by dismounted orderlies, except the communication is urgent, when it is sent by a mounted orderly. In the latter, mounted orderlies are sent between the general and his staff, on subjects relating to the army and requiring expedition. Important messages forwarded to a distance, and where the bearers may fall into the enemy's hands, should be sent in duplicate, one real, the other false; the former to be concealed in a quill about his person, in such a way as is not likely to be discovered, and which way will in peril suggest itself; the latter in the form of a letter. One orderly is not considered safe; one or two more should be sent at certain intervals of time, say two or three hours between each. Emissaries sent from besieged cities with messages to relieving forces or to friends should use great wariness to avoid falling into the hands of the enemy; but if they do, they should be able to conceal the message, which in all probability would be in cipher and in only a few words, about their person. The modes resorted to in warfare, to avoid written communications being seized, are numerous. During the siege of Metz, Marshal Bazaine, desirous of communicating with the government at Tours, sent two emissaries disguised as peasants, who both managed to pass through the German lines; one carried his despatch in cipher inside a hollow tooth, and the other had his message woven in one of his socks. Carrier pigeons very often play an important part in the transmission of messages during hostilities, as they did during the siege of Paris in 1870-71.

MESSENGERS.—Officers employed by Secretaries of State to convey dispatches at home and abroad. In former days their occupation consisted, to a considerable extent, in serving the Secretaries' warrants for the apprehension of persons accused of high treason and other grave offenses against the State, nor was it unusual for them to keep the prisoners whom they apprehended at their own houses. They are now principally employed in foreign service.

MESS-KIT.—That portion of camp equipage consisting of cooking utensils. The cooking implements and table necessaries should be so selected as to nest compactly. The camp kettles may enclose the dishpans, and these the skillets and smaller articles. It is best with a view to packing to have the skillets, fryingpans, etc., so constructed that a spoon



may be applied as a handle, and removed when not in use or when packed. The drawing shows the idea.

MESTRE DE CAMP GENERAL.—The next officer in rank, in the old French cavalry service, to the Colonel-General. This appointment was created under Henry II. in 1552. *Mestre de Camp Général des Dragoons*, was an appointment which first took place under Louis XIV., in 1684.

METAL.—1. A term in Heraldry. The field of the escutcheon and the charges which it bears may be of metal as well as of color; and the two metals in use among heralds are gold and silver, known as or and argent. It is a rule of blazon that metal should not be placed on metal, or color on color. 2. Broken stone, etc., used as a road cover.

METAL CASTING.—The art of obtaining casts of any desired object by means of pouring melted metal into molds prepared for the purpose. It has risen to great importance in recent times, on account of the many new applications of iron. Iron-founding, brass-founding, type-founding, as well as casting in bronze and zinc. are the principal divisions of the art. The casting of the finer metal and alloys, as gold, silver, and German silver, is necessarily conducted on a smaller scale. When the casting of an object is required, it is necessary, in the first place, to make a pattern. Suppose it to be a plain round iron pillar, such as is used for hanging a gate upon. A pattern of this is turned in some wood which can be readily made smooth on the surface, such as pine, and then varnished or painted so as to come freely out of the mold. This wooden pillar, or any similar pattern, is always made in at least two pieces, the division being lengthwise, for a reason which we shall presently see. The next step is to prepare the mold. The molds used by the iron-founder are either of sand or loam, but more generally of fine sand. Proceeding with the preparation of the mold, the founder takes a molding-box, which is composed of two open iron frames with cross bars, the one fitting exactly on the other, by means of pins in the upper dropping into holes in the lower frame. One half of the box is first filled with damp sand, and the pattern laid upon it a little dry *parting sand* being sprinkled on the surface. The upper half of the box is then put on and sand firmly rammed all around the pattern. The box is then carefully opened, and when the pattern is removed, its impression is left in the sand. The mold at this stage, however, is generally rough and broken. It is necessary, therefore, to give it a better finish, which is done by taking each half of the mold separately, repairing it with a small trowel, and reintroducing the corresponding half of the pattern till the impression is firm and perfect. Finally, the surface of the mold is coated with charcoal-dust, which gives a smooth surface to the future casting. These columns being made hollow, there is yet another matter to arrange before the casting can be made—namely, the *core*. In the instance before us, it would simply be a rod of iron, covered with straw and loam to whatever thickness the internal diameter of the column happened to require. The core of course occupies the center of the mold.

The cast iron is melted with coke in a round fire-brick furnace, called a *cupola*, the heat being urged by means of a powerful blast, created by fanners revolving at high speed. The molten metal is run from a tap at the bottom of the furnace into a malleable iron ladle, lined with clay, from which it is poured into the mold through holes called *runners* or *gates*. When the mold is newly filled, numerous jets of blue flame issue from as many small holes pierced in the sand. These perforations are necessary for the escape of air and other gases produced by the action of the hot metal on the mold. Care must also be taken not to have the mold too damp, otherwise steam is generated, which may cause holes in the casting, and even force part of the metal out of the mold. The casting remains covered up for a time, in order to cool slowly, and is then removed by breaking away the sand, and drawing out the core. In the case of a fluted or otherwise ornamented pillar, the pattern would require to be in at least four pieces instead of two, because it is only a plain pattern that will come out of the mold in halves without tearing away the sand. When a pattern is necessarily made in several pieces, it is drawn out of the mold bit by bit, to the right or left, as the case may be, and so parts from the sand without breaking it. Suppose that a small ornamental vase was to surmount the pillar, the founder would prepare the pattern of this in a more elaborate manner. He would first mold it in wax or clay, from which a cast in plaster of Paris is made; from that, again, a cast is taken in an alloy of tin and lead, which, after being sharply chased, and divided into the required number of pieces, is used as a pattern to cast from. All ornamental patterns, such as figures, scrolls, leaves, enriched moldings, and the like, are made in this way, whatever metal the ultimate casting is to be produced in. Very large engine cylinders, pans, and such vessels, are cast in loam-molds, which are built of brick, plastered with loam, then coated with coal-dust, and finally dried by means of a fire. This method is adopted with large plain objects, where a pattern would be expensive, and when very few castings of one kind are required. Iron molds, coated with black lead or plumbago, have recently been introduced for casting pipes into; they are greatly more expensive than any other kind, but they enable a founder to dispense with a pattern, as, when once made into the required form, they are not destroyed like molds of sand or loam at each casting. Bronze and brass are cast in molds prepared with finer sand than that used for iron. Pewter and similar soft metallic alloys are cast in brass molds. The type-founder, on the other hand, uses molds of steel, which are now worked to a great extent by a machine. The variety of articles produced by casting are very numerous, among others we may mention cylinders, cisterns, paper-engines, beams, boilers, pumps, and the heavy parts of machinery generally, gates, railings, lamps, grates, fenders, cooking-vessels, and the like, in iron; cannon, many portions of machinery, and numerous ornamental objects, in brass; sculpture and other works of art in bronze and the more costly metals. One of the most remarkable castings yet executed for the requirements of modern engineering, was the cylinder of the hydraulic press used for raising the tubes of the Britannia bridge. It measured 9 ft. x 3 ft. 6 in., the metal being 10 in. thick, and weighed upwards of 20 tons. It remained red hot for three days, and it was seven days more before men could approach it to remove the sand. Sole plates of steam-hammers, and for other purposes, have been cast more than double this weight, but the same care was not required in their execution. In regard to sculpture, perhaps, the most wonderful casting known is the colossal statute of Bavaria at Munich, finished in 1850, which stands 54 ft. high, the face being equal to the height of a man. It took eight years to cast, and the cost of the bronze used was about £10,000. See *Foundry*.

METALLIC AMMUNITION FOR SMALL-ARMS.—For the manufacture of metallic ammunition for small-arms and friction and electric primers for cannon on a large scale, the following buildings are required: No. 1. *Fire-proof factory* with L; basement being provided with machinery adapted to the manufacture of primers, etc., with a separate room containing grindstones, emery-wheels, etc., and tumbling barrels. The first story being fitted up with all the machines, tools, and benches of a first-class machine-shop, for manufacture and repair of the machines and tools employed in the works, with necessary office and engine rooms, and well furnished with presses and cabinets for surplus tools, standard gauges, specimens, etc. A room in L, with all appliances for washing cases, and a large and conveniently arranged drying-room over the engine boiler. The second story contains all the machinery necessary for drawing, trimming, heading, and forming cartridge-cases, with a separate room in L provided with machines and tables for making paper packing boxes; printing-presses, type-fonts, etc., for printing. No. 2. *Fire-proof factory* for manufacture of bullets, with separate rooms for charging cases and inspecting and packing finished ammunition. No. 3 *Blacksmiths' shop* and stacks for forgings and small castings, and annealing furnaces for tools, etc., with a separate room for annealing and pickling cases. No. 4. *Carpenter-shop*, for making boxes, tools, implements, etc.

No. 5. *Paint-shop*. No. 6. *Retort-house*, for manufacture of fulminate of mercury. No. 7. *Magazine*, for powder. No. 8. *Small Magazine*, for fulminate of mercury and friction-powder. No. 9. *Storehouse*, for storing cartridges, primers, etc.

The modern center-fire metallic cartridges may be divided into three classes: the solid attached head, the solid head, and the folded head. There are two varieties of folded-head cartridges the reinforced and non-reinforced. As regards priming, the above-named classes are divided into outside and inside primed cartridges, and may be designated respectively as re-loading and non-reloading cartridges. They are generally made from sheet-copper or brass, the latter material having more elasticity, and the former more uniformity and durability.

Manufacture—Sheet metal of the required thickness, from .025″ to .09″, is used for the various kinds of cartridges. This is fed to a double-acting die and punch, which cuts out a disk and forms it into a cylindrical cup at one operation. The cup is reduced to a cylinder of the required length in from four to six operations by dies and punches, and is called drawing or reducing. The cylindrical shell is trimmed to a standard length in a machine called the case-trimmer. After washing, the shells or cases have a flange formed at the closed end by pressure in a special machine called the header. The headed case is tapered to a standard size. The open end is made cylindrical for the length the bullet enters it, so as to inclose the latter snugly; and if it be inside-primed, like the present service cup-anvil cartridge, the anvil is inserted and fastened at the same time by crimping the case around its edge.

Priming is done in a machine called the primer. For outside priming a percussion-cap is used, made in the ordinary way. Priming of fulminate of mercury should not under any circumstances, be deposited on brass, as it forms an amalgam, and rapidly deteriorates the metal and priming. Shellac varnish is used to protect the surface of brass. No injurious deterioration from this cause has been noticed in the use of copper. *Bullets* are made in a bullet-machine from a cast slug or rolled bar; the last is considered the best; they are trimmed by a machine called the bullet-trimmer. The diameter is required to be up to standard with no minimum allowance, and they are sized at the lubricating machine by passing through a die. The form, width, and depth of grooves must conform to the standard with very little variation. The weights should not vary more than two grains from the standard of 405 grains. The lubricant should be free from acid reaction, and of vegetable origin as bayberry or Japan wax, and filled into the grooves by a machine. Loading, or assembling the case, powder, and bullet, is done in a machine called the loader, by one operation (as in the Frankford arsenal loader), or by several operations known as plate-charging. The bullet should be perfectly concentric with the case at the time of insertion. The charge of powder should be as uniform as possible, with not more than two grains variation from the standard weight of 70 grains. All cartridges should be wiped clean and gauged as to diameter, length, and diameter and thickness of head. Those should be rejected showing any defects in material, or bad workmanship. Each cartridge should be weighed to detect loss of parts or deficiency in weight of powder. A special automatic weighing machine is used at Frankford arsenal.

That the present degree of perfection in the manufacture of these several classes of metal cartridges has been the result of gradual and careful develop-

 METALLIC AMMUNITION FOR SMALL-ARMS.

ment, is evident from a cursory examination and comparison of the earlier, intermediate, and more recent best forms.

Among the first of metal cartridges of American invention is the Morse, which was brought out a short time before the war of the rebellion, but not thoroughly experimented with at the time or introduced into service. Its objectionable features are apparent in the light of progress made. Its merits over paper or similar ammunition are apparent, the chief, perhaps, being that it was designed as a self-primed cartridge, had a flanged-head for extracting the case, and that it reduced the operations of loading.

About the same time the Burnside, Maynard, and a few others, were produced, some of which were good in their day, and for the arms for which they were designed, but were fired by means of a cap, through a vent, at some distance from the cartridge, and were extracted by the fingers. With them there was not that necessary nicety of fit to the chamber of the gun, the joint was not absolutely closed, and the failures to explode were as frequent as with the old-fashioned paper cartridge and percussion-cap. Such failures would, now-a-days, be considered a most unwarranted percentage in any metallic ammunition laying claim to excellence, and, in the best known varieties, do not occur to the extent of one in one thousand rounds; in fact, many attain a much higher standard of surety than indicated by this figure. The records of the testing-rounds show long-continued firing and consumption of thousands of rounds without failure at all from any cause, and the summation of a year's practice and test, in proof of manufacture, exhibits but an exceedingly small percentage of such failures.

For some time the idea of combining the primer and cartridge did not assert itself, but some inventions were pushed in this direction, and the rim-primed cartridge was produced. In this the fulminate composition was placed in the folded head of the case. This mode of priming requires a large charge of the priming composition, which, being thrown into the fold by swiveling, the entire circumference of the head was not always primed thoroughly, and as the cartridge is exploded by striking the rim at a part of the head under the hammer, it not infrequently happened that it failed from the point struck not having any priming. The large charge required, also (about 5 grains against ½ grain for the center-fire), was a further objection to rim-priming; the exploding of so large a quantity of quick-powder in the folded head, the weak part of the cartridge, tending to strain and open the fold to bursting, as it frequently did. Another objection to rim primed cartridges is that they are more liable to accident in handling, and in shock of transportation, and in those incident to service; in fact, a number of instances of explosion in the magazine of repeating-arms, and in patent cartridge-boxes for service of such, have been reported, by which serious injury resulted to the soldier.

Hence, efforts to produce a still more reliable and satisfactory cartridge, and the development, production, and general adoption for service of what is now so well known as *center-primed metallic ammunition*, its advantages being sure explosion when struck by the point of the firing-pin; less of fulminate and less strain on the head of the cartridge; greater security in handling and using under all exigencies of service. These cartridges have been subjected to the severest tests to demonstrate their capability to resist all accidents, such as mashing up boxes of ammunition, and even firing into them with bullets. Only the cartridges actually impinged upon exploded under such tests, their neighbors being only blackened and not otherwise damaged. The safety of handling and transporting this ammunition in comparison with that of the old-fashioned kind is vastly in its favor, and the risk attending its carriage is almost nothing. Its greatly superior quality to resist exposure of climate, moisture, etc., has also been proven by such exceedingly severe tests that it may be asserted to be practically water-proof. A central and direct blow on the point primed is an essential and highly important feature of the center-primed cartridge; its general adoption, and adaptation of all breech-loading service small-arms to its use, is the best proof of its acknowledged superiority. Simple modifications of the form of the head adapt it to safe use in magazine arms, even though the front of one bullet rests on the head of the preceding cartridge, while with all varieties of repriming ammunition the central fire is a *sine qua non*. Other reasons in its favor might be given, but it is believed sufficient have already been adduced to warrant the statement that whatever may be claimed as the particular merit of any one variety of metalic ammunition, by ardent inventors and admirers of special forms, all are agreed that, for military purposes at least, the palm to center-priming must be yielded. The service-cartridge, made of a copper case with a folded-head and copper fulminate primed cup anvil, crimped in position, has been so long used and tested on the experimental ground and in the field, and by various boards of experts on small-arms, and its excellence in all these fields of trial so well demonstrated, that no particular description of its construction and performance is here necessary. Some of the varying modifications of the folded-flange cartridge are noted in the drawings. It is of rare occurrence that the fold is sometimes slightly opened or burst in firing, probably from a defect or thinness of the metal, but this is not attended with the least inconvenience or risk to the person or arm, and, in most cases, would escape notice altogether outside the carefully scrutinized cases at the experimental and testing grounds.

So far this has not been deemed of any consequence in the service, and none of the best model breech-loading arms take the least notice of it. If necessary, however, the folded-head cartridge is abundantly susceptible of improvement, in an easy and practicable manner, as is evident from an examination of the various forms of re-enforcement of cartridges of this construction, experimentally tested and herein described.

The Berdan, made in large numbers for the Russian government, for use in the Berdan breech-loading rifle, has been most strictly and severly tested during manufacture, and has proved of great excellence. It is exceedingly ingenious; its re-enforcement simple and effective; its capacity as a reloader fully tested and demonstrated by prolonged and repeated trial, daily, during production of millions of rounds; a number of the shells being reloaded, primed, and fired ten times, and much more extended trials have been had for special test of the endurance of the cases in this particular. Its chief distinguishing feature is that its anvil is of the same continuous piece of metal as that of which the case is made. Herein there is no possible displacement or misplacement of the anvil, and it has a fixed position with respect to the primer. The cartridge is singular in this respect, and superior to its rivals that require a separate anvil. In it was a happy idea hit upon by the inventor of making his anvil by a simple return of the metal of the pocket for the primer. All other anvils are its inferiors in that they have to be handled in assembling the parts of the shell. Another advantage is, it presents a point to the primer inside, rendering it sensitive to the blow of the hammer. The use of the special Hobbs' primer is most excellent in this combination. Other varieties of an excellent re-enforcement may be referred to, as exhibited in the drawings and notes under this class.

These re-enforcements may be accomplished in various ways, as by a ring of expanding metal, a ring of solder, felt or *papier-maché* wads, etc. When the ring of this metal is used as a re-enforcement it is best applied, and perhaps only effectually, in those cartridges having a pocket or return of the head for the priming. In these cases it should be so formed as to act by expansion against the walls of the case and of the pocket, to cut off the escape of gas to the folded head in both directions. The solder ring has been found to be a good re-enforce also, and in the wrapped-metal and some other varities of cartridges it serves also to attach the flanged-head to the body of the case. It was first used here for this purpose, and that it acted also as a re-enforce was a resulting discovery. The felt or *papier-maché* wad is not believed to be as good or to hold the head as securely, although it is extensively used in the various forms of Boxer ammunition. It is not believed that a simple ring of any soft metal of any shape, as lead or its alloys, forced into the case at the head, will act as a re-enforce, as has been claimed. No matter how closely the metallic surfaces are in contact, if the re-enforcement does not expand more promptly and as fully as the case itself under all the pressure of the gas, it does not strengthen or re-enforce the point to which it is applied. A re-enforcing ring works well, applied to a Martin cartridge, as well, in fact, as to a Berdan, and in the same manner. An objection to the Martin is its small anvil for small-headed cartridges, and their liability to burn the priming composition inclosing the pocket on the anvil, a difficulty met with in their manufacture, with the bar-anvil, and which can only be wholly eliminated by careful inspection of primed cases.

A very notable cartridge is the Boxer, as made at the Royal Arsenal, Woolwich, for the Snider and Martini-Henry rifles. A perusal of the English reports of their small-arm ordnance board will show the most casual reader that the failures of these cartridges, from all causes, have been what would be considered in our trials of the best American cartridges as a very large percentage, sufficient to warrant the abandonment of a cartridge that failed so often. Unlike its American prototype, from which it was originally taken, its parts are more numerous, and the steps of operations in its production more than double those in that simple cartridge. Its cost, hence, is also large, considering the low prices of labor and materials, and the very large numbers fabricated in the country of its adoption; a cost very much in excess, it is believed, of that of any other of the most approved American varieties of metal cartridges fabricated under similar advantages of cheap labor, low-priced materials, and large production. It does not appear to be well adapted to stand the shocks of transportatin or exigencies of service, is easily indented and disfigured, so much so as seriously to interfere, with ease of loading. Per contra, it is beautifully expanded and brought into shape of the exact walls of the chamber in firing, and extracts readily if the head holds, which, from the reports, seems not always to be the case. It is not suitable in its present state and form for use as a reloader, whatever may be claimed for it in this respect, and it is doubtful if it could be made so. The idea of such a use does not seem to receive encouragement from recent reports. Its attachable heads, from the peculiar and awkward mode of fixing them, are not exact or even, and may not always be firmly put on. Made of iron, it is believed they never should be for cartridges subjected to all varieties of climate. The use of this metal for a cartridge, otherwise so costly, is the poorest kind of economy.

There are several varieties of solid heads, as the Hotchkiss, the Dutch, the United States Cartridge Company's &c. The head, here, is re-enforced by using a thick sheet-metal strip to form the case, and leaving sufficient stock in the head, in drawing the case, to flow out and form the flange solidly. That this is effective in making a very strong case is unquestionable; its manufacture requires some heavier plant for special operations; its cost in metal and production is somewhat greater; and it is believed that the head is unnecessarily strong for the present work required by well-constructed breech-loading small-arms.

Experience, it is believed, has fully demonstrated that, in order to insure the best results in service, our small Army should be furnished with the most approved arms and material practicable. To effect this, the careful selection of an excellent (the best if it can be determined upon, for the chief trouble of such a selection seems to be from *embarras de richesse* in this branch of invention) system of breech-loading rifle small-arm, and suitably working efficient ammunition for the service of the same, is preeminently desirable. Supposing the first part of the proposition accomplished, and such a breech-loading system selected, approved and adopted, their production in such numbers as may be required by the Government for the Army, the uniform equipment of the militia, and the necessary reserve-stores for future emergencies, can unquestionably be accomplished at the National Armory, and no danger need be apprehended of any serious difficulty in the way of adaptation of its present machinery and plant, to the manufacture of any breech-loading system of small-arms, perfectly interchangeable, in these days of advanced scientific manufacture, when the production of the most complete and intricate machinery, interchanging in all their parts, is a problem of an easy, sure, and daily accomplishment.

If, from the abundance of good things to be chosen from, the difficulty of selection can be overcome, the rest, with adequate appropriations, is comparatively easy. A prime essential of such manufacture should be the institution of a rigorous standard from which there should not be the slightest departure, except by competent authority. *Especially should this apply to the chamber of the gun or seat of the cartridge*, the dimensions of which should be invariably fixed, and the greatest nicety of finish and adjustment of breech-mechanism insisted upon. In other words, the chambers should, within the limits of mechanical construction, be of the same dimensions, to the thousandth of an inch, both for the body of the cartridge and its flange or head. *The seat of the extractor should not occupy any part whatever* of the body of the chamber, and its surface should be as smooth as it is possible to make it. The depth of the flange recess of the chamber should only be sufficiently deeper than the thickness of the head of the cartridge to be employed in it to allow for the easy closing of the breech-block, the small variations of thickness of metal from which the case is made, and of necessary manufacture. A difference of 0".01 is believed to be ample for all purposes; its diameter may be at least 0".03 larger than that of the cartridge-head, which should itself be great enough to allow a secure hold to the extractor. *All the angles of the chamber should be slightly rounded.* The length of the chamber should be but a few hundredths of an inch longer than that of the case of the cartridge, and its throat, or seat of the projecting part of the bullet, should be accurately attended to, so that, with the cartridge *in situ*, the breech-block being closed, it should always occupy the same relative position with respect to its bearings in the chamber, and the bullet have the smallest necessary distance to move before engaging the grooves of the barrel, which engagement should be well advanced before the bullet is free from the case, to insure that it will start with its axis in the direction of the axis of the barrel. The expansion of the case in firing should immediately shut off escape of gas around its body to the rear—the only limits in difference of diameter of chamber and case allowable being those necessary to insure the required case in loading, and there should be no fouling of the chamber in firing ball-cartridges.

A little reflection will convince all that *an invariable chamber is the prime essential to the proper performance of the cartridge,* assuming, of course, that the latter is also as carefully made. This once obtained, let us insist on the case of the cartridge fitting as closely as practicable—the limit of variation allowable being only the very small unavoidable range of thickness in metal strips, and a reasonable life or wear of dies and punches necessary to the production of ammunition by the quantity. These degrees of perfection *can* be obtained only *by the adoption and preservation of exact standard gauges,* by frequent and every-day careful inspection of material and work, and keeping the attention of mechanics directed to the necessity of constant watchfulness over and frequent verification of their tools dies, and punches, in current use to insure the desired nicety Without this constant care in keeping up to the standard, work, however satisfactorily and successfully inaugurated, will soon become indifferent.

All experience shows that the fulminate composition for priming should not be in contact with any easily corroding metal, or so deposited in the primer or in assembling the parts as to render any galvanic action possible for its deterioration and eventual destruction. It is not believed that the service fulminate composition for priming in contact with pure copper undergoes any such deleterious change, as our percussion-caps of twenty years ago are now prompt and perfectly reliable. It should not be in immediate contact with brass, however, where brass is used in construction. This is not necessary, as in the Hobbs' primer, for instance, it is efficiently protected by being between two coats of varnish, one applied to the botom of the cap before the priming is dropped in, the other to one side of a tin-foil varnished disk pressed over the priming, which also holds it securely in place. Similar means of protection are used in other primers, or an equivalent. The United States Cartridge Company's primers, the Millbank, etc., are well protected from moisture, deterioration, and injury. See *Ammunition.*

METAL-LINED CASES.—Powder barrels lined with sheet copper, for the purpose of holding prepared cartridges. Metal-lined cases are used as portable magazines. When tested.they should be water-tight.

METALLURGY.—The art of extracting metals from their ores. The operations are partly mechanical and partly chemical. Those processes which depend principally on chemical reactions for their results have reference chiefly to the roasting and smelting of ores, and are described under the heads of the different metals. But there are certain preliminary operations of a mechanical kind which metallic ores undergo, such as crushing, jigging, washing, etc., which we shall describe here, as they are essentially the same for the ores of lead, copper, tin, zinc, and indeed most of the metals. Ores are first broken up with hammers. into pieces of a convenient size for crushing or stamping. Waste material, such as pieces of rock, spar, etc., which always accompany ore, are as far as possible picked out by hand, and the ore itself is arranged in sorts according to its purity. Various kinds of apparatus, such as riddles, sieves, etc., are then used for separating it into different sizes, in order to secure a uniform strain on the crushing machinery. In one of the most approved forms of crushing-mills the ore is raised by means of small wagons to a platform, where it is ready to be supplied to the crushing-rollers through an opening. These rollers are mounted in a strong iron frame, held together by wrought-iron bars, and bolted to strong beams. Their distance apart is regulated by means of a lever to which a weight is attached. The bearings of the rollers slide in grooves, so that when any extra pressure is put upon them by a large or hard piece of ore, the lever rises, and allows the space between the rollers to widen. The crushed ore falls upon a series of sieves, which are made to vibrate. These have meshes increasing in fineness as they descend; and the upper two are so wide that pieces of ore too large to pass through them are conducted into the lower part of the bucket-wheel and raised again to the platform to be recrushed. The lower four sieves separate the remaining portion of the crushed ore into different degrees of fineness, which is collected in pits.

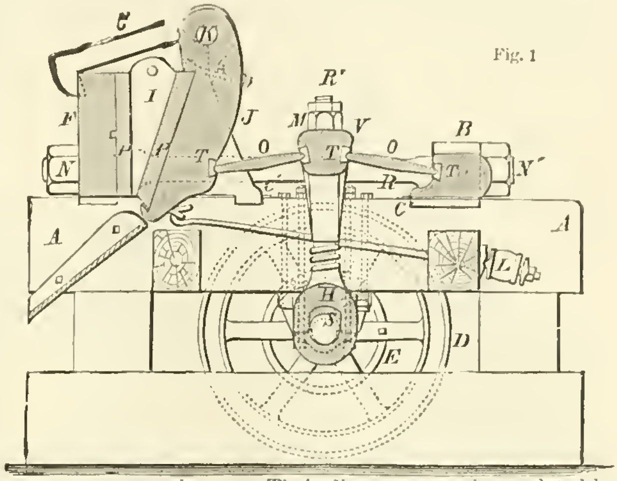


Fig. 1

A sectional view of the Blake Ore Crusher, standard in the United States and abroad, is shown in Fig. 1. A three-sided framework of cast-iron,with broad flanged base, holding the movable jaw, J, in suspension, from the front part of the machine,between the upright convergent jaws of which the stone is crushed. The jaw shaft, K, is held in place by wrought iron or steel clamps, C, which serve to take part of the strain due to crushing in the upper part of the jaw space, and also serve as walls thereof. In the lower part of the three-sided frame or front part of the crusher, and on each side of it, are holes in the casting to receive the main tension rods which connect the front and rear part of the machine. The rear part B, is called the main toggle block, and is also provided with holes for the tension rods R. R., corresponding to those in the front casting. These two parts of the machine are connected by the main steel tension rods, R R., each provided with screw-thread and nuts, N. N., by which their lengths and the jaw opening are readily adjusted to crush coarse or fine, as may be desired. The front and rear castings are supported on parallel timbers, to the under side of which are bolted the boxes carrying the main eccentric shaft, S, provided with fly wheels and pulley, D and E. The timbers are thus made component parts of the machine, and take the transverse strain which comes upon the pitman connecting the main shaft and the toggle joint placed to the rear of the movable jaw, and between it and the main toggle block.

Between the broad flanged bases of the front and rear castings and the timber on which they rest, are placed flat rubber cushions, C C, one-quarter to three eighths of an inch thick. Every revolution of the shaft brings the toggles, O, O, more nearly into line, and throws the swing jaw forward; it is withdrawn by the rod provided with rubber spring L. In this way a short reciprocating or vibratory movement is communicated to the movable jaw.

The rigidity inseparable from machines with cast iron frames, and which is the cause of frequent breakages is completely overcome in this machine, and the longitudinal as well as the transverse strains are brought upon materials which are strong and elastic as compared with cast iron. The rubber cushions.

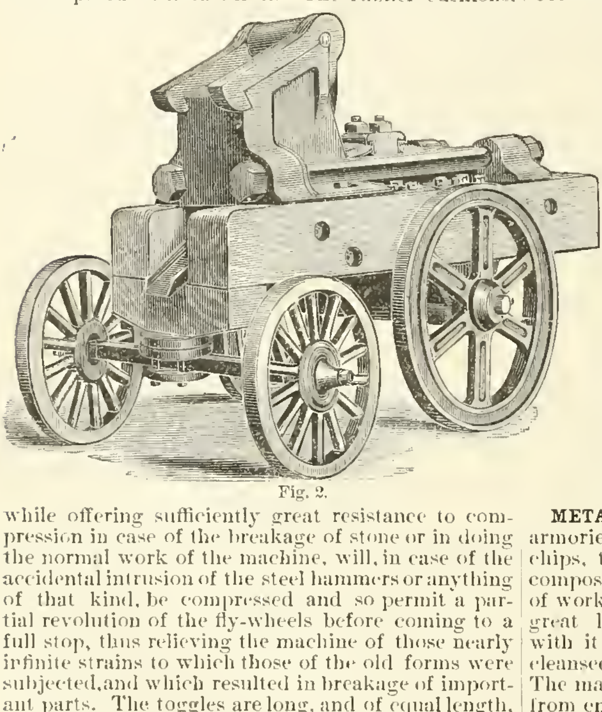
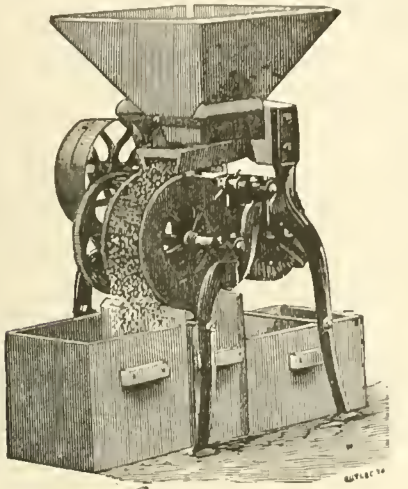


Fig. 2.

while offering sufficiently great resistance to compression in case of the breakage of stone or in doing the normal work of the machine, will, in case of the accidental intrusion of the steel hammers or anything of that kind, be compressed and so permit a partial revolution of the fly-wheels before coming to a full stop, thus relieving the machine of those nearly infinite strains to which those of the old forms were subjected, and which resulted in breakage of important parts. The toggles are long, and of equal length, and may be worn indefinitely as compared with those in the old machines. The construction of the pitman, R' H, is such as to admit of change of inclination of the toggles, and consequently of adjustment of the length of stroke of the movable jaw. The jaw opening can be varied between any working limits by means of the nuts, M, on the tension rods, and the machine be set to *crush coarse or fine* as may be desired. This Breaker can be run at a higher rate of speed with safety than any of the old forms of crusher with cast iron frames, and will consequently do a greater amount of work. It is very much lighter than the old forms, and has at least double their strength. It has been repeatedly subjected to the test of a steel hammer being thrown between its jaws, when going at as high a rate of speed as 300 revolutions per minute without the slightest injury to or any breakage of the machine. The manner of mounting the Crusher, so that it may be readily hauled from place to place, is illustrated in Fig. 2. It will be seen how peculiarily well adapted this style of Breaker is for mounting. The fly wheels themselves serve as the rear pair of wheels. The keys of the main fly wheels are withdrawn, and the main shaft is provided with a collar and set screw to hold the wheels in place when the machine is being hauled about. After being crushed, the ore is washed and sifted on a jigging sieve. In one of its simplest forms the ore is placed on a table from which a sieve is filled. It is then immersed in a tub of water and a jigging motion communicated to it by a workman alternately raising and lowering a handle. This effects two purposes—it washes the ore, and separates the material into two layers: the upper consists of the lighter spar and other impurities, which are raked off; and the lower consists of the heavier and purer portions of the ore, which are now ready for the roasting furnace. It will be apparent that in the bottom of the tub there must be a quantity of more or less valuable ore, which, from its fineness, has fallen through the sieve. This is called sludge or slime; and the minute particles of ore it contains are recovered either by simply forming an incline on the ground, and washing it with a current of water, or by using an inclined table called a *sleeping-table*. Ore which has been reduced to powder at the stamping-mill, as well as slime, is washed by this apparatus. The material is put into a chest which is placed in a sloping position, and is supplied with water on turning a stopcock. The current carries the contents of the chest through an opening at the bottom, and spreads it, with the aid of a series of stops, or small bits of wood, over the surface of the table. A stream of water is then kept flowing over the table till the earthy impurities are all carried down into a trough, the pure particles of the ore remaining, by reason of their greater specific gravity, near the top of the table, whence they are removed to be smelted. Sometimes the table is suspended by chains and receives a succession of blows at the top from a *buffer*, moved by cams on the same principle as the stamping-mill. The variety of machinery and apparatus used in dressing ores is very great, and they pass under different names in different districts, but they are all very similar in principle to those we have described. See *Iron*.

METAL SEPARATOR.—A machine much used in armories and arsenals for separating iron and steel chips, turnings filings etc., from those of brass or composition. Its capacity and utility for this kind of work are very great. The machine is not only a great labor-saving device, but brass-stock treated with it is much improved, as it is so thoroughly cleansed that it may be used for the best of work. The machine may also be used for separating iron from emery. The driving shaft should run 90 to 100 turns per minute. There are two things absolutely necessary in using the machine: 1st, Whenever the machine is not running, raise the brush and cover the wheel with iron. 2d, The tray under the hopper should strike equally on each side, so as to distribute the stock evenly on the wheel. If you wish it to feed faster, draw the hopper forward. The boxes should be placed as shown in the drawing.

METCALFE CARTRIDGE-BLOCK.—This consists of a wooden block, 5 inches by 1 3-4 inches by 11-16 inch, bored on its edge with eight holes to receive the same number of rifle cartridges. It is provided with a carrier or metallic hook, sliding upon the belt, in which it is proposed to carry the block full of cartridges. The rifle and the block are so arranged that, at pleasure, they can be secured together in a very convenient position for loading. It is intended that the blocks, when exhausted, shall be thrown away; but they can, if necessary, be refilled and used many ines. It is proposed that as many of these carriers and blocks be worn upon the belt as may be necessary, due regard being had to the size of the men and to the character of the service requiring their use. The advantages of this invention are manifold. The block in itself is a good package for the cartridges. It is nearly indestructible in transportation or by wet; it keeps the cartridges from jostling together, and



Metal Separator.

thereby, as has been shown by experience, endangering their surety of fire. It also protects them from dust and sand, quite as injurious to the gun as moisture would be to the cartridge. It is a convenient package in shape and size, if an extra supply of ammunition had to be carried in the men's pockets.

When combined with the gun, a considerable increase in the possible rapidity of fire is attained and a very marked advantage is found in firing lying down. In this position it seems probable that much of the firing of the future is to be conducted. The only portion of a man so firing which it is at all necessary to move is his right arm. If an isolated skirmisher, he need not twist or roll over to get at his back or side for ammunition, and thereby attract attention. The cartridges are immediately in front of the firer, under his eye. He sees just where they are, and how many are left him. We have frequently heard of troops engaged in intrenchments spreading, for convenience, their cartridges on the parapet in front of them. In a similar case, a man provided with the block has all this facility of manipulation, with this additional advantage, that, if obliged to change his position hurriedly, he does not have to leave his ammunition behind him, but carries it with the gun to which it belongs. Pickets or other troops exposed to surprise may sleep with their belts off if they have their blocks fixed. In case of a surprise, they have but one thing to look for—the gun.

Moreover, the block protects the hand from burning on the barrel. After a few shots have been fired from the new Springfield rifle, especially on a hot day, the barrel becomes so hot that it can hardly be touched. The block, when fixed, prevents the hand from touching it if the thumb be properly laid along the stock. The English War Department has consequently been obliged to issue leather pads to buckle over the barrel at the grip. With the cartridge-block *it is never so much needed as when it is used.*

METEOROLOGICAL REGISTER.—A monthly report prepared and transmitted by the Senior Surgeon on duty at each military post. It embraces the following items, as noted in the forms on pages 324 and 325.

METHYLATED SPIRIT.—Alcohol(C^4H_5OHO), of specific gravity of ·83, mixed with 10 per cent. of wood spirit, or methylic alcohol (C^2H_3O,HO), which is one of the products of the destructive distillation of wood. Methylated spirit is used for damping detonating compositions, so as to form them into paste, when they can be handled. It dissolves shellac.

METIER.—A term applicable to those nations which keep up large standing armies, and make war their principal object and pursuit. Chevalier Folard gives the following definition relative to the question which is often discussed on the subject of war, namely whether war be a trade or a science. The English call it a profession. Folard, however, distinguishes it in this manner: *La guerre est une métier pour les ignorants, et une science pour les habiles gens.*

METRICAL MEASURES. The frequently recurring necessity for changing tables expressing the dimensions, weights, and power of foreign guns (other than British) into their equivalents in our own system has suggested the preparation and compilation of the tables on pages 326 and 327. Some of the tables have been published in part, or in another form, but such have been generally based upon values for the *meter* and *kilogram*, which the latest accurate investigations have rendered obsolete; other of the tables, if ever published, are not generally accessible. All (except table M) are based upon the value of the meter in *inches* and of the kilogram in *grains*. The standard inch and grain of the United States are copies of the British; the tables, therefore, also express the equivalents of metrical in British measures.

MEASURES OF LENGTH, SQUARES, AND CUBIC MEASURES. —(Tables A., B., and C.) The international bureau of weights and measures at Paris is now engaged in determining, with the utmost exactness, the relations of the French standard to those of other nations. Since 1868 the United States Coast Survey Office has used a value for the meter equal to 39.370432 inches, as determined by an extensive series of comparisons, the results of which are published in a volume entitled "Comparisons of the Standard of Lengths of England, France, Belgium, Prussia, Russia, India, and Australia, made at the Ordnance Survey Office, Southampton, 1866." Pending the result of the investigation at Paris, this value of the meter is generally accepted by scientific men. The fact that the meter is standard at 0° C. (32° F.) and the yard at 62° F. has been taken into account, and the value given is that of the meter in inches of the standard yard. Tables A, B, and C, like all the remaining ones, consist of the values of each denomination, from 1 to 9 inclusive, which can be applied to all numbers, by decimal multiplication and division.

WEIGHTS.—(Table D.) The standard troy pound of the United States, at Philadelphia, is our only standard of weight; it is an exact copy of the imperial troy pound of Great Britain, obtained in 1827. Elaborate comparisons, since 1855, of this troy pound, weighing 5,760 grains, and of the commercial or avoirdupois pound of 7,000 grains, derived from the former, with copies of similar weights from the standard pound of Great Britain, have shown that there is less than $\frac{1}{1000}$ of a grain difference between the money standards (troy weights) of the two countries. The British *standard pound avoirdupois* is the weight, in the latitude of London, of a certain piece of platinum kept in the exchequer office. In the Philosophical Transactions for 1856, is published Prof. W. H. Miller's determination of the weight of the kilogram equal to 15.432.34874 grains, which is accepted as authoritative. This value has been used in the preparation of Table D.

AIR SPACE PER UNIT OF WEIGHT OF POWDER-CHARGE. —(Table E.) In the metrical system, the volume of the chamber and bore of the gun is expressed in decimeter cubes (d. c.) or liters. The space in the bore (or chamber), in rear of the projectile in place, in which the combustion of the charge takes place, constitutes the *initial volume*, and the *final volume* results when the projectile leaves the piece and the in

Station ________ . Lat. ________ . Long. ________ . Alt. of bar. above sea, ________ feet.

188 .	Thermometer.				Self-registering thermometer.			Movements of atmosphere.									Amount of cloudiness.			Rain and melted snow.			Remarks.
Month								7 A. M.			2 P. M.			9 P M.									
								Winds.		Motion of clouds.	Winds.		Motion of clouds.	Winds.		Motion of clouds.							
	7 A. M.	2 P. M.	9 P. M.	Daily mean.	Max.	Min.	Mean.	D.	F.		D.	F.		D.	F.		7 A. M.	2 P. M.	9. P M.	Began.	Ended.	Quantity.	

SUMMARIES OF WINDS AND WEATHER.

N.		N.E.		E.		S.E.		S.		S.W.		W.		N.W.	
No.	Force.	No.	Force.	No.	Force.	No.	Force.	No.	Force.	No.	Force.	No.	Force.	No.	Force.
Average cloudiness.						No. of days of rain and hail.				No. of days of snow.					

Surgeon, U. S. Army.

188 .	Barometer and thermometer attached.						Remarks.
Month.	7. A. M.		2 P. M.		9 P. M.		
	Bar.	Ther.	Bar.	Ther.	Bar.	Ther.	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
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17							
18							
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20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							

188 .	Dry and wet bulb thermometer.													Remarks.
Month.	7. A. M.		2 P. M.		9 P. M.		Month.	7 A. M.		2 P. M.		9 P. M.		
	D.B.	W.B.	D.B.	W.B.	D.B.	W.B.		D.B.	W.B.	D.B.	W.B.	D.B.	W.B.	
1							17							
2							18							
3							19							
4							20							
5							21							
6							22							
7							23							
8							24							
9							25							
10							26							
11							27							
12							28							
13							29							
14							30							
15							31							
16														
Monthly mean......................................														

Table.			No.	Logarithm.	Logarithm.	No.		
A.	Inches in a	Millemeter	0.039370432	2.5951702	1.4048298	25.399772	Millimètres	in an inch.
		Centimeter	0.39370432	1.5951702	0.0048298	2.5399772	Centimèters	
		Decimeter	3.9370432	0.5951702	1.4048298	0.25399772	Décimèter	
		Meter	39.370432	1.5951702	2.4048298	0.025399772	Mèter	
	Feet in a	Decimeter	0.328086933	1.5159890	0.4840110	3.017972	Décemèters	in a foot.
		Meter	3.28086933	0.5159890	1.4840110	0.3047972	Mèter	
		Kilometer	3280.86933	3.5159890	4.4840110	0.0003047972	Kilomèter	
	Yards in a	Meter	1.09362311	0.0388677	1.9611323	0.9143917	Mèters	in a yard.
		Kilometer	1.093.62311	3.0388677	4.9611323	0.0009143917	Kilomèter	
	Mile in a	Meter	0.000621377	4.7933550	3.2066450	1609.33	Mètres	in a mile.
		Kilometer	0.621377	1.7933550	0.2066450	1.60933	Kilomèters	
B.	Square inches in a square	Millimeter	0.00155003	3.1903404	2.8096596	645.14836	Millimèters carrés	in a square inch.
		Centimeter	0.155003	1.1903404	0.8096596	6.4514836	Centimèters carrés	
		Decimeter	15.5003	1.1903404	2.8096596	0.064514836	Décemèters carré	
		Meter	1550.03	3.1903404	4.8096596	0.00064514836	Mèter carré	
	Square feet in a square	Decimeter	0.10764104	1.0319779	0.9680221	9.29014	Décimètres carrés	in a square foot.
		Meter	10.764104	1.0319779	2.9680221	0.0929014	Mètre carré	
	Square yards in a square meter		1.1960115	0.0777354	1.9222646	0.8361123	Mètre carré in a square yard.	
C.	Cubic inches in a cubic	Millimeter	0.000061025	5.7855106	4.2144894	16386.61887	Millimètres cubes	in a cubic inch.
		Centimeter	0.061025394	2.7855106	1.2144894	16.386681887	Centimètres cubes	
		Decimeter	61.02539436	1.7855106	2.2144894	0.01638661887	Décimètre cube	
		Meter	61025.39436	4.7855106	5.2144894	0.00001638662	Mètre cube	
	Cubic feet in a cubic	Decimeter	0.035315626	2.5479669	1.4520331	28.3160784	Décimètres cube	in a cubic foot.
		Meter	35.315626	1.5479669	2.4520331	0.0283160784	Mètre cube	
	Cubic yards in a cubic meter		1.3079861	0.1166031	1.8833969	0.7645342	Mètre cube in a cubic yard.	
D.	Grains in a	Gram	15.43234874	1.1884320	2.8115680	0.064798955	Gramme	in a grain.
		Kilogram	15432.34874	4.1884320	5.8115680	0.000064798955	Kilogramme	
	Ounces (avoirdupois) in a	Gram	0.035273935	2.5474539	1.4525461	28.3495454	Grammes	in an ounce (avoirdupois.)
		Kilogram	35.273935	1.5474539	2.4525461	0.0283495454	Kilogramme	
	Pounds (avoirdupois) in a	Gramme	0.00220462132	3.3433340	2.6566660	453.59263	Grammes	in a pound (avoirdupois.)
		Kilogramme	2.20462132	0.3433340	1.6566660	0.45359263	Kilogramme	
		Ton (millier)	2204.62132	3.3433340	4.6566660	0.00045359263	Tonne	
	Ton (2,240 pounds) in a	Kilogramme	0.0009842059	4.9930860	3.0069140	1016.0474	Kilogrammes	in a ton (2.240 pounds.)
		Tonne	0.98420591	1.9930860	0.0069140	1.0160474	Tonne	
E.	Cubic inches of air space to a pound of powder in a cubic decimetre of air-space to a kilogramme of powder.		27.6806688	1.4421766	2.5578234	0.036126291	Décimètre cube of air-space to a kilogramme of powder in a cubic inch of air-space to a pound of powder.	
F.	Pounds to the square inch in an atmosphere.		14.6967	1.1672200	2.8327800	0.06804245	Atmosphere in a pound to the square inch.	
	Ton to the square inch in an atmosphere.		0.006561	3.8169720	2.1830280	152.4150877	Atmospheres in a ton to the square inch.	
G.	Pounds to the inch in a kilogramme to the centimetre.		5.59968718	0.7481638	1.2518362	0.1785814	Kilogramme to the centimètre in a pound to the inch.	
	Tons to the foot in a ton to the metre		0.29898255	1.4770970	0.5229030	3.33351923	Tonnes to the mètre in a ton to the foot.	

Table.		No.	Logarithm.	Logarithm.	No.	
H.	Pounds to the square inch in a kilogram to the square Millimetre	1422.3078688	3.1529936	4.8470064	0.00070308274	Kilogramme to the Millimètre carré in a pound to the square inch.
	Pounds to the square inch in a kilogram to the square Centimetre	14.223078688	1.1529936	2.8470064	0.070308274	Kilogramme to the Centimètre carré in a pound to the square inch.
	Ton to the square inch in a kilogram to the square Millimetre	0.63495884	1.8027456	0.1972544	1.57490507	Kilogrammes to the Millimètre carré in a ton to the square inch.
	Ton to the square inch in a kilogram to the square Centimetre	0.0063495884	3.8027456	2.1972544	157.490507	Kilogrammes to the Centimètre carré in a ton to the square inch.
	Pounds to the square foot in a Kilogram to the square metre.	0.204812311	1.3113561	0.6886439	4.88251819	Kilogrammes to the mètre carré in a pound to the square foot.
	Pounds to the square foot in a Ton to the square metre.	204.812311	2.3113561	3.6886439	0.00488251819	Tonne to the mètre carré in a pound to the square foot.
	Ton to the square foot in a Kilogram to the square metre.	0.0000914341	5.9611081	4.0388919	10936.84131	Kilogrammes to the mètre carré in a ton to the square foot.
	Ton to the square foot in a Ton to the square metre.	0.0914341	2.9611081	1.0388919	10.93684131	Tonnes to the mètre carré in a ton to the square foot.
I.	Pounds to the cubic inch in a kilogram to the cubic millimetre.	36126.29166	4.5578234	5.4421766	0.00002768067	Kilogramme to the millimètre cube in a pound to the cubic inch.
	Pound to the cubic foot in a kilogram to the cubic metre.	0.06242623	2.7953671	1.2046329	16.0189	Kilogrammes to the mètre cube in a pound to the cubic foot.
	Ton to the cubic foot in a ton to the cubic metre.	0.02786885	2.4451191	1.5548809	35.882355	Tonnes to the mètre cube in a ton to the cubic foot.
K.	Foot-pounds in a kilogram-metre	7.233075	0.8593230	1.1406770	0.13825377	Kilogrammètre in a foot-pound.
	Foot-tons in a ton-metre	3.2290518	0.5090750	1.4909250	0.30968843	Tonnes mètres in a foot-ton.
L.	Foot-pounds to an inch of circumference in a kilogram-metre to a centimetre of circumference.	18.3718474	1.2141528	2.7358472	0.05443111	Kilogrammètre to a centimètre of circumference in a foot-pound to an inch of circumference.
	Foot-tons to an inch of circumference in a ton-metre to a centimetre of circumference.	8.201717	0.9139048	1.0860952	0.12192567	Tonne-mètre to a centimètre of circumference in a foot-ton to an inch of circumference.
	Foot-tons to a square inch of cross-section in a ton-metre to a square centimetre of cross-section.	20.832175	1.3187346	2.6812654	0.04800267	Tonne-mètre to a centimètre carré of cross-section in a foot-ton to a square inch of cross-section.
	Foot-pounds to a pound of powder (or gun) in a kilogram-metre to a kilogram of powder (or gun)	3.2808693	0.5159890	1.4800110	0.3047972	Kilogrammètre to a kilogramme of powder (or gun) in a foot-pound to a pound of powder (or gun.)
	Foot-tons to a pound of powder (or gun) in a ton-metre to a kilogram of powder (or gun).	1.464674	0.1657410	1.8342590	0.68274578	Tonne-mètre to a kilogramme of powder (or gun) in a foot-ton to a pound of powder (or gun.)
	Foot-tons to a pound of pressure in a ton-metre to an atmosphere of pressure.	0.2197126	1.3418550	0.6581450	4.5514	Tonne-mètres to an atmosphere of pressure in a foot-ton to a pound of pressure.
M.	Fahrenheit degrees in a Centigrade degree	1.8	0.2552725	1.7447275	0.5555555	Centigrade degree in a Fahrenheit degree.
	Fahrenheit degrees in a Réaumur degree	2.25	0.3521825	1.6478175	0.4444444	Reaumur degree in a Fahrenheit degree.
N.	Units of heat in a Calorie	3.96831835	0.5986065	1.4013935	0.25199593	Calorie in a unit of heat.

flamed gasses have expanded to completely fill the whole of the bore. The definite relation between the powder-charge and the initial and final volumes, which we express by "— —cubic inches of air-space to the pound of powder," is in that system expressed by "———decimeter cubes of air-space to the kilogram of powder." Table E enables us to convert these expressions.

Pressure of an Atmosphere.—(Table F.) The value of the *unit atmosphere* (or atmo.) which has been adopted in the metrical system, and used by Regnault in his investigations to determine the relations between the temperature and pressure of gases, is the pressure of 760 millimeters(29.922 inches) of the mercurial column at 0° C. (32° F.) at Paris; which amounts, in that latitude, to 1.0333 kilograms on the square centimeter, or 14.6967 pounds on the square inch. In consulting this table it is therefore necessary to remember that it deals with an arbitrary *unit atmosphere.*

The Encyclopædia Britannica, gives as *an atmosphere*, in the English system, the pressure due to 29.905 inches of the mercurial column at 32° F. at London, which atmosphere thus becomes 0.99968 of that of the metrical system. Under this pressure (29.905) distilled water boils at 212° F.

Rankine assumes as the value of an English *atmosphere* the pressure due to 29,922 inches of the mercurial column at 32° F., which in the latitude of London corresponds to a pressure of 14.704 pounds per square inch. This, it will be observed is the *height* used in the metrical system, which is thus indicated as the universal standard.

There are two ways of taking such a standard. 1st. If the *absolute pressure at Paris*, due to 76 centimeters of the mercurial column at 0° C., be assumed, then if we would have the same absolute pressure in taking readings of the barometer for *pressures*, in a different latitude, allowance must be made for a difference of height of the mercurial column, corresponding to the difference between the latitude of the place of observation and that of Paris. The height of the mercurial column at 0° C. giving a pressure equivalent to that of *this* metrical atmosphere, can be computed in centimeters by the following expression:

$$76 \times \frac{1 + .00531 \sin^2 48° 50'}{1 + .00531 \sin^2 l.}$$

for any latitude l. (48° 50′ being the latitude of Paris.) Thus we have for New York City, taking l=40° 42′ 43″, a value for the expression, of 76.06314 centimeters=29.946 inches, which height of the mercurial column at 32° F. at New York City would indicate a pressure equivalent to the metrical atmosphere of *constant pressure.*

2d. On the other hand, assuming the universal standard to be the pressure (wherever taken) due to 29.922 inches of the mercurial column at 32° F., then the absolute pressure of *this unit atmosphere* at New York would equal but 14.686 pounds on the square inch, which is 0.999272 of the metrical atmosphere *at Paris.* It may be added that 29.922 inches of the mercurial column at 32° F. corresponds to 30 inches at 57°.8 F.; the reduction to 32° for this reading being—0.078 of an inch for an observed reading of the attached thermometer of 57°.8 F.

Bending-Stress per Unit of Length.—(Table G.)—In the case of a uniformly distributed load, or of a pressure tending to bend or burst open a structure, this table enables us to pass from "kilogrammes to the centimeter" to "pounds to the inch," etc., and *vice versa.*

Stress per Unit of Square and Cubic Measures.—(Tables H and I.) The first of these tables finds its application especially in the conversion of expressions giving the tensile strength of materials, wherein we change the metrical expression in "kilogrammes to the square millimeter" into "pounds to the square inch," otherwise stated simply as "—— pounds tensile strength." The two tables apply to the conversion of values of forces of compression; the word *stress* being used to indicate either a force of extension or compression.

Units of Work or Energy.—(Table K.)—This table gives simply the equivalent values of "kilogrammeters" in "foot-pounds," and "tonnes-metres" (sometimes written *dynamodes*) in "foot-tons." It will be used in the translation of abstract quantities of work or energy.

Energy of Projectiles.—(Table L.)—The translation of expressions for total energies will be made by Table K, while in this series (L) we pass readily to expressions for energies of projectiles in terms of the "units of the shot's circumference" and "units of the shot's cross section." This series also enables us to translate the proportion of the total energy due to each kilogram of the powder-charge, each kilogram of the piece, or each kilogram of the projectile, into equivalent denominations in our own system, and *vice versa.* Further, it includes a translation of the proportion of the total energy due to each unit of the terms in which the pressure upon the bore is expressed; as, for example, "tonnes-mètres (of energy) per atmosphere of pressure" in "foot-tons per pound of pressure."

In Ordnance Notes, No. XLV, Maj. George W. McKee, United States Army, has already called attention to the influence of the *local* value of the force of gravity (g) in using the formula $E=\frac{Wv^2}{2g}$, which is employed for determining the energy of a projectile. In connection with these tables, it may be remarked that while they translate the value given in the foreign tables, yet the values thus deduced may not always be strictly comparable with each other or with our own. The practice of the United States Ordnance Department is to use a value for g=32.2, which is the same as that used in Great Britain; this makes the published tables of energy directly comparable for the two countries, but slightly underrates the local power of our own guns.

The French use the value of g at Paris, where it is equal to 9.81 meters=32.185 feet, which, it will be seen, gives slightly greater energies for one of their guns than we publish for one of ours, supposing all the values entering in the formula (except g) to be identically the same for the two guns under comparison. Small changes introduced in the value of g will, however, make little practical difference in the published results, which, for energies, are usually given in foot-tons to tenths only.

Thermometers.—(Table M.) This table presents merely a tabulated solution of the formula

$$F° = \frac{C° \times 9}{5} + 32 = \frac{R° \times 9}{4} + 32.$$

By decimal multiplication and division it can be applied to all numbers, as the others. In passing from centigrade or Reaumur to Fahrenheit we first take out the tabular numbers and then add 32; in the reverse operation we first subtract 32 from the Fahrenheit degrees, to be converted into centigrade or Reaumur, and then take out the tabular numbers corresponding to this remainder.

Units of Heat—(Table N.)—The thermal unit centigrade is the amount of heat required to raise unit mass of water from 0 to 1° C.

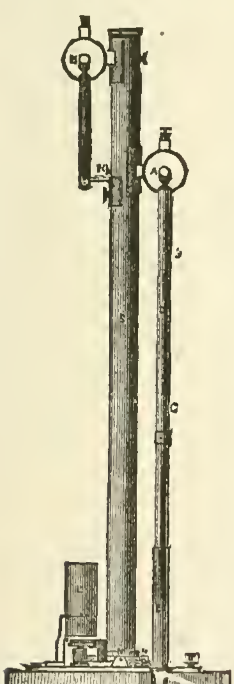
This table expresses the relation between the amount of heat required to raise *one kilogram* (2.2046 pounds) of water from 0 to 1° C. (1°.8. F), and the amount of heat required to raise *one pound* of water 1° F, (from 32° to 33° F). The mechanical equivalents of the "unit of heat" in the two systems bear a like relation to each other. This mechanical equivalent, in the English system, is the number of foot-pounds of mechanical energy which must be expended in order to raise the temperature of one pound of water one degree. For Farenheit's degree that quantity (Joule's equivalent) is 772 foot pounds; for the Centigrade degree $\frac{9}{5}$ of 772 = 1389.6 foot-pounds. If we replace the pound by a kilogram (2.2046+ pounds), that quantity becomes for the Centigrade degree 2.2046 of $\frac{9}{5}$ of 772 = 3063.54 foot-pounds, which is the mechanical equivalent of the metrical unit of heat, and is equal to 423.55 kilogrameters.

METRONOME.—A valuable machine for indicating the correct time or cadence. It was invented in 1815 by Mälzel, the inventor also of the automaton trumpeter. The test of a correct metronome is, that when set at 60 it shall beat seconds.

MEURTRIERES.—Small loop-holes, sufficiently large to admit the barrel of a rifle or musket, through which soldiers may fire, under cover, against an enemy. Likewise the cavities made in the walls of a fortified town or place.

MEXICAN SADDLE.—The Mexican, or California saddles as sometimes called, are extensively used throughout the Western States of America; and, in proportion to their excessive cost, are considered by the traders and Indians far superior to any other saddles manufactured. They are furnished with wool-lined bastos, llama skin anqueras, sudaderos, tapaderos and stirrup-leathers handsomely cut-stamped. These saddles, direct descendants of the Moorish-Spanish, brought over by Cortez 300 years ago, have hardly improved in the changes. The convenience and safety of the rider are alone considered. The shape of the bearing surface running through all the many varieties is invariably *bad*. They can never be used without a great thickness of saddle cloth or blankets, and even then cut, gouge, and lacerate the back of the horse. They are always *heavy* and *awkward*.

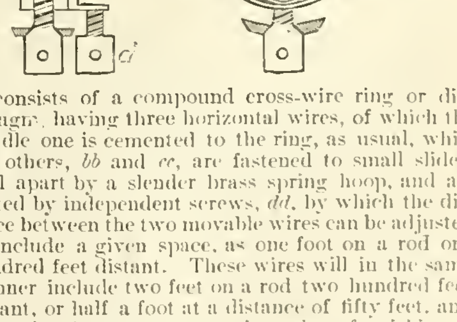
MICRO CHRONOMETER.—When the chronograph is used, with an interval of 50 meters or more between the targets, the chronometer receives the dents near the top, when of course it is moving with its greatest speed, and, consequently, small differences in time give proportionately large differences in height. But when the interval to be measured becomes small this no longer obtains, for then the dent of the shot is imprinted on the *lower* recorder near the disjunction circle before the chronometer has acquired much acceleration. To obviate this difficulty the arrangement shown in the drawing is adopted. The electro-magnet of the registrar with its stop is removed to the upper part of the column, and *introduced in the circuit that is broken first*. By this arrangement we obtain a disjunction dent near the *upper* end of the chronometer and thus regain the advantage, even when the interval is very small, of recording very minute times where the representative scale is greatest. This disjunctor-reading is about 0″.3, at least double what it was before, hence the representative dents of small times are readily marked on the chronometer



when it has double its former velocity. We may remark here that for diminishing velocities and in measuring small times for decreasing intervals, the units of the scale in the one case and the corresponding spaces on the chronometer in the other increase —most desirable attributes of instruments of this class. The fall corresponding to the time to be measured is recorded *negatively*, as the firing dent is below the disjunctor-reading, and the duration of this fall is found by subtracting that of the former from the latter. These heights are measured to tenths of a millimeter by means of the scale engraved on the rule and by its vernier and the corresponding times may be calculated from the formula $T = \sqrt{\frac{2H}{g}}$, or taken directly from a table, which is formed analogously to the ordinary logarithmic tables. When the interval becomes so great as to give a dent below the upper recorder, the ring on the rod must be removed, and two of the larger tubes applied to the chronometer, one above the other. The largest interval that can be recorded by the instrument thus arranged is that which corresponds to the disjunctor-reading, a little over 0″.3. When the time between the rupture of the two circuits exceeds this reading, the chronometer is struck before it has commenced to fall, and the dent of the origin is obtained. See *Le Boulengé Chronograph*.

MICROMETER.—An instrument used with a telescope or microscope to measure small distances, or the apparent diameters of objects which subtend very small angles. The micrometer with a graduated scale is used for measuring distances by direct comparison. The application of the micrometer to the telescope is credited by Whewell to Huyghens, Malvasia and Azout. It was a great advance in the attempt to do by accuracy of measurement what had previously been attempted, and in part accomplished, by enlarging the instrument so as to enable the measurements of smaller arcs. The first micrometer on record is that of Gascoigne, of England, constructed about 1640, and used by him in measuring the diameters of the moon and some of the planets. The instrument had nicely-ground parallel edges of brass-plate, and parallel hairs were substituted by the renowned Dr. Hooke.

The drawing shows the micrometer used with the Engineer's Transit and other standard instruments.



It consists of a compound cross-wire ring or diaphragm, having three horizontal wires, of which the middle one is cemented to the ring, as usual, while the others, *bb* and *cc*, are fastened to small slides, held apart by a slender brass spring hoop, and actuated by independent screws, *dd*, by which the distance between the two movable wires can be adjusted to include a given space, as one foot on a rod one hundred feet distant. These wires will in the same manner include two feet on a rod two hundred feet distant, or half a foot at a distance of fifty feet, and so on in the same proportion, thus furnishing a means of measuring distances, especially over broken ground, much more easily and even more accurately than with a tape or chain.—See *Engineer's Transit*, *Gradienter* and *Stadia*.

MICROPHONE.—This instrument, invented in 18 by Prof. Hughes, does for faint sounds what the microscope does for matter too small for sight; the fall of a bit of tissue-paper or the tread of a fly being rendered audible at many miles distance. In principle the microphone illustrates the action of sonorous vibrations on the strength of an electric current. One of the most sensitive substances for microphonic action is willow-charcoal, plunged in a state of white heat into mercury. The theory is that in a homogeneous conductor the compressions and dilatations of the molecules balance each other, and no variation of current ensues while under minute subdivision, with electrical continuity, sonorous waves affect the strength of an electric current, and variations in the current reproduce sonorous waves. One form of microphone consists of a piece of mercury-tempered carbon an inch long, placed vertically between two carbon-blocks hollowed to receive its ends, wires connecting the blocks with the battery and the receiver by which the sounds are to be heard. "A piece of willow-charcoal," says the inventor, "the size of a pin's head is sufficient to produce articulate speech." Two nails laid parallel, with wire connections, and a third nail laid across them, make a simple form of microphone. A few cells of any form of battery may be used. A continuous sound has been made by the mutual interaction of the microphone and telephone, each instrument in turn repeating the sound made by the other. Many useful applications of the microphone have been made or suggested.

MICROSCOPE.—An optical instrument by which objects too small to be viewed by the naked eye may be seen and examined. A *single* or simple microscope is one by which the object is seen directly; it may consist of a single lens or more than one. In a *compound* microscope two or more lenses are so arranged that the image formed by one is magnified by the others, and viewed as if it were the object itself. In a *solar* microscope a reflector and condensor are employed to direct the sun's rays on the object. In a *lucernal* microscope the rays of a lamp are similarly directed. The microscope is used for a variety of military purposes in arsenals, and also for detecting adulterations in the ration and fabrics. Another use to which it may be applied was disclosed during the late Franco-Prussian war. Copies of newspapers, reduced many-fold in size by photography, were fastened in large numbers to carrier-pigeons and introduced into besieged cities. These were easily read by the microscope.

The United States Army microscope, made by Zentmayer, is thus described: It has a brass body, 16 inches high, on a brass stand, with a joint to incline it to any angle, double-milled head-rack and pinion for coarse adjustment, micrometer-screw for fine adjustment, and a movable glass stage; under the stage a tube is fitted for carrying the accessory illuminating apparatus, concave and plane mirrors, arranged for direct or oblique illumination, two eye-pieces, one achromatic object-glass $\frac{8}{10}$ of an inch focus, of 24 degrees angular aperture, one achromatic object-glass $\frac{1}{5}$ of an inch focus, of 80 degrees angular aperture (not adjustable for glass-cover), giving power of 50, 100, 250, and 450 diameters; camera lucida, stage micrometer ruled $\frac{1}{100}$ and $\frac{1}{1000}$ of an inch, and a condensing lens two inches diameter on a separate stand.

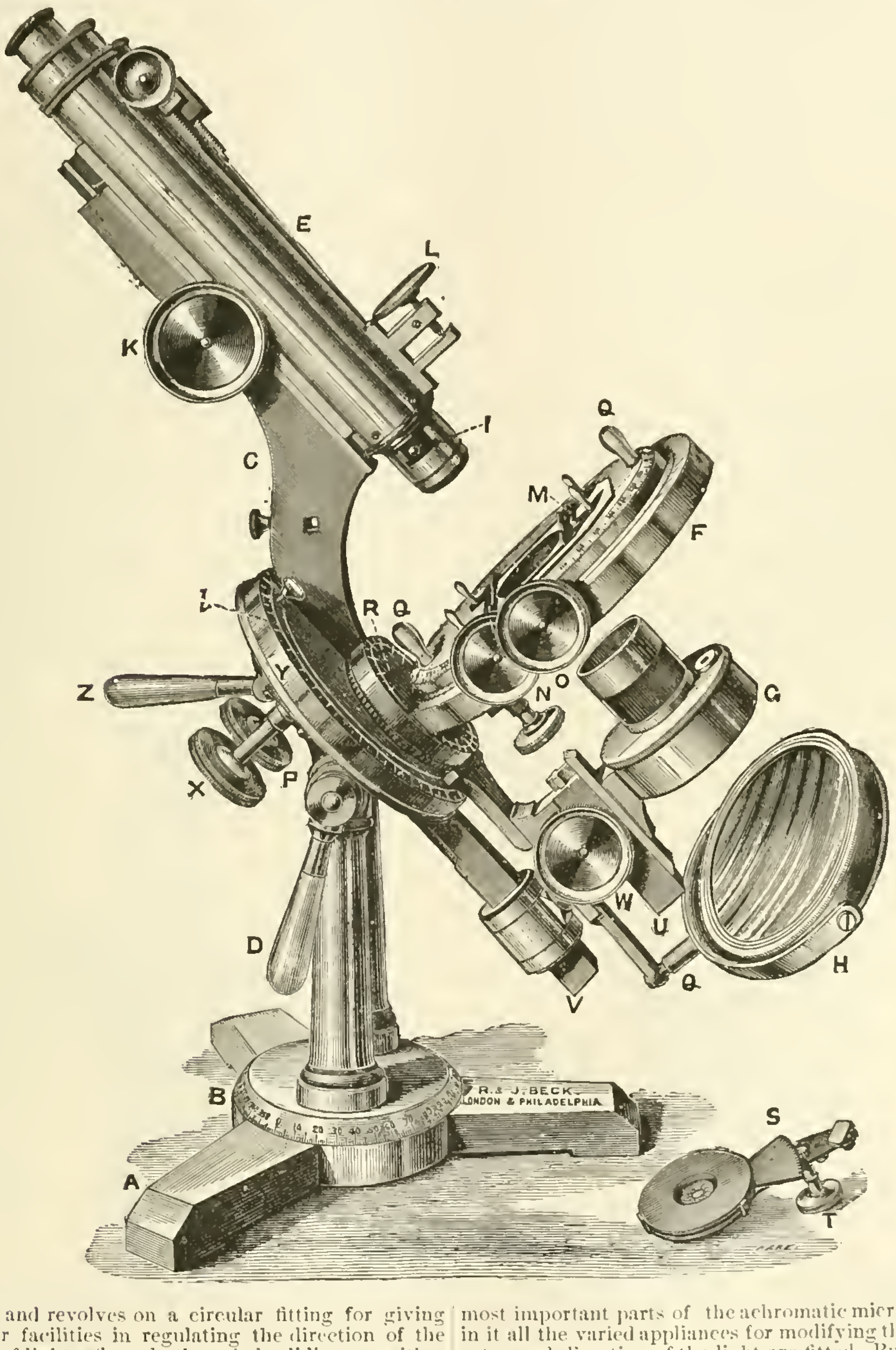
The drawing shows one of the latest improved microscopes and stands. The stand has a tripod (A) for its base, upon which is placed a revolving fitting (B), graduated to degrees, by which means the microscope can be turned around without its being lifted from the table, and the amount of such rotation registered; upon this fitting two pillars are firmly fixed, and between them the limb (C) can be elevated or depressed to any angle, and tightened in its position by the lever (D). The limb carries at one end the body (E) (binocular or monocular), with eye-pieces and object-glasses; in its center the compound stage (F), beneath which is the circular plate, sliding on a dove-tailed fitting, and moved up and down by the lever (Z), and carrying the supplementary body or sub-stage (G); and at the lower end a triangular bar carrying the mirror (H). Each of these parts requires a separate description.

The binocular body consists of two tubes, the one fitted in the optical axis of the microscope, and the other oblique. At their lower end and immediately above the object-glass there is an opening, into which a small brass box or fitting (I) slides; this box holds a prism so constructed that when slid in it intercepts half the rays from the object-glass, diverts them from their direct course, and reflects them into the additional or oblique tube. To the prism-box is attached a spring-catch, which, when pressed in, permits of the removal of the prism-box; but this is only needed for cleaning, as, when the box is drawn back to the distance properly allowd by this spring, the prism in no way whatever interferes with the field of view, and all the rays pass up the direct body and the microscope is converted into a monocular one. The upper or eye-piece ends of the tubes are fitted with racks and pinion for varying the distances between the eyes of various persons; and arrangements are made for racking out one tube more than the other, to suit irregularities or inequalities between the eyes of the observer. This body is moved up and down with a quick movement by means of the mill-heads (K), and with a very delicate and a fine adjustment by the milled head (L). This milled head works against a lever, which moves a slide independent of the rack-movement, and gives an adjustment at once certain and decided.

The compound stage is of an entirely new construction: the object is most frequently merely placed upon it, but, if necessary, it can be clamped by carefully bringing down the spring-piece (M); the ledge will slide up or down, and the object may be pushed sideways; this arrangement forms the coarse adjustment. Finer movements in vertical and horizontal directions are effected by means of two milled heads (N and O), the screws attached to which are kept up to their work by opposing springs, so as to avoid all strain or loss of time. The whole stage revolves in a circular ring by the milled head (P), or this can be drawn out, and then it turns rapidly by merely applying the fingers to the two ivory studs (Q, Q) fastened on the top plate, which is divided into degrees to register the amount of revolution. The stage is attached to the limb on a pivot, and can be rotated to any angle, which angle is recorded on the divided plate (R), or can be turned completely over, so that the object can be viewed by light of any obliquity without any interference from the thickness of the stage. Beneath and attached to the stage is an iris diaphram (S), which can be easily and altogether removed, as shown in the illustration, from its dove-tailed fitting, so as not to interfere in the slightest degree during the rotation of the stage. The variations in the aperture of this diaphragm are made by a pinion working into a racked arc and adjusted by the milled head (T).

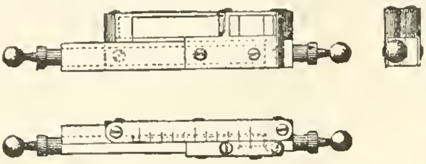
Beneath the stage are two triangular bars (U, V), the one revolving around and the other rigid in the optical axis of the instrument. On the former the sub-stage (G), carrying all the apparatus hereafter described for illumination and polarization, fits, and is racked up and down by the milled head (W): the mirror also, if desired, slides on the same bar: the revolving motion to this bar is given by the milled head (X), and the amount of angular movement is recorded on the circle (Y), whilst the whole of this part of the stand is raised and lowered concentric with the optical axis of the instrument by the lever (Z), and the amount of such elevation or depression registered on a scale attached to the limb. This bar can be carried around and above the stage, and be thus used for opaque illumination. The lower triangular bar (V) carries the mirror H, or a right-angle prism, when the illumination is required to be concentric with the optical axis of the instrument, and independent of the movements of other illuminating apparatus. The mirror-box contains two mirrors, one flat and the other concave; it swings in a rotating semicircle attached to a lengthening-bar, which enables it to be turned from one side to the other, and revolves on a circular fitting for giving greater facilities in regulating the direction of the beam of light reflected, the whole sliding on either of the triangular bars, previously referred to, and made to reverse in the socket (a) so as to bring the center of the mirror concentric with the axis of the microscope in either case.

As the mirror alone is insufficient for many kinds of illumination, some provision has to be made for holding various pieces of apparatus between the object and the mirror. For this purpose a supplementary body, or sub-stage, is mounted perfectly true with the body, and is moved up and down in its fitting by rack and pinion connected with the milled heads (W). This sub-stage, to which reference has already been made, is now regarded as one of the most important parts of the achromatic microscope; in it all the varied appliances for modifying the character and direction of the light are fitted. But a few years since it was considered sufficient for this part of the stand to be constructed so as to move up and down perfectly coincident with the optical axis of the instrument, and for that purpose it was racked in a groove planed out on the same limb as that on the



upper end of which the optical portions were carried. But lately microscopists have shown the desirability of affording every facility for lateral angular adjustments; and this has led to the sub-stage being attached to an arc (*b*) working in the circular plate (Y), and moved by a rack and pinion (X), whilst the amount of such angular movement is recorded on the upper surface of the plate (Y). Having once fixed the angular direction of the light, the focusing of it depends upon the lever (Z), which moves the circle up and down, and with it the arm carrying the illuminating apparatus, *in the optical axis of the instrument.*

MICROSCOPIC-GAUGE.—An instrument used in connection with the testing machine. It consists of a pair of glass sides, which are connected with the specimen by collars in the manner shown. One of the



glass sides is graduated to thousandths of an inch, and the other to hundredths of an inch. A microscope using a one-inch objection is employed in reading these scales, and by means of it the scale of thousandths may be readily subdivided into ten thousandths of an inch by the eye alone. The microscope is supported by an adjustable arm attached to one of the posts or the testing machine, or to a post expressly provided for this purpose, and detached from the machine. See *Taper-rule* and *Vernier gauge*

MICRO-SPECTROSCOPE.—A spectroscope placed in connection with a microscope, in order that the absorption lines may be readily produced. The instrument is employed in various testings; but notably, by Surgeons in viewing the absorption bands of blood in toxicological research. The micro-spectroscope designed by Walmsley and Co., and shown in figures 1 and 2, consists of a series of prisms, (A), arranged for direct vision, fitted into an eye-piece, and supplied with various appliances—namely, a slit, (B), a supplementary spectrum arrangement, consisting of a small right-angle prism, D, a stage, for placing an object upon, and a mirror, for reflecting the light and all the necessary adjustments. In the focus of the top lens of an eye-piece especially constructed is placed what is technically termed a slit, B; this consists of two shutters meeting in the center of the field, the one sliding up to the center of the field of view, and the other adjusting by means of a delicate milled head. Upon the delicacy of the edge of this slit the value of the Spectroscope largely depends, any irregularity or piece of dust appearing a dark band at right angles to the spectrum under examination, and greatly interfering with the definition. In the same part of the instrument is inserted a small right-angle prism, (D), which can be pushed forward or drawn back out of the field of view by a milled head. In the former position it reflects the rays passing through any object placed upon the supplementary stage to the eye placed at the eye-end of the instrument, and enables the observer to compare two spectra with one another, or to measure and record the position of the absorption bands. Placed on the flat surface of the eye-piece are a couple of levers, moving two shutters, placed immediately over the slit, for regulating the length of the spectrum under examination. Above the top lens of the eye-piece the most important portion of the instrument slides; this consists of a series of prisms, (A), so arranged as to give a direct-vision spectrum, and upon the amount of the dispersion of which prisms much of the value of the instrument depends. At the side of the main tube is a supplementary stage, upon which a standard scale, or a second object is placed, supplied with a mirror, for reflecting the light through the object, the rays then being totally reflected by the right-angle prism, (D), before alluded to, and thrown up the tube to the observer. To use the instrument, remove the ordinary eye-piece of the microscope, and slide the spectroscope eye-piece (Figs. 1 and 2) into the body in its place. Remove the upper tube, containing the series of prisms, and draw back the sliding slit by a milled head, so that one-half of the field of view is clear. Focus the microscope to the object to be examined,

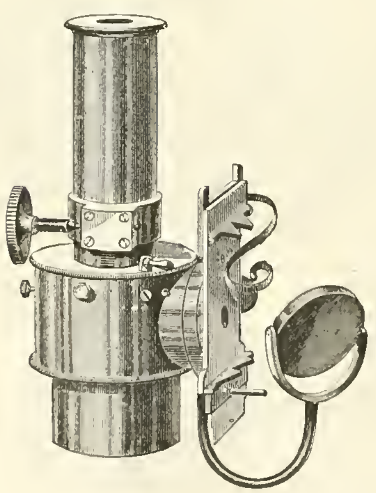


Fig. 1.

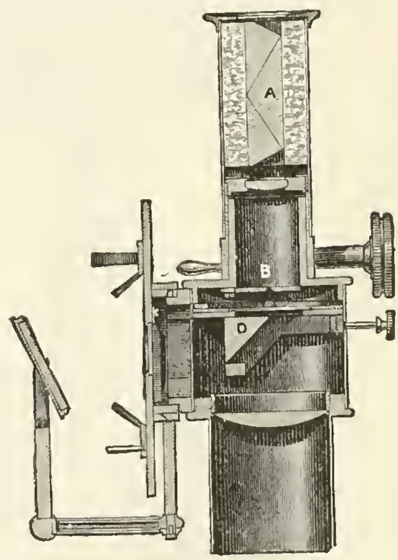


Fig. 2.

which is placed upon the stage, pass it up to the edge of the slit, move the side shutters by the levers, so as to shut off all side light, save that passing through the object, and push back the sliding side of the slit by the milled head. Focus the top lens of the eye-piece to the slit by means of the rack-and-pinion, place the tube, containing the compound prism, (A), over the eye-piece, remove the object from the stage, adjust the slit by means of an adjusting milled head, so as to obtain clear vision, if by daylight, so that the Fraunhofer lines are faintly seen, replace the object to be examined upon the stage, and the absorption-bands will be readily seen. The character of these bands and their position varies in every object; and if any practical use is to be made of the investigations, it is necessary not only to observe, but to record their position, by means of a standard scale provided for the purpose.

MICROTASIMETER.—An instrument invented by Mr. Thomas A. Edison for the purpose of measuring very minute variations of pressure caused by the expansion or contraction of any given body, from whatever causes, heat, moisture, etc. A part of the apparatus is constructed upon the principle of the pyrometer, and when the expansion is caused by moisture, upon that of some forms of hygrometer. But the novel and unique part of the invention consists in the effect which the pressure of the expanding rod has upon the electric resistance of a piece of carbon placed in the circuit of a galvanic battery. A rod of vulcanite is used as the expanding element when it is desired to use the instrument to ascertain slight variations in the heat vibrations coming from any object, as the sun, or a gas, or electric light. This rod is adjusted in a strong frame kept at an equable temperature, so that no expansions or contractions shall exert any influence, except those which take place in the vulcanite rod itself. In the chamber which receives one end of this rod, or plate, there is placed under a follower, or slide, a piece of carbon, which becomes compressed with great force upon the expansion of the vulcanite rod. If radiant heat is to be measured, a large funnel is placed in front of the apparatus to gather the rays and throw them upon the rod or plate. When the rays increase in intensity the rod expands, compresses the button, and changes its conducting capacity, which at every moment is indicated by a galvanometer. The instrument has been used successfully to ascertain the variations in the radiation from the sun during an eclipse. It may also be used to note the variations taking place on a day when clouds are passing across the sun's disk, or when the transmission of his rays differs from increase or decrease of moisture. It may be used as a delicate hygrometer by substituting in place of the vulcanite rod a body containing gelatine, which expands under the influence of moisture.

MIDDLE AGES.—The designation applied to the great historic period between the times of classic antiquity and modern times. The beginning and close of this period are not very definite. It is usual, however, to regard the Middle Ages as beginning with the overthrow of the Western Roman Empire in the year 476; and there is a pretty general concurrence in fixing on the Reformation as the great event which brought this period to a close. It began with the rise of the Frankish upon the ruins of the ancient Roman Empire, and with the commencement of civilization among the barbarous tribes which had taken possession of what were formerly Roman Provinces. In course of it the different nations of Modern Europe were formed, and their political and social systems developed. It was a period of much superstition, in connection with which much religious enthusiasm very extensively prevailed, manifested in many great religious endowments, in magnificent ecclesiastical buildings, in pilgrimages, and, above all, in the Crusades. In the earlier parts of this period the Church was much occupied in the extension of its bounds in the north of Europe, where heathenism still subsisted, and the means employed were not always consistent with the spirit of Christianity. During the Middle Ages the Hierarchy acquired enormous power and wealth, and the Papacy rose from comparatively small beginnings to its utmost greatness. During the Middle Ages chivalry had its rise and decline, modifying and, in many respects, tending to refine the feelings and usages of society. Towards the close of the Middle Ages the revival of letters, the increase of knowledge, and the formation of a wealthy and influential class in society, distinct alike from the aristocracy and the peasantry, tended, even before the Reformation, both to the diminution of the power of the Hierarchy and the decay of the feudal system.

MIDDLE ASSEMBLINO BAR. A component part of the caisson. It is made of iron, has two ears in the middle to serve as stay-plates for the middle-chests, and a slot for the axe on the right of the middle-rail.

MIDDLE CHEST.—The front ammunition-chest on the body of the caisson; so called because it is between the hind chest and the limber-chest when the caisson is limbered.

MIDDLE-CULVERIN. A cannon of the French artillery, under Henry II., carrying a projectile weighing two pounds.

MIGNON.—The former French term for a *picked soldier*—at present called *Elite*.

MIKADO. The popular title of the Emperor of Japan, though in official documents the term Tenno (Heavenly King) or Tenshi (Child of Heaven) is most frequently used. Other titles used in the native parlance or literature are Nin-ó (King of men), O-ó or Dai-o (Great King), Ko-tei (Ruler of Nations). Other terms arising from the application of the name of the Mikado's place of residence to his person, are Dai-ri (Imperial Palace), Chó-tei, (Hall of Audience), Kinri (the Forbidden Interior), Go-sho (Palace), which names occur frequently in old European works on Japan. The term Mikado means Honorable Gate, like the Turkish "Sublime Porte," and the Egyptian "Pharoah." The Dynasty of Mikados is the oldest in the world, the present ruler, Mutsuhito, being the 123d of the Imperial Line. The first Mikado was Jimmu Tennó, who began to reign 660 B. C., the professed starting-point of Japanese chronology. The first seventeen Mikados in the official list are said to have died at ages ranging from 100 to 141 years. The Mikados have each a personal name, but no family name, and the name of any one Mikado is never repeated; though in two instances in the list, two Mikados reigned each twice, and have each two posthumous titles. Seven of these Sovereigns of Japan were females. The average duration of each reign is nearly 21 years. The Mikados claim descent from the heavenly gods, and their regalia of sovereignity are a mirror, crystal ball, and sword. The possession of these palladia is the test of legitimacy during civil or dynastic war, of which but one is known in Japanese history—the period 1336-92, when a compromise was made by the rival in possession of the regalia receiving the title of Ex-Emperor, and handing over the sacred emblems to the other. After death, the Mikado receives a posthumous title by which he is known in history. The Mikado is allowed twelve *miogo* or concubines, besides the Empress; and in addition, there are four noble families called Shinno from whom heirs may be chosen for adoption. Succession is not always to the oldest son, but usually to the Mikado's nominee. The Imperial Household forms a distinct department of the government, called the Kunaishó.

MILANAISE.—A German fluted armor of the beginning of the sixteenth century. The cuirass is rounded, the breast-plate does not possess the central ridge or *tapul*, and the shoulder pieces are large with *passe-gardes*. The cuishes and upper arm pieces are fluted like the rest of the armor but, the lower arm pieces and the greaves are plain. The *solerets* are paw-shaped and indicate the time to which this armor belongs.

MILBANK GUN.—A breech-loading small-arm, having a fixed chamber closed by a movable breech-block, which slides in the line of the barrel by direct action. The piece is opened by raising the handle of the breech-bolt from its recoil-bearing in the receiver, and then drawing back the bolt. It is closed by reversing the action of the bolt; the hammer-bolt striking a sear-bolt in closing, and thereby compressing the spiral mainspring which surrounds its rear portion. It is locked by the support afforded the base of the handle by its bearing on the recoil-shoulder of the receiver when the piece is closed. The piece is fired by the action of a spiral mainspring surrounding the hammer-bolt. The hammer-bolt is kept from accidentally discharging the cartridge by striking the firing-pin before the breech is fully closed, by means of a transverse stop-pin, which, when the handle is up, passes through the firing-pin and keeps it forced back with its point flush with the face of the bolt. When the breech is fully locked by turning down the handle into place, the transverse pin is drawn back by an inclined surface in the hole of the firing-pin through which it passes, and it leaves the firing-pin free to be driven forward, at pleasure, in the usual way. The rear end of the firing-bolt when drawn back passes through the base of the rear section of the breech-bolt, and indicates the position if cocked. Extraction is accomplished by a hook swinging on a pin passing transversely through the recoil-block near its face. Ejection is caused by the action of a spiral spring, set in the face of the bolt and pressing against the lower edge of the cartridge-head until the shell is clear of the chamber. The shell being then free to turn, is rotated around the hook by which it is held and is thrown clear of the gun. A safety-lever is connected with this arm and serves to dispense with the necessity of a half-cock notch. The accidental opening of the breech may be prevented by turning up the handle part way and pressing down its stop-pin ; the point of this passes into a hole in the side of the recoil-block, and thus prevents the revolution of the entire bolt.

MILD STEEL.—The statistics of iron and steel are very suggestive of the condition of the times. In the middle of the last century the amount made in England was about one five-hundredth part of what it is at present; the amount imported was more than that manufactured at home, whilst now the English annually export millions of tons; the last few years have shown a striking increase in the world's annual production, though great fluctuations have occurred; the amount produced has risen from some 10½ million tons in 1869 to about twenty-one millions in 1882 —an enormous increase due to the vast development in the use of iron and steel for ships, railways, bridges, buildings, machines, etc. Apart, however, from the increase in the total quantities we notice (Fig. 1) that cast iron, wrought iron, and steel have not increased uniformly, but the last has far surpassed the others in the rate of its growth, having multiplied some twelve times in the thirteen years under consideration.

Although steel has been made from remote ages, it was only about twenty-five years ago employed on a comparatively small scale for such articles as tools, knives, swords, springs, etc., and from the expenditure of time and fuel on its manufacture, it was necessarily an expensive article: but the inventions of Bessemer, Siemens, and others have resulted in the production of a class of "mild" steel in large quantities, moderate in price, suitable for various purposes of construction, and surpassing wrought iron in all, or almost all, of its good qualities. Of late years competition in the trade has led to numberless improvements, and great economy in manufacture, especially in the amount of fuel consumed. It may be interesting to notice the proportion of iron and steel annually produced (in 1882, for example) in each country. We are at once struck by the salient feature that Great Britain is far ahead of all others in *quantity;* in fact, excluding the United States, her production probably exceeds that of all the rest of the world put together; but other nations are also now making good progress. With regard to *quality*, the reputation of English iron and steel is deservedly very high: the great majority of modern improvements in manufacture are due to English inventors, practically developed by English makers, and many foreign firms are glad of English assistance. Iron ores and good coal, as well as materials for fire-bricks and fluxes, are found abundantly all over England, while the great carrying trade gives facilities for the plentiful supply of good ores from Spain, and pig iron from Sweden for modern steel making, as well as for the export of manufactured iron and steel to foreign customers. The resources of other countries are, however, being largely developed.

Second on the list comes the United States, whose rate of increase of manufacture is unexampled. The demand has been hitherto so great, to meet the wonderful development of the railway system, and other large works, that millions of tons have been sent from across the Atlantic, but the time has now come when the United States produces sufficient for its own wants. Its natural resources are very great, and it has excellent ores of great richness and abundance, vast coal-fields, calculated to last for centuries, and a people full of energy. At first sight it may seem strange that at the present moment steel for only an 8-in. gun can be produced, but this is simply because until lately there has been no demand for it. The colossal plant needed for heavy gun manufacture does not exist in America, where the heaviest hammer is one of 17 tons, while France has one of 100 tons, and Krupp is said to be making one of 150 tons. Whitworth is now supplying the Government of the States with steel for 10 in. guns. The United States have lately sent a Gun Foundry Board to make inquiries in Europe concerning the manufacture of steel for military purposes; their report has been published, and contains most valuable information: a supplement submitted to the Senate 22d December last, gives plans of two proposed gun factories, one for the Army and the other for the Navy. Besides certain annual expenses, it is estimated that a sum of £7,000,000 will last for six and a half years, in-two years will be required.

Next on the list of producers comes Germany, which possesses the largest manufactory in the world —that of Krupp—remarkable for its excellent steel which soon attained a wide reputation, as shown by the fact that in 1865 England ordered from this firm, for her own use and that of her colonies, no less than 11,396 tyres and 564 axles for railway purposes. Krupp early applied his steel to the manufacture of ordnance, and he has supplied several nations with guns. Germany depends greatly on this maker for her ordnance, but the American officers do not consider this a wise arrangement, as the Government may find it difficult to deal with a single private firm in times of great emergency.

Fourth in magnitude comes France; with her well known Le Creusôt, Terre Noire, and other works. The first, with its massive plant and 100-ton hammer has produced steel armor plates of excellent quality; while the second has, after many difficulties, attained great success in steel castings, and in the manufacture of steel projectiles. Although the loss of Alsace has told heavily on the production of iron and steel by France, and though half her ores are imported, her progress is certainly very good, especially in the steel required for warlike purposes, as after the war of 1870 the French Government encouraged private companies to such an extent that several can produce the largest steel ingots, others have the plant of a gun factory, and others again are able to produce armor-plates of excellent quality. The American officers consider that France has made better arrangements than other nations between the Government and the steel makers.

Belgium has good supplies of coal, but having exhausted her own ores, has to import for the manufacture of steel; nevertheless she has made good progress, especially considering the means at her disposal, and she enters keenly into competition with England in certain departments of the trade.

Austria, though formerly celebrated for metallurgical manufactures, and possessing excellent ones, has been unable to keep pace with other countries in the production of iron and steel. The want of coal, and of easy communications, and perhaps the lack of organization and capital, have proved hindrances to development.

Russia possesses excellent ores in the mountains of Siberia and the Ural, but the want of good means of transport and of coal prevents a large manufacture; but mild steel has been made since 1876, and the production for military purposes is now considerable. The Russian Government seems anxious to supply itself with steel; armor and guns up to 50 tons are now made in Russia. Formerly Krupp supplied ordnance.

The best Swedish pig iron is of capital quality, as the ores from which it is produced are very pure, and the charcoal employed as the fuel in smelting being free from sulphur, does not contaminate the cast iron: but the want of coal limits the supply.

Fig. 1.

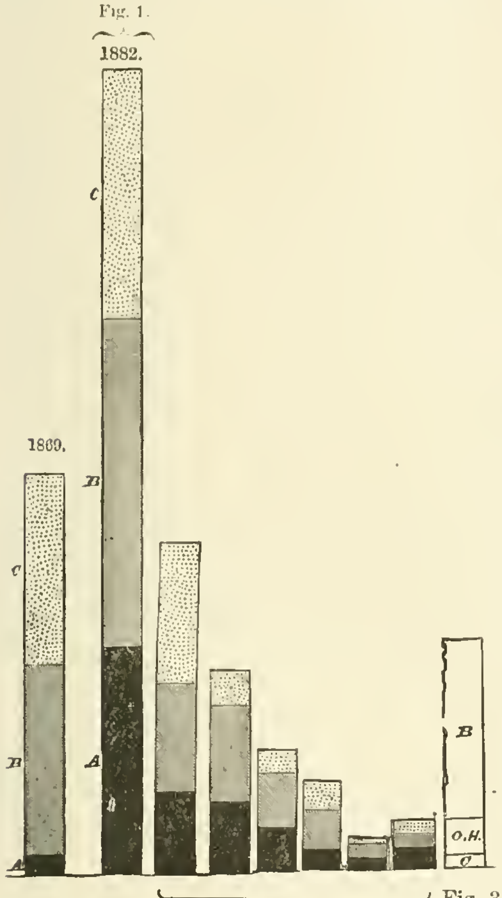


Fig. 2

The production of iron and steel by the countries of the world in 1882.

Increase of the world's annual production of iron and steel during 13 years—1869 to 1882.

Great Britain. United States. Germany. France. Belgium. Austria, Russia, Sweden, and the rest of the world approximately. Quantities of steel produced by the different methods in 1882.

Figs. 1 and 2:—A, steel; B, wrought iron; C, cast-iron. Fig. 3:—B, Bessemer; C, crucible; O. H., open hearth.

Spain cannot be called a manufacturing country; but the Bilbao ore has lately been very largely used in steel making; twenty years ago hardly any foreign ore was used in England; now she annually imports about 3,000,000 tons from Spain, and other nations also supply themselves largely. This country is consequently important to the steel makers.

Italy has hardly any iron or steel works; the Elba ore has long been famous, but is not so important as formerly. The huge armor-clad ships of Italy, with their very heavy guns, have, however, called for large supplies of mild steel for warlike purposes from abroad, and they have contributed not a little to the development of some private firms for producing heavy war material. According to the *Standard* of recent date the firm of Sir W. Armstrong and Co. has obtained a concession for establishing large factories for making guns and armor plates in the neighborhood of Naples.

The other nations of Europe produce but little iron and steel, and they are chiefly supplied from those already named. In the other countries of the world considerable progress has been made, as also in some of the colonies—the establishment of a gun foundry at Quebec is under consideration; and in many places large supplies of ore are available.

Steel is by no means easy to define, since it is a complex body, and as all persons are not exactly agreed concerning the difference between it and iron, lawsuits have consequently arisen; but the definition of mild steel given by Holley, quoted in the Royal Gun Factory Treatise, that it is "an alloy of iron, cast, while in a fluid state, into a malleable ingot," has, at any rate, the advantage of simplicity, if not of perfect exactness. This definition serves to distinguish it from cast iron on the one hand, and from wrought iron on the other: as cast iron is not malleable, but crumbles to pieces if heated and struck by the hammer, and wrought iron, though malleable, is produced, not as a fluid, but as a pasty mass, the temperature of the ordinary furnace being insufficient to melt it.

Wrought iron is more fibrous than mild steel, and it contains, from the method of its manufacture, an average of 3 per cent by weight, or 7½ per cent by volume of slag, dispersed through its mass in fine filaments, which detracts from its strength; on the other hand, the process of fusion in the manufacture of mild steel gets rid of all traces of slag; and this is a great advantage. Old definitions of steel stated that the proportion of carbon in it was more than in wrought iron, but less than in cast iron; but this hardly holds good at the present time, when some mild steel has no more carbon than some wrought iron. Sir W. Armstrong states that "steel is iron produced by a process of fusion instead of by one of adhesion, and in that sense it is independent of any particular sense of carbonization. Using the term in this sense, steel has the advantage over iron in being free from defects in welding. It generally contains more carbon than wrought iron, which renders it stronger. It is also tougher under some tests, but more prone to fracture under others. . . . The manufacture of steel continues to improve, while that of iron is stationary, and the time is probably near when the manufacture of iron, as now practiced, will entirely merge into that of steel, as produced by the process of fusion."

Taking Holley's definition, carbon is the essential substance which alloys with iron to form steel; it increases the hardness, elasticity, and tenacity, although it decreases the elongation before fracture: it also gives rise to the important property of tempering by rapid cooling, by which these advantages can be increased, though with a further loss of power to elongate. Annealing, or softening by slow cooling, may be called the reverse of tempering. The presence of carbon, however, greatly adds to the difficulty of forging, which must be done at a lower temperature as the proportion of carbon increases; if too hot, the mass will crumble to pieces under the hammer, or if this does not actually take place, the result will be to give brittleness instead of strength in the operation of forging—producing what is technically called "burnt steel," : in explanation of this remarkable fact it can only be stated that some physical and (possibly) chemical change takes place in steel at a certain temperature depending on the proportion of carbon present, which causes it to assume a coarsely crystalline structure, greatly decreasing its strength and reliability: the forging of steel is consequently generally more tedious than that of wrought iron, which can often be heated to a white heat when it becomes soft, and can then be quickly hammered into the required shape. At the beginning of modern steel making, the necessity for care about the temperature for forging was not fully recognized, and "burnt steel" was often produced, accounting probably for many of the mysterious fractures which happened, and which gave reason for so much distrust. At Terre Noire especially, the men who had been accustomed to deal with wrought iron could not understand for a long time that steel must be treated differently, and experience was only gained at the cost of a good many failures. On one occasion, the ordinary workmen were turned away, and carpenters who had to learn the work, but who would do what they were told, were engaged instead

So great, however, is the progress in some departments of steel-making, that notwithstanding these difficulties of working we find Mr. Denny writing that "steel for ships' plates has become so uniform as to have lost interest, while iron attracts attention from its deterioration and want of uniformity, and the men complain if they are put to work upon it on account of the amount of spoilt work involved;" and this is not an isolated opinion. It cannot be said, however, that the large masses of steel for guns are as yet produced with such uniformity.

Mild steel can be welded like wrought iron, but the operation becomes more and more difficult as the carbon increases; the 13-pr. steel axletree is consequently made in one piece without any weld, but wrought iron axletrees are most conveniently made in two pieces, which are afterwards welded together. On the other hand, large quantities of excellent tubular steel are now produced by the process of lap welding.

It is more difficult to cast mild steel than cast iron, because a more uniform result is required, and since the temperature of fusion is so much higher (from the smaller proportion of carbon), much greater contraction takes place on cooling, giving rise to a variety of intense molecular strains, which are sometimes sufficient to tear the metal apart in the mold, and often cause surface cracks, telling of a state of strain which must be allowed for and counteracted as far as possible by suitable methods of cooling and reheating Krupp takes the greatest care on this point, making the cooling of his ingots very slow indeed, keeping them warm with hot ashes sometimes for weeks, and they are said to be remarkably free from cracks or flaws. Annealing for several days is often resorted to in the case of steel castings.

As small differences in the proportion of carbon make very great differences in the elasticity, tenacity, hardness, elongation, etc., it is most important to use every effort to control the quantity admitted into steel in manufacture, and it is one of the greatest aims in making steel for ordnance, to obtain, as nearly as possible, the desired proportion of carbon: for this purpose it ranges from about 0.25 to 0.5. For the hard steel face of compound armor plates it may be as high as 0.8 per cent.

In all modern steel there is a considerable proportion of manganese; this is supposed to act in the same way as carbon in hardening, but its effect is not so marked. It is always added to melted steel in manufacture, in order (it is supposed) to take away ferrous oxide, which forms at a high temperature, and also to a certain extent, it may take away other impurities which would impart red shortness or brittleness at the forging temperature; as manganese has an extraordinary affinity for oxygen, it is prepared for use as an alloy with carbon and iron, termed spiegeleisen or ferro-manganese, according as the proportion of iron or manganese predominates; both of these alloys are now important articles of commerce. When the manganese mixture is put into the liquid steel, some of it immediately attacks the ferrous oxide, deprives it of its oxygen, and becoming itself oxidized, runs harmlessly into the slag, leaving a certain small quantity of metallic manganese to alloy with the steel; this is the last operation before pouring out, in the Bessemer and "open hearth" processes, so that no time may be given for the formation of any more ferrous oxide. Mild steel should not have more than about 1.0 per cent. of manganese, or it will be brittle, but it is generally best to have less than this quantity. Messrs. Hadfield and Co., however, have lately produced steel having as much as 12 per cent. of manganese which has shown remarkable qualities, and may perhaps become of practical utility in various ways. This alloy is very hard, but not brittle, and is scarcely affected if heated and plunged into water; but considerable variations have occurred in its properties.

Silicon has the property of rendering cast-steel ingots sound and free from blow-holes; small quantities of pig iron rich in silicon are often added for this purpose. It is supposed to de-oxidize, the carbonic oxide gas which forms the bubbles, and thus silica is produced which enters the slag. Not more than about 0.3 per cent. of silicon should be present, and much less if the steel is to be of very mild quality (or brittleness will be produced.)

Sulphur and phosphorus (especially the latter) are the enemies of the steel maker, for if present beyond a very small amount (say 0.04 and 0.06 respectively) they produce brittleness: as a very large proportion of the ore-deposits in the world contain too much phosphorus to allow them to be used in the manufacture of steel as it is generally carried on, it has long been a great problem to invent some process by which it could be eliminated, and it appears that this has at last been practically accomplished by the basic process, invented by Messrs. Thomas and Gilchrist, in which freshly calcined magnesian limestone (dolomite) absorbs the phosphorus almost entirely when the metal is melted, and by this process good steel has been produced from highly phosphoric ores. The averages of analyses made in the North Eastern Railway Company's laboratory by Mr. Routledge, of twenty steel rails made from hæmatite iron, and of twenty others made from phosphoric Cleveland iron by the basic process, give very nearly the same results.

	Carbon	Silicon.	Sulphur.	Phosphorus.	Manganese.	Iron.
Hæmatite steel.	0·452	0·105	0·121	0·052	1·178	98·092
Cleveland steel.	0·450	0·065	0·095	0·054	1·201	98·134

As far as present experience goes, the physical qualities of the two steels are said to be similar: basic steel has not yet, however been employed for ordnance.

Although this plan was invented by Englishmen, it has been more widely adopted in some parts of the Continent (where phosphoric ores abound) than in England, where good ores are generally procurable from abroad if not close at hand; and the practical question now seems to be generally one of economy, whether it is better according to local conditions, cost of carriage, etc., to employ an expensive ore and a comparatively cheap method of production, or a cheap ore and a somewhat more expensive process: as further experience, however, is obtained, the additional labor and expense of the basic lining plan may possibly be reduced. The results have been so good that it seems as if a new departure has occurred in the progress of steel making; already about a million tons of steel are manufactured annually in Europe from phosphoric pig, and the highest honors have been given to the inventors. It must, however, be stated that ores rich in silicon present some difficulty with this process, as the furnace lining is much corroded, and care must be taken to use freshly calcined limestone, as it soon absorbs moisture from the atmosphere.

The power to resist abrasion and rubbing possessed by mild steel, is greater than that of wrought iron; this is apparently due, not only to greater hardness imparted by more carbon, but it also results from the greater uniformity of its structure: wrought iron, on the other hand, flakes off, from the presence of filaments of slag. The advantage of mild steel over wrought iron in this respect has been shown in a marked manner by the superior endurance and uniformity of steel rails: as, for instance, when the London and Northwestern Railway Company some years ago made a careful experiment at Chalk Farm Station at a spot where the traffic was specially heavy, the top side only of steel rails lasted eleven times as long as both sides of wrought iron ones on the other side of the same line. Steel has consequently been widely adopted for rails, though it cannot be said that all now manufactured are of nearly such good quality as those made for that experiment. This same property was long ago recognized in gun making, when the bores of ordnance, which have to resist the abrasion of studs, etc., and the erosive action of fired gunpowder, were made of steel.

The process of drawing into wire increases the elasticity, tenacity, and elongation of steel to a degree unattainable in any other way. Advantage has of late years been taken of this fact in the manufacture of ordnance, as this method also allows of the initial tensions being very accurately adjusted, and no extensive flaws can remain undetected. Many other physical and chemical properties of steel might be considered, but those just mentioned are probably the most important for the purposes under consideration.

Excluding the older processes for the manufacture of hard tool steels, we find that mild steel for constructional purposes is produced by the three following methods:

1. Crucible. 2. Open hearth. 3. Bessemer.

In each of these plans a very high temperature must be obtained in order to melt the steel, which must not be in contact with the solid fuel, because if it were so, the proportion of carbon in the steel would be too large; and means are always taken to render the product as uniform as possible.

1. The crucible plan is by far the oldest, but it is now the least employed; it has long been known that wrought iron enclosed in a crucible with carbonaceous matter is capable of combining with the carbon, and melting, to form steel, at a temperature insufficient to melt wrought iron alone. At the present time, carefully weighed proportions of wrought iron, with sometimes a little steel, or even good cast iron of known composition, powdered charcoal, and spiegeleisen are put into a crucible capable of holding some 60 to 100 pounds, this being about the limit which its strength will enable it to bear without risk of cracking. A number of such crucibles are placed in a furnace specially constructed for their reception; a very high temperature is obtained, and after some two and a half to three hours, according to the degree of carbonization required, the contents are melted, the carbon has alloyed with the iron to form steel, and the manganese in the spiegeleisen has reduced any ferrous oxide which may be present. A liquid slag formed at the top, and a fire-clay cover prevent oxidation, which might otherwise occur at the high temperature attained; the contents of several crucibles are then poured into the same ingot mold as rapidly as possible. Krupp has greatly developed this method, and he has poured from as many as 1,800 crucibles into one mold: great care and arrangement in the large numbers of men employed being necessary.

The advantages claimed for this plan are that the flame is not in contact with the steel, and, therefore, cannot contaminate it; and uniformity of quality is gained if the temperature and time of heating are the same, otherwise the reactions may differ in different crucibles if the heat varies in duration and intensity. The disadvantages are, the expense and the great care and arrangement necessary for very large ingots, when great numbers of men must be carefully trained to work together; the length of time taken in casting is also a drawback, but the product is often excellent if all necessary conditions are observed, and it has been largely employed for gun tubes, where Firth's crucible steel has been much used.

2. The open hearth plan is perhaps the most recent method of steel making, and it owes its success to the invention of Siemens and others, who have constructed furnaces of the regenerating type, capable of producing very high temperatures. This so-called hearth is somewhat spoon-shaped, sloping down to one point, and the bed is covered with partly fused sand; good cast iron is first thrust in, and the flame beating down or reverberating from the low roof, soon melts it, as the metal is readily fusible from the large quantity of carbon which it contains, and thus the so-called "bath" is formed. Sometimes only one kind of pig iron is used, but generally it is more economical to make a mixture; for instance, a very pure Swedish pig iron combined with a cheaper iron from English haematite ore, which has a good deal of sulphur, but not enough to make an injurious amount in the mixture, and sometimes steel mixed at first with the cast iron. When the bath is sufficiently fluid, steel scrap, crop ends of rails or wrought iron are thrown in, after being warmed by the waste heat, the object being to obtain a mixture having less and less carbon; when these have been well melted down, a further reduction of carbon is effected by the addition of known quantities of good Spanish haematite ore—an oxide of iron. When this is added, a violent ebullition ensues, due to the combination of the carbon in the melted charge with the oxygen in the haematite, and the consequent production of carbonic oxide gas; this is technically called "boiling." The whole operation *might* be done by the use of pig iron and ore without any wrought iron or steel. This was a good deal practiced at one time, but it was found to be very expensive, as more fuel was required, and the wear and tear of the furnace lining was considerable, from the corrosive action of the large quantities of slag produced. During the latter part of the process the steel maker is constantly testing the composition of the molten mass, by inserting a large iron rod with a spoon at the end of it, and taking out a little of the steel; this is judiciously cooled, hammered on an anvil, bent over and broken, and the fracture and general appearance are compared with the samples previously obtained which have given good results, and which have been chemically analysed. If it is judged that the carbon is not low enough, more ore must be added if no "boil" is going on; but if, on the other hand, it is too low already, some good pig iron must be put in, and on leaving off the operation the steel should be as quiet and free from bubbles as possible, to avoid blow holes in the casting.

Great practical skill is required on the part of the steel maker; his tests must be taken rapidly, and a judgment must soon be made from the scanty and apparently rough data furnished by the comparison of the test pieces with the standards but, nevertheless, the same results may be repeatedly attained by the same operator within comparatively narrow limits.

Just before the pouring out, comes the addition of the proper quantity of spiegeleisen or ferro-manganese: both of these necessarily contain carbon, and consequently the melted mass should previously be more decarbonized than the finished steel. The manganese is previously heated, carefully scattered over and stirred up in the steel, and allowed to remain a short time to become thoroughly incorporated and to ensure uniformity of composition; at the last moment two spoon tests are taken, one for chemical analysis of the carbon and the other for physical trial; the tapping hole at the bottom is knocked through by means of hammers and a long rod, and the liquid steel flows out along a gutter into a large iron ladle lined with fire-clay and previously heated; if not heated, or if the temperature of the liquid steel is too low, a good deal of waste occurs from the formation of a considerable "skull," or metallic lining, caused by the solidifying of the outer part of the steel in the ladle. When all the steel has been poured out, two spoon samples are very generally taken for chemical and physical tests, the ladle is carried by a powerful crane to the ingot mold it is desired to fill, and a plug is raised at the bottom, worked by a rod passing through rings of fire-clay in the liquid mass; the steel then runs out of the bottom of the ladle and fills the ingot mold; the slag being lighter remains at the top and is not mixed up with the steel, unless indeed any difficulty occurs with the bottom plug, when the steel must be poured from the top of the ladle, as water is from a jug: in this case, small quantities of slag may become entangled in the steel, and the ingot will probably be spoilt.

Sometimes the metal is run direct into the ingot mold without the use of a ladle, but this is not generally considered a convenient plan. The whole operation lasts from 7 to 11 hours, or longer, according to the size of the furnace and the weight of charge; the largest furnace yet made will melt over 30 tons at a time; the furnace bottom needs repair after each charge. The advantages of this process are that it is cheaper than the last, the composition of the steel can be very carefully controlled, but it requires very great attention and skill on the part of one or two responsible persons. It is very largely employed in making steel for ordnance, carriages, and other military constructions, where uniformity and high qualities are more desirable than economy.

3. By far the largest proportion of mild steel (nearly 80 per cent.) is manufactured by the Bessemer process, but it is not applied to military purposes to anything like that degree; the rapidity and economy of this plan are considerable, and the whole operation is startling and impressive. A large egg-shaped iron vessel called a "converter," can revolve on trunnions, one of which is provided with teeth which gear with rack-work, by means of which it can be turned up or down. The other trunnion is hollow, and through it comes a pipe communicating with a great number of small holes or "tuyéres" fitted in the fire-bricks situated in the bottom of the vessel; a blast of air can thus be sent from an engine through the tuyéres. The top of the converter is provided with a short chimney, and the interior is lined with a very refractory material called ganister. The operation is as follows: The converter being heated, it is turned down and melted cast-iron is poured in by a gutter, either from a reheating furnace, or in some cases, as first practiced at Terre Noire, direct from the blast furnace, where it is reduced from the ore; when a sufficient charge has been poured in—only about ⅕ of the total capacity, so that the iron may not rise to the tuyéres on pouring in—the blast is turned on, and when it is fully on, the converter is turned up; the liquid iron cannot run down the small tuyére holes through which the blast comes, but on the contrary, the pressure is sufficient to cause a continuous stream of bubbles of air to rise up through the molten mass, thus oxidizing the carbon in it with the formation of carbonic oxide gas, which burns with a strong flame some 20 feet in length at the top of the chimney.

The temperature of the iron is considerably raised by the combustion of the carbon in it, and, although it becomes decarbonized and consequently more infusible, it still remains liquid; after some 20 minutes the flame becomes much shorter and alters its character, signifying that the carbon is becoming very low, and that the operation is nearly completed; it is essential that the exact time of leaving off should be chosen, as if the "blow" is stopped too soon, sufficient carbon is not extracted; if, on the other hand, it is continued too long, the iron becomes oxidized, when not only is some of it wasted but the quality of the rest is spoilt, for the iron itself burns, and excess of oxide is formed. The appearance of certain lines in the spectroscopic appearance of the flame is employed to find the proper time for leaving off, but it is often determined by eye alone. Before pouring out, however, comes the addition of manganese, which is absolutely necessary in this plan; as from the method of manufacture a good deal of ferrous oxide must necessarily be formed; the "blow" is continued for rather less than a minute, after which the steel is poured out into the ladle, when it is sometimes stirred by means of an "agitator" to distribute the manganese and produce uniformity. The ingot casting is the same as in the "open hearth" system. The rapidity of this plan enables an enormous output to be made with a moderate plant, as each "blow" lasts less than half an hour to produce 6 to 12 tons of steel, but this very rapidity prevents the careful control over the results which can be exercised in the last method; in a large firm this can be allowed for by sorting the ingots produced, and applying each to the purpose for which it is most suited; but it is most difficult to know what will be the exact proportions of carbon and the other qualities of any particular "blow." It does not appear at present to be well suited for the manufacture of ordnance; and the following extract from the "Proceedings of the American Society of Civil Engineers" about the Monongahela Bridge, Pittsburg, seems to represent the facts concerning the employment of this steel for work of the higher qualities: "The difficulty seemed to consist in controlling the uniformity of the steel within close limits for quality and strength with the Bessemer process. After a while, the attempt was given up, and the 'open hearth' was substituted—no trouble was then experienced in getting a uniform grade of steel of prescribed quality." Some 42,000 tons of "open hearth" steel will be used in the construction of the Forth Bridge. Bessemer steel is very much used for rails, and also for a great variety of other purposes, including compound armor.

When steel is to be forged, it is cast into an ingot mold of a very simple form, efforts being made, by the use of silicon, either in the pig or in a special mixture, or by fluid pressure as used by Whitworth, to get rid of blow-holes; the ingot is taken out, reheated, carefully inspected, cracks cut out, and it is then either hammered, rolled, or pressed to the required shape, great care being taken about the temperature. In order that the blows may be well transmitted through the mass, it appears that very heavy hammers are now generally preferred, probably because mild steel is not in as soft a condition as wrought iron when forged. As large masses of steel are now worked, it is probable that the numbers of already existing very heavy hammers may be increased, unless Whitworth's method of hydraulic pressure be employed instead; and this now appears to be very generally preferred; great progress has been made in some of the leading factories abroad; and this seems an important matter for English manufacturers to consider, with reference to the large masses required for ordnance. Larger ingots have been produced in France and Germany than in England.

Increase of tenacity can be obtained by the important operation of tempering, but this is at the expense of elongation before fracture. The temper obtained varies with the amount of carbon in the steel, the temperature and the nature of the cooling material—rape oil—being generally considered the best for large masses, as it has a less conducting power than water, and cools the metal more slowly. Krupp is said to temper his steel at a uniform heat; while our plan for ordnance is to temper a test piece at 1,450 deg. F., and if this does not give good results, the temperature is varied within certain limits, and then the whole mass is treated in the same way as nearly as possible, as the test piece which gave the best results. Tempering lowers the specific gravity slightly, consequently warping and surface cracks are often produced by this operation, when large masses are acted upon. The Schneider steel plate at the Spezzia experiment in 1882 was tempered on the face to gain hardness, and it consequently warped so much that it had to be planed off at the corners to make it fit the frame it was placed in. Gun tubes often develop surface cracks after tempering, but sufficient thickness of metal is allowed so that they may afterwards be cut out in the lathe.

With steel castings, every effort is made to get rid of blow-holes; this generally involves (for all good work) a very considerable deadhead, which adds to the expense, and has to be cut off. Annealing for several days is resorted to by some, while others are content with slow cooling in hot ashes; tempering is sometimes used for special purposes, such as the head of an armor-piercing projectile, though it cannot be said that cast-steel projectiles are as yet very successful for armor-piercing purposes against steel or compound armor. Great progress has recently been made in steel castings; and they are now used for a great variety of purposes; some cast trucks have been subjected to very rough treatment, and yet they have not shown any signs of fracture,but have simply bent out of shape. Swedish castings now being exhibited by Mr. Nordenfeldt have attracted very great

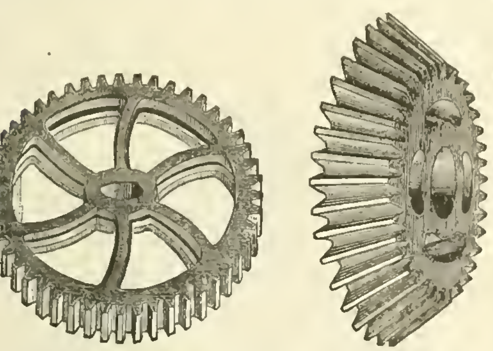


Fig. 2.
Examples of steel castings of complicated forms. Messrs. Hadfield & Co.

attention on account of their soundness and excellence; a very high temperature is obtained when melting the steel, and liquid fuel is employed. In designing the shape of a casting, sharp corners and great differences of thickness must, if possible, be avoided on account of the difficulties of preventing unequal strains tending to produce rupture in contracting on cooling down.

A great variety of tests are applied to steel in different places, according to the purpose for which it is required; latterly there has been a growing tendency towards uniformity; the workmen's rough tests of bending, breaking, and observing the fracture has been systematized in various pulling machines, actuated by a dead weight or by levers, or by hydraulic pressure, by all of which the limits of elasticity and tenacity are indicated; bending and torsional tests are also often applied, and in other cases dynamical trials are made, as by dropping heavy weights on to rails, or by exploding gun-cotton, as is sometimes done with boiler plates, which are made of very mild steel, having but little carbon.

For ordnance, the tension and bending tests are generally sufficient; the elasticity, tenacity, and elongation are carefully recorded, and the area of the fracture and its general appearance are also noticed both before and after tempering. In gun manufacture the behavior of the tempered test piece serves as a guide for the treatment of the mass from which it came; but it appears now to be generally acknowledged, that the same heat will cause a different temper in a small test piece, and in the large mass, as the latter will cool so much more slowly,and will not, therefore, be so much affected as the smaller piece. It seems a sound method to proceed (as it is believed the French do) to cut a piece off the tempered mass and then test it, and the result will be a more certain knowledge of the tenacity etc., really attained—more particularly as with all the care at present used, it is not possible to be quite sure that the large mass is brought to the same heat as the test piece was. The elongation on fracture has of late attracted attention, as it is a well recognized fact that a short test piece will elongate much more per cent. of its length than a longer one of the same material; this is explained by the circumstance that as the elongation is only considerable just immediately at the point where rupture takes place, the *total* elongation of the long piece is not actually

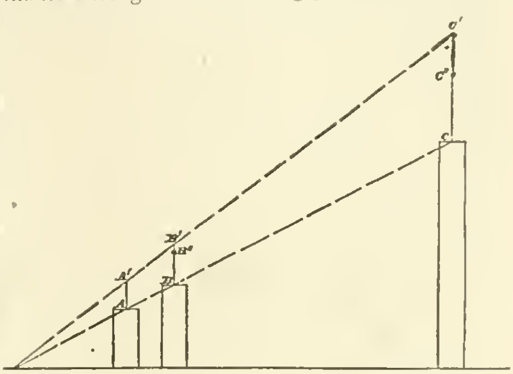


Fig. 3.
Showing loss of elongation per cent. in test pieces of thin proportions, but of the same material.

The dotted lines A B C, A'B'C" are drawn to indicate similar elongations A A', B B', C C".)

much more than that of the short piece, and is consequently less in proportion to its length—or the elongation per cent. of its length is less—(*vide* Fig. 3, where a test piece of Whitworth's dimensions is supposed to elongate an amount A A; if the same material is made according to Royal Arsenal pattern, it will only elongate BB", instead of BB' which would be in the same proportion as the last, while if the test pieces are still longer, the elongation CC" is even less per cent;) thus if a test is taken according to the Woolwich plan, it will not give such a favorable result as by the Whitworth method unless the differences in the proportions of the test pieces are taken into account. It is usual to say that the elongation is so much in a test piece of so many inches, but this is not really correct, as a thick piece will elongate more than a thin one: it is now proposed that all test pieces shall be of the same proportion of length to thickness.

It is important that the tests imposed should be reasonable and possible, but this apparently has not always been the case, as, for instance, when iron was first employed in the construction of ships,the test employed by Lloyd's was the single one of good tenacity, irrespective of elongation, before fracture; the consequence was that much inferior brittle iron was built into many a vessel, accounting, doubtless, for numbers of casualities. On the other hand, to show the advantage of good elongation before fracture, many instances have occurred of steel vessels grounding on rocky places, when the bottom plates have been bent and crumpled, but not fractured, as they doubtless would have been if they had been brittle, although with a high tenacity. Going to the other extreme, the demands for tenacity *and* elongation, within certain limits of temperature for tempering, have been so high in some specifications that it has not been found possible to come up to the standard when large masses have been supplied; the steel has in some cases been rejected wholesale, whilst at other times it has been passed, when the tests being set aside became useless.

Not only are mechanical tests employed, but the chemical composition of steel is found by quantitative analysis in a most systematic manner; and each large factory has a regular laboratory, with one or more analysts, a class of men created by the requirements of the steel trade, in which sound scientific training in those concerned is a *sine quâ non* for successful manufacture.

The tests imposed by the Ordnance Committee on large masses of steel appear to have been very stringent, and manufacturers have found a difficulty in complying with the conditions, but the making of steel in the Royal Arsenal has given a decided impetus to gun steel, which differs somewhat from that required for most other purposes. The French Government, intent upon progress, have insisted on rigorous tests for steel which their own makers at first declined, but afterwards agreed to comply with; in the meantime, however, a large contract was given to a foreign firm. It would appear to be the wisest course to insist on obtaining the very best material for gun steel.

The amount of steel used for naval and military purposes bears only a small proportion to that which is used for ordinary industries, and this ratio varies greatly in different countries, being probably highest in Russia and lowest in the United States. A great part of the steel for warlike uses can only be produced by special plant on a colossal scale—thus we hear of 100-ton hammers, immense rolling mills for armor, 160-ton cranes, a tank containing 100 tons of oil for tempering, railway trucks for taking immense weights, and tools for machining enormous masses of metal. The number of factories in the world where the heaviest guns and armor can be produced is thus necessarily limited.

About two years ago a most important decision was made that English ordnance, of all calibers, was in future to be constructed entirely of steel, and wrought iron coils were abandoned, as there was no longer a doubt that steel is much superior to wrought iron for this purpose, from its greater strength. This has been especially noticed with guns firing the modern large charges of slow-burning powder. The steel for ordnance should be of such a quality as to possess a considerable elastic limit, so that permanent deformation or enlargement of the bore may not take place to any appreciable extent, its *uncertainty* being always urged as a reason for its non-adoption in the service as long as wrought iron was used in manufacture. It appears, however, that reliability and uniformity are now being attained, though only by most unceasing and intelligent care in all processes of manufacture. Especially is this recognized to be the case where very large masses are forged, as the difficulties in obtaining uniformity in the mass become greatly increased. The percentage of carbon is about 0.4 to 0.45 with crucible steel when the manganese is low; but with the "open hearth" steel the percentage is a good deal less (0.28 to 0.31) when more manganese is present.

A modern heavy steel gun is constructed as follows: The tube is made from the ingot by repeatedly and alternately heating and drawing out under the hammer, and a core is then cut out or trepanned and thus most of the material cut to pieces in the ordinary process of boring is available for other purposes; the process is also quicker. Whitworth proposes, however, to proceed in a different manner, suggesting the plan adopted with such success by his firm in forging hollow propeller shafts, which are made thus: An ingot is bored, and the shavings remelted; the interior containing a higher percentage of carbon and other constituents, is not considered of sufficiently good quality for further use without remelting. The hollowed ingot or cylinder is then heated, a hollow steel mandrel of smaller diameter than the interior is passed through it, and both are

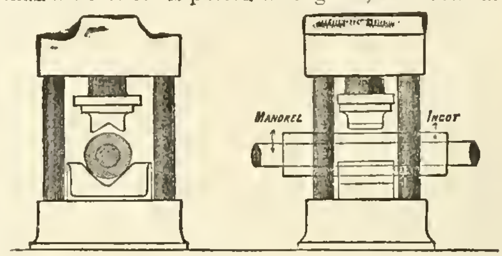


Fig. 4.
Whitworth's Hydraulic Forging Press. Drawing out a Tube.

placed in the powerful hydraulic pressing machine, which presses the metal of the cylinder against the mandrel by repeated pressings while the cylinder and mandrel are turned round into fresh positions (Fig. 4); the consequence is the hollow cylinder becomes gradually less in diameter, but increases in length. this process is repeated with thinner mandrels and repeated heats until the cylinder assumes the desired proportions of the propeller shaft; the mandrels are kept cool by water circulating through them. No service gun tubes, except those supplied through the Elswick Company, have yet been made in this manner, though it may possibly be adopted for some of the largest.

The hoops for service guns are also made from the ingot, which is trepanned, the ends cut off and remelted, and the rest is cut into thick rings, each of

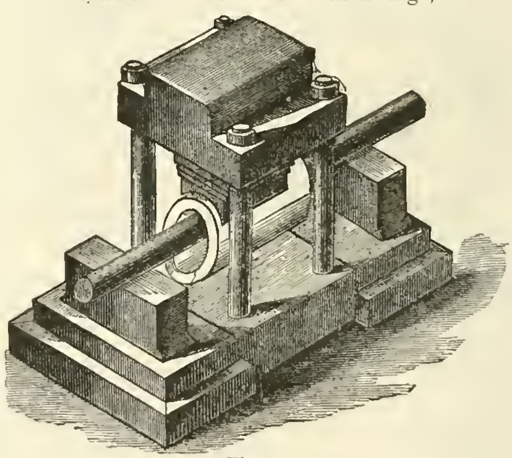


Fig. 5.
Whitworth's Hydraulic Forging Press. Enlarging a Hoop.

which is afterwards heated and made thinner by hammering on a mandrel placed through it and supported at each end (the hoop is thus suspended on the mandrel). This operation naturally increases the diameter, and the manufacture resembles that of the weldless tires of railway wheels. Whitworth makes some hoops in this way, substituting the press for the hammer (see Fig. 5), but he proposes to construct others in the same way as the tube, in the form of long, thin cylinders, and thus the heaviest guns could be made of fewer parts than those at present designed. For instance, the 110-ton gun is intended to be made of forty-three parts, but one of Whitworth design would consist of only eleven pieces. The new English heavy guns are now required in large numbers for the Navy, and also for the coast defenses of England and the Colonies, and every effort should be made to supply them with all the rapidity consistent with efficiency. The steel for the 110-ton guns is being made by Whitworth and Cammell, and the forgings will be handed over to the Elswick Ordnance Company, who will machine them and build up the guns. In a few months time Whitworth's fine establishment will have all the tools necessary for completing the heaviest guns, and Elswick will probably have the plant for casting and forging the heaviest ingots; the country will then possess two complete establishments to supplement the Royal Gun Factories, and there are of course several other firms which can produce excellent steel in large masses, and who are accustomed to the working of heavy steel forgings. Care should be taken that thoroughly reliable guns are produced, and close inspection should be insisted on during manufacture, as well as rigorous proofs, before the guns are admitted in the service. Military *matériel* has before now been neglected in our country for years during peace time, from indifference or on the score of economy; then suddenly, when the need for it has been felt, on the outbreak of war, a hurried order has been given for large quantities; this is an expensive plan, as a high price is necessarily charged under such circumstances, and it is difficult to make proper inspection: it is far the wisest plan to proceed methodically and diligently while there is time.

The barrels for small arms are made of mild steel from the bar, in an ingenious machine with a series of vertical and horizontal rolls, which in one heat draws out the barrel to the required length with accuracy. This has been in use some six years at Enfield, and copies have since been supplied by an English firm to several foreign governments. The bayonet is made of a hard steel welded by the aid of borax to a socket of softer steel; great care being taken not to overheat the end of the bar, which will form the blade, while the socket being milder, is made much hotter; the tests to which bayonets are subjected before being passed into the Service have lately been made a good deal more severe than before the late war in the Eastern Soudan.

The increased strains which the large charges of modern guns impose on gun-carriages have necessitated the employment of steel in their construction, in order to obtain the necessary strength; and steel plates and axles are now freely used, as in the 13-pr., but wrought iron is still preferred for some parts, as for instance the trail eye of a field gun-carriage, which is subject to constant jars. Steel castings are much used for heavy gun carriages; some of 55 cwt. each have been made in considerable numbers for the sides of 43-ton gun-carriages; and steel castings on a grand scale are contemplated for the proof carriage of the 110-ton gun. Steel racers have long been introduced for use with some of the heavier garrison guns, as they well resist the blow caused by the jump of the platform on firing, which indented the older and softer wrought-iron racers, and rendered subsequent traversing a difficult operation; the path and twenty-eight rollers of cast iron on which the turrets of the *Inflexible* revolve have not been found hard enough; in future they will probably be of steel. Tubular steel linings are employed for the cylinders of Vavasseur mountings; and corrugated steel plate has been tried for field artillery ammunition boxes and appears to succeed.

Steel has been applied to shells with great success, but at present the expense is considerable. Shrapnel are made for the 7-pr. and 12-pr. of Delmard's tubes, with thin walls and bursting charge in the head; the proportion of useful weight in the former being 45.4 per cent., while in other natures it is 25 per cent., and often much less. Steel has been tried for common shells, as they do not break up so often on striking earth as cast-iron shells. An example of the advantage of their use was furnished by an experiment, when a parapet was more readily breached by a 12-pr. with steel shells, than by a 5-in. gun with 50 lb. cast-iron ones, the velocities being about the same in each case: the walls of steel shells being made thinner than those of cast-iron a larger bursting charge can be inserted. By lengthening shells and compressing the powder, it has been found possible to more than double the bursting charge; thus with the 6-inch gun the bursting charge in the ordinary common shell is under 7 lbs., but long steel ones have been made holding 16 lbs. of compressed powder; this increase is most important when destroying earthworks, etc. Krupp has done a good deal in this direction. It is doubtful which is the best way to apply steel for these purposes, whether to cast it at once to the required shape or to forge it; the first is the simplest and cheapest way: but at present difficulties are apt to appear with blow-holes which may lead to fracture in the bore when the walls of the shell are thin; however, with recent improvements in casting steel, this objection may very possibly be overcome.

Another plan is to cut off lengths of tubular steel heat it, bend in one end for the head, and turn in and close up the other end for the base, or else weld in a base disk; another device has been ingeniously employed of cutting off a piece of thick bar steel stamping it into a hollow, and drawing up the sides gradually when heated to form a shell. With regard to armor-piercing projectiles, some few years ago experiments were made at Shoeburyness with 9-inch projectiles, with striking velocity about 1,500 f. s., to determine the best material of which they should be made, and also the form of head, etc. The general result was that forged steel (from Sir J. Whitworth and Co.) was decidedly the best, but at the same time it was very expensive; since then, however, conditions have altered, and not only is the striking velocity of modern projectiles often considerably above 1,500 f. s., but the steel and compound armor of ships now being made is harder than the wrought iron plates which were formerly employed. Consequently, the projectiles break up, and it cannot be said that the present shells are quite satisfactory. Careful experiment is needed to find out the best methods to pursue. It is to be hoped that the subjects of steel armor piercing projectiles for the heaviest guns may be thoroughly gone into, and the best material for the purpose employed.

At the present time the Service Palliser cast iron chilled shells do very great damage to the targets, but they break up in doing so. Krupp has produced a good armor-piercing projectile, and the French Navy has for some years past been provided with steel armor-piercing shells for 32 and 19 cm. guns, all supplied by contract under severe tests for reception. The following conditions were imposed some time ago when the French Government invited their steel makers to supply a large number (2,100) of armor-piercing projectiles for 32 and 27 cm. guns: the conditions imposed appear to be somewhat severe, and show that a high standard of excellence is desired. The total number is divided into four for each caliber, and the behavior of two shells tested out of each lot will determine the acceptance or rejection of the others. The heavier projectiles are to be fired almost at right angles against a 30 cm. Creusôt steel plate with wood backing with striking velocity of 435 to 445 meters per second, while the lighter ones will strike a 25 cm. steel plate with a velocity of 455 to 465 meters per second. If the first projectile perforates the target unbroken and uncracked, the lot to which it belongs is to be at once accepted; but if it breaks up in perforating, the second projectile will be fired, and only if it gets through uninjured will the lot be accepted. If the first round does not perforate the target, the lot will at once be rejected. Facilities were given to allow the makers to fire trial shots against steel plates before submitting their finished shells.

Nordenfeldt bullets for penetrating the sides of torpedo-boats are forged from steel bars by drawing down a part to form two heads; pieces are then cut off, stamped to true shape in a die, and oil tempered. Compound armor is constructed on two plans by the only two firms which at present manufacture it in England.

The Atlas Works (Sir J. Brown & Co.) make it on Ellis's patent; a considerable thickness of wrought iron and a thin steel face plate are kept at a few inches distance from each other, with wedge plates round three sides, and small steel studs at several points keep them from coming too close to each other in the furnace; the whole mass is then strongly heated with the plates horizontal; when hot enough it is taken out and lifted by a crane, swung vertical, placed in a pit, and melted steel is poured from a large ladle into a trough which distributes little streams into the cavity between the two plates and joins them together; in a short time the whole plate is taken up and put back again into the furnace; when reheated, it is taken out, and the whole is passed through the large rolling mill.

In Wilson's plan, adopted by Cammell and Co., a large wrought iron plate built up of many thicknesses is passed through the rolls, and is then pushed horizontally into a huge iron chamber which can revolve on trunnions; when the plate is secured, the whole is turned up and becomes vertical, and liquid steel is poured in from a ladle and trough, between one side of the wrought iron and the side of the box, precautions being taken to prevent it from flowing elsewhere. In Wilson's plan the steel was formerly poured on to a wrought iron plate provided with a rim and placed horizontally; but this was given up, as the scum, etc., tended to remain on the face of the plate. The whole is afterwards rolled.

The steel constitutes about one-third of the weight in both systems, its object being to break up the projectile on impact; it consequently has a considerable amount of carbon in order to give it the necessary hardness, while the wrought iron at the back of the plate is intended to hold the plate together, and to prevent the formation of cracks and splits as far as possible. This class of armor has achieved good results: the experiments at St. Petersburg and at Spezzia during the last two or three years, as well as some made at Shoeburyness, having been favorable. Ellis's plan has the advantage of a very good front surface, but the results attained by each are generally considered to be about the same as far as present experience has shown. The resisting power of compound armor is greater than that of wrought iron, and consequently a less weight will give as great protection under ordinary circumstances, and it is coming into use on board ships; on land, however, it will probably be little used, except, perhaps, in some very confined situations. Wrought iron of equal resisting power, but of greater weight is cheaper.

The injury sustained by wrought iron when it is struck is generally local; but compound armor tends to split over a considerable area, and is not well calculated to resist blows falling close together. Very good estimates can be formed beforehand by calculation of the probable penetration of wrought iron, if the plate be of ordinary quality, but the resisting power of compound armor is at present difficult to foretell; it depends more, perhaps, on the total weight than on the thickness of the plate, and the nature of the backing has a most important influence on the resistance offered. It has been suggested that a considerable number of experiments might profitably be made on a small scale in order to endeavor to determine the value of various alterations in its arrangement. Compound armor is now made in large quantities in Russia, Germany, and France on the Wilson system; in the latter country there are three factories busily engaged and in Germany the Dillengen works have been in operation for two years producing compound armor for the three ships *Oldenburg*, *Bremse*, and *Bremmer*. The Russian works at Kolpino, 16 miles from St. Petersburg, are just completed, and the first of their compound armor-plates, under an English director, are now being manufactured. The works will probably be well employed, as the Russians are rapidly developing their navy, and six large armor-clads are fast approaching completion. Excellent steel armor has been made at Le Creusot, of a milder quality than the face plates of compound armor, and it has given good results when tested at Spezzia, in competition with compound armor. Thin shields are used for the protection from musketry fire of men working machine-guns; they are $\frac{1}{4}$ inch thick, and oil tempered; the resisting power is considerably better than that of wrought iron.

Steel enters into the construction of a variety of warlike stores, notably in torpedoes; the beautiful air receiver before us is a good example of the finest work, forged from a bored-out ingot, oil tempered, and accurately turned down till the metal is very thin. It is most carefully tested to make sure that it will sustain the pressure of the compressed air which drives the engine in the Whitehead torpedo; and the hollow torpedo propeller shaft also presents a good example of a weldless steel tube of great strength. Tubular steel also comes into use in rocket cases and in sockets for tent poles, in which strength and lightness are combined. Large quantities of compressed hay have been sent out to Egypt bound round with Bessemer steel wire. A very interesting and recent example of the use of welded steel tubes is furnished by the gas vessels which contain compressed hydrogen for military balloons. These have only been developed during the last few months, and 150 are now in South Africa with Major Elsdale, R. E., who hopes to make good use of them under Sir Charles Warren. It was considered difficult to make hydrogen in the field, and therefore the plan was adopted to carry it in strong receivers. Various makers were asked to produce this rather novel work, and many responded, with the result that the pattern shown by Mr. Delmard was considered far the best, as it holds more than any other with due regard to weight and safety. Each vessel is proved before use, and it must not show signs of any permanent enlargement when charged with a test pressure very considerably in excess of that which it will have to stand when the hydrogen is stored in it. Some said that under such high pressure the gas would get through the thin metal; but as a matter of fact it does not do so, and some vessels have remained fully charged for months. It will be most interesting to hear how this contrivance will answer on active service. The receivers can easily be transported; the weight of gas in them is only 12 ozs. when fully charged, and they will float in water. In fact some fully charged have been formed into a raft. Somewhat similar vessels are also employed for carrying oxygen and hydrogen under great pressure for use with the lime light when signalling. See *Steel*.

MILEAGE.—An allowance of eight cents per mile paid to officers for travel. To entitle an officer to mileage the travel must be performed *without troops*, and be covered by a specific order in the case issued by a superior officer previous to commencement of the journey. Suco orders are issued only where the journey is on account of and necessary to the public service. Distances must "be calculated by the shortest usually traveled route," no matter by what route the travel was performed. Exception to this rule may be made only when the terms of the order, or impracticability of the "shortest usually traveled route," compel the officer to proceed by a longer route. In such cases mileage may be paid for "each mile actually traveled." Lists of distances are furnished by the Paymaster General. Mileage cannot be allowed for such part of a distance as lies over that portion of a "railroad on which the troops and supplies of the United States are entitled to be transported free." Officers whose orders entitle them to mileage may exercise the option of "mileage" for the entire journey (free railroads excluded); or of "transportation in kind" for the entire journey; or of "mileage" and "transportation in kind" for different parts of the same journey. But mileage cannot be allowed for any distance for which transportation in any other form has been furnished by the United States. Advance mileage may by paid, without special authority, when the distance to be traveled, exclusive of any part which may by embraced in the list of free roads, is not less than two thousand miles. This will not apply, however, to journeys in which the order contemplates delays at intermediate points affording opportunity to collect mileage for completed travel. In the following cases no expense of travel is allowed: In joining for duty upon first appointment to the military service; or under first order after reinstatement, reappointment, or revocation of an order of dismissal; or to effect an exchange of station, or a transfer from one company or regiment to another when the same is made at the request of the parties. Excepting only in the following cases: Assistant Surgeons, approved by an examining board and commissioned, joining for duty under the first order; graduates of the Military Academy, from West Point to their stations; enlisted men journeying under first order after appointment or commission.

MILES.—A soldier of the Middle Ages, usually of noble or knightly rank. He went to the wars, mounted on a good war-horse and followed by an escort, more or less numerous in accordance with his own rank and means, composed of vassals and serfs, who were equipped with slings, bows and arrows, cutlasses, and spears.

MILITARY ART.—Military art may be divided into two principal branches. The first relates to the order and arrangement which must be observed in the management of an army,—when it is to fight, to march, or to be encamped. This branch is generally known under the name of *tactics*, which signifies order. The second belongs to the other branch of military art, and includes the composition and application of warlike machines.

MILITARY ASYLUM, ROYAL.—An educational Government Institution at Chelsea, near, but wholly distinct from, the Royal Hospital for Pensioned Soldiers. Its object is the suitable education for trade, etc., of 500 male children—generally orphans—of British soldiers. For these, there are a Model School and an Infant School, and the boys have a completely military organization, with scarlet uniform, band, etc. As a result of their training, a large proportion of the pupils ultimately volunteer into the army. This school was originally established in 1803 by the late Duke of York, whence it is still commonly known as the "Duke of York's School." Originally a similar school for soldiers' daughters was included, but was not found to answer, and has been discontinued. Attached to the school is a training establishment for military schoolmasters, known as the Normal School. The total cost of the whole Institution is about £11,500 per annum.

MILITARY BRIDGE.—A temporary construction, to facilitate the passage of rivers by troops, cannon, and military wagons. The most efficient are described under PONTOON; but there are many other kinds. A *bridge of boats* is formed of small-craft, especially cargo-boats, collected from various places up and down the river; trestles are placed in them to bring their tops to one common level: the boats are anchored across the river, and baulks of timber, resting on the trestles, form a continuous road from boat to boat across the whole breadth of the river; the boats ought to be of such size that, when fully laden, the gunwales or upper edges shall not be less than one foot above the water. *Rope-bridges* are sometimes, but not frequently, used by military engineers. A *boat-and-rope bridge* consists of cables resting on boats, and supporting a platform or road of stout timber. A *cask-bridge* consists of a series of timber-rafts resting on casks; the casks are grouped together in quadrangular masses; at certain intervals timbers are laid upon them to form rafts, and several such rafts form a bridge; it is an inferior kind of pontoon-bridge. A *trestle-bridge* is sometimes made for crossing a small stream in a hilly country; it consists of trestles hastily made up in any rough materials that may be at hand, with planking or fascines to form a flooring, cables to keep the trestles in a straight line, and heavy stones to prevent them from floating. *Raft-bridges*, consisting of planks lashed together, are easily made of any rough materials that may be found on the spot; but they have little buoyancy, and are not very manageable. A *swing-flying bridge* consists of a bridge of boats, of which one end is moored in the center of the river, and the other end left loose; this loose end is brought to the proper side of the river, the boats are laden, and they make a semicircular sweep across the river, by means of rudders and oars, until the loose end of the bridge reaches the other bank. A *trail-flying bridge* is a boat or raft, or a string of boats or rafts, which is drawn across a river by ropes, in a line marked out and limited by other ropes.

History has many examples of the use of military bridges. The first of magnitude, of which we have detailed accounts, was the one built of boats, over the Hellespont, by Xerxes, when he invaded Greece, nearly two thousand four hundred years ago. This bridge was about one and one half miles long, and was composed of two roadways. One was used by the troops; the other by the baggage train and camp followers. It is said that the number with him was 5,283,220, and that they were seven days and nights in crossing. Bridges across the Tigris resting on boats are mentioned by Xenophon. Alexander the Great used skins of animals inflated, or filled with hay, as floats in crossing streams, as shown in his passage of the Oxus. The Romans carried with their armies small boats and bridge material, when rivers intersected their lines of march. An example of a military bridge resting upon fixed points of support is described in the fourth book of "Cæsar's Commentaries." This bridge was across the Rhine, and was of sufficient strength to meet all the demands made upon it. We find many descriptions of military operations along the Rhine, and of the means used to pass this river, by armies operating along its banks. The same may be said with reference to the Danube. History records, in many cases, the failures arising from a want of a military equipage, and the disasters averted by the use of such equipage, or by the construction of an improvised bridge from the materials found in the neighborhood. The want of a bridge equipage was particularly felt by Bonaparte in his campaign in Italy, in 1796. The presence of such an equipment would have enabled him to cross the Po in time to place his forces in the rear of the Austrians, and would have avoided the forcing of a passage over the Adda, at Lodi. The importance of bridge equipages was particularly felt by the armies of the United States in the war of 1861–5. The delay in the arrival of the bridge material was, on more than one occasion, a cause of disaster. No better example of the importance of a bridge equipage and the value of skilled pontoniers can be given than the single instance of Napoleon's crossing of the Beresina, in 1812, in his retreat from Moscow. See *Bridges* and *Pontoon*.

MILITARY COLLEGES.—The great improvements made in the art of war in late years, in weapons and discipline, makes a demand for a body of trained officers capable of moving, directing, and bringing into effective operation the modern appliances of war. As this special training cannot be obtained at the few Government Institutions and ordinary educational establishments, it has become the policy of most governments to encourage a study of military science by establishing military departments in the various State and private Colleges. In the United States, officers of the army are detailed as professors at Colleges and Universities as follows:— The details are apportioned throughout the United States as nearly as may be practicable according to population; such States as do not contain sufficient population to entitle them to one officer are grouped with one or more contiguous States or Territories, so that the combined population of the group will allow the detail of one or more officers, to the extent of thirty officers in all. As a rule Captains of Companies, Regimental Staff Officers, or officers who have served less than three years with their regiments or corps, or who have recently completed a tour of detached duty, are not eligible. No details are made that will leave a battery, troop, or company without two officers for duty with it. The period for detail is not longer than three years. Retired officers, if acceptable to any Institution, may, on their own request, be detailed on this duty among the thirty authorized. Besides this number, any retired officer may arrange to serve at a College or University without detail from or reference to the War Department; but unless *detailed* under section 1225, Revised Statutes, such service will not entitle the institution to the arms, etc., provided by that section. No detail is made for any Institution except upon an application from its proper representatives, nor is any other so detailed, unless acceptable to the authorities of the Institution, who should make their selection from the officers available for this duty. Applications for officers should be addressed to the Secretary of War, and should duly certify the number of male students the College or University has the capacity to educate, and should also be accompanied by the last printed catalogue. Officers of the army desiring a detail at Colleges or Universities may make application to the Adjutant General, through the usual military channels; their applications and the recommendations forwarded therewith will, if the officers are available, be furnished to such Institutions as may desire to make a selection.

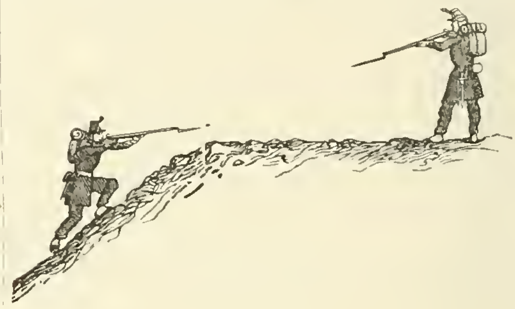
Issue of stores, limited to the following, will be made, under section 1225, Revised Statutes, by the Chief of Ordnance to any selected Institution upon its filing a bond in the penal sum of double the value of the property, conditioned that it will take good care of and safely keep account for the same, and will, when required by the Secretary of War, duly return the same, within thirty days, in good order, to the Chief of Ordnance United States Army, or to such officer or person as the Secretary of War may designate to receive it.

2 3-inch rifled guns, wrought-iron, model 1861, at $450,	$900 00
2 carriages and limbers, 3-inch gun, at $325,	650 00
2 gunners' haversacks, at $3,35,	6 70
4 lanyards, at 10 cents,	40
2 priming wires, at 10 cents,	20
2 handspikes, trail, at $1,	2 00
4 sponges and rammers, 3-inch, at $1,	4 00
4 sponge covers, 3-inch, at 30 cents,	1 20
2 tube-pouches at $1.50,	3 00
4 thumbstalls, at 20 cents,	80
2 tompions, 3-inch, at 30 cents,	60
2 vent-covers, at 40 cents,	80
1 pendulum hausse, 3-inch,	2 50
1 pendulum hausse seat,	60
1 pendulum hausse pouch,	75
2 paulins, 12 by 15 feet, at $11,75,	23 50
150 Springfield "cadet" rifles, cal. .45, with appendages, etc., at $18,	2,700 00
150 bayonet scabbards, steel, "cadet," at 91 cents,	136 50
150 waist belts and plates, at 50 cents,	75 00
150 cartridge-boxes, cal. 45, at $1.25,	187 50

For practice-firing the following allowances of ammunition will be made annually to each of the various institutions, viz: 1,000 carbine metallic ball-cartridges, cal. .45; 1,000 metallic blank cartridges, cal. .45; 100 rounds blank cartridges for 3-inch gun; 300 friction primers. This ammunition is issued upon requisitions, which should be forwarded to the Chief of Ordnance by the presidents or superintendents of the institutions. See *Military Schools*, and *Post Schools*.

MILITARY COLUMN.—Among the Romans a column on which was engraven a list of the forces in the Roman Army, ranged by legions in their proper order. They had another kind of *Military Column* called *Columna Bell'ca*, standing before the Temple of Janus, at the foot of which the Consul declared war by throwing a javelin towards the enemy's country.

MILITARY CREST.—A common expression for the top line of a slope. The drawing shows how the defender (who, while standing near the military crest, uncovers only his shoulders and observes



the whole body of the assailant as he climbs the ascent) will, on receding from the crest, place himself below the prolongation of the slope and lose sight of his climbing adversary. At the same time, he will receive the enemy's grazing fire as the latter ascends to the crest. See *Interior Crest*.

MILITARY DECORATION.—A medal, cross of honor, etc., bestowed for distinguished services.

MILITARY DEPARTMENT.—A military sub-division of a country. The whole territory of the United States is divided into Military Departments, each being under the command of a general officer. See *Geographical Departments and Divisions*.

MILITARY DISCIPLINE.—The obedience to and exercise of all orders and regulations which have for their object the good government and management of a regiment or army. In fact, discipline may be defined as the perfection of order and regulation in an army. To it may be attributed in the day of battle much of the success which has attended the arms of a nation. Without it, an army becomes a rabble; and though bravery will do much towards achieving success, it is by discipline mainly that the object of a war can be ultimately attained. In the United States service, the following regulations in this connection are observed: All inferiors are required to obey strictly, and to execute with alacrity and good faith the lawful orders of the superiors appointed over them. Military authority is to be exercised with firmness, but with kindness and justice to inferiors. Punishments shall be strictly conformable to military law. Superiors of every grade are forbidden to injure those under them by tyrannical or capricious conduct, or by abusive language. Courtesy among military men is indispensable to discipline; respect to superiors will not be confined to obedience on duty, but will be extended on all occasions. Deliberations or discussions among any class of military men having the object of conveying praise or censure, or any mark of approbation toward their superiors or others in the military service, and all publications relative to transactions between officers of a private or personal nature, whether newspaper, pamphlet, or hand-bill, are strictly prohibited. See *Discipline*.

MILITARY EXECUTION. The punishment inflicted by the sentence of a Court-Martial; also the ravaging or destroying of a country or town that refuses to pay the contribution inflicted upon them.

MILITARY FIRST PRINCIPLES. The bodily training for a soldier, to make him hardy, robust, and capable of preserving health amidst fatigue, bad weather, and change of climate; to march at such possible pace, for such length of time, and with such burden, as without training he would not be able to do.

MILITARY FRONTIER. The former name of a narrow strip of land along the Turkish frontier of the Austro-Hungarian Empire. It had a special military constitution and formed a separate "Crown-land." Of late, however, the peculiar institutions of the Military Frontier have been abolished; portions of the territory have been incorporated with adjoining provinces; and since 1873 the remainder of the Military Frontier, now officially termed the Croato-Slavonic Border-land, forms, along with Slavonia and Croatia, a dependence of the Hungarian Crown. The Constitution, civil and military, is now accordingly similiar to that of the other Provinces of the Hungarian part of the Empire. The area of the Military Frontier was about 7,500 square miles, and its population in 1869 was 690,300. The breadth of the territory once known under this name is considerable towards the western extremity, but diminishes to only a few miles at the eastern. The surface has an average elevation of upwards of 2,000 feet. All the important rivers flow eastward. The climate is severe in the highlands of the west, but mild in the lower districts toward Slavonia. Maize, wheat, oats, fruits, and vegetables are the principal productions. The Military Frontier owes its origin as a Crown-land to the necessity of having a permanent body of defenders on the borders during former wars, and especially during wars with the Turks. In the 15th century the Austrians had gained from the Turks certain tracts of territory on the banks of the Save and Danube. These tracts they colonized, making it, however, a condition that the Colonists must render military service against the Turks. Thus originated the Capitanate of Zengg, during the reign of Mathias Corvinus. The Warasdin Frontier originated in the same manner in the 16th, and the Banat Frontier in the 17th century. The Constitution of the Military Frontier, as it existed till 1873, has been thus described: The military stations along the frontier serve a threefold purpose—the defense of the country, the prevention of smuggling, and the prevention of the spread of contagious disease into the territories of the Austrian Empire. The inhabitants of this Crown-land enjoy peculiar privileges. Their immigrant ancestors received only the temporary use of lands consigned to them; but in 1850 a law was passed making over the land to the occupiers as their own property. This right of property does not belong, however, to individuals, but to the family in a united sense. The oldest member of a family (called the *Hausvater*) is intrusted with the management of the land; his partner (the *Hausmutter*) ranks equal with him, and they each receive a double share of the profits for the year as recompense for the management of the estate. A family of this sort is called a border-house (*Grenzhaus*). All who are able to bear arms are sworn to the service from their 20th year. The soldier of the frontier, who is clothed as well as armed and supplied with ammunition by Government, finds it his duty not only to watch and protect the frontier, but to preserve peace and order in the interior, and to go on foreign service when required. Only the smaller portion of the forces of the Military Frontier is retained in readiness for active service, while the remainder pursue their ordinary employments. To facilitate the accomplishment of the purposes aimed at by the Military Frontier, the *cordon*, a series of guard-houses along the frontier, affording accommodation to from four to eight men, as well as larger ones accommodating twelve men and a junior officer, has been instituted. Within this line are the officers' posts. Without announcing himself at the posts, no one is allowed to pass the boundary; and, after permission is given, the passenger must remain a longer or shorter time at the quarantine establishment, in order that all introduction of disease may be prevented.

MILITARY INDICATIONS. There are many indications which, if reported to a General and his Staff, enable them to judge of what they wish to know, as clearly as if a detailed picture of the enemy were spread before them. It is necessary, therefore, that every officer and soldier should know how to mark and collect these signs. They consist, when a camp, bivouac, or cantonment is observed, in the color of coats and pantaloons; other distinctive marks, the numbers of videttes, sentinels, fires, and tents of the enemy; the frequency and direction of rounds, patrols, and reconnoissances; the nature and time of signals by trumpet or drum; the placing of signal posts; measures of straw; boughs broken off; the arrival of reinforcements; new uniforms; collections of fascines, beams, joists, ladders, boats. When a corps is watched on the march, the signs to observe are the depth and front of columns; the number of subdivisions; the sort of troops, infantry, cavalry, artillery, trains; the quickness and direction of the march; the height of the dust; the reflection of arms; the number of the flankers and the eclaireurs. When an army ready for battle is observed, we should particularly note the number of its lines, their extent, the composition of the troops in column or in line of battle; the caliber of pieces; their position relative to cavalry and infantry; the number of skirmishers; their maneuvers; the concentration of forces or artillery on such a point, flank marches of one or many corps. If troops are followed on their march, we note the tracks of men and horses, those made by wheels, cattle, and beasts of burden; the relative positions of these tracks; whether they are regular and preserve an invariable order; whether the places where they stop have little or much space between them; whether the route passed over is covered with remains of animals; whether the skletons of the horses are lean and sore; whether the ground is bloody; if graves have been freshly made, whether some indications may not show them to be for superior officers; whether the country has been devastated; whether the entrails of beef, mutton, or horses are seen; whether the fires are recent; whether they are numerous, and show much or little ashes; whether bridges are broken, and in what parts; whether the inhabitants of the country are anxious, sad, humble, animated, or satisfied. See *Signs*.

MILITARY JURISDICTION.—Military jurisdiction is of two kinds: first, that which is conferred and defined by statute; second, that which is derived from the common law of war. Military offenses under the statute law must be tried in the manner therein directed; but military offenses which do not come within the statute must be tried and punished under the common law of war. The character of the courts which exercise these jurisdictions depends upon the local laws of each particular country. In the armies of the United States the first is exercised by Courts-Martial: while cases which do not come within the "Rules and Articles of War," or the jurisdiction conferred by statute on Courts-Martial, are tried by military commissions. See *Jurisdiction*.

MILITARY JUSTICE.—That species of justice which prevails in the army, and which is administered by military tribunals in accordance with the Articles of

War. In Russia justice is frequently obtained through what is known as the Court of Honor. In the United States the Articles of War provide that any officer who thinks himself wronged by the Commanding Officer of his regiment, and upon due application to such Commander, is refused redress, may complain to the General commanding in the State or Territory where such regiment is stationed. The General shall examine into said complaint and take proper measures for redressing the wrong complained of; and he shall, as soon as possible, transmit to the Department of War a true statement of such complaint with the proceedings had thereon. Any soldier who thinks himself wronged by any officer may complain to the Commanding Officer of his regiment, who shall summon a Regimental Court-Martial for the doing of justice to the complainant. Either party may appeal from such Regimental Court-Martial to a General Court-Martial; but if, upon such second hearing, the appeal appears to be groundless and vexatious, the party appealing shall be punished at the discretion of said General Court-Martial., See *Articles of War*, 72 to 105, *Court of Honor*, and *Courts-Martial*.

MILITARY KNIGHTS.— An Institution of Military Knights at Windsor, England, formerly called "Poor Knights," which owes its origin to Edward III., and is a provision for a limited number of old officers. These officers consist of a Governor and 12 Knights on the upper foundation, and 5 on the lower, together 18, and are composed of officers selected from every grade, from a Colonel to a Subaltern, chiefly veterans, or on half-pay. They are allowed three rooms each in Windsor Palace, and 2 shillings per diem for their sustenance, besides other small allowances. See *Knights*.

MILITARY LAW.—Under the Constitution of the United States, Congress is intrusted with the creation, government, regulation and support of armies; and all laws passed by Congress for those purposes are military laws. Congress, being also invested with power "to make all laws which shall be necessary and proper for carrying into execution the foregoing powers, and all other powers vested by this Constitution in the Government of the United States, or in any department or officer thereof," is supreme in all military matters. The office of Commander-in-Chief, intrusted by the Constitution to the President, must have its functions first defined by Congress. Such military powers only as Congress confers upon him can be exercised. Excepting that, being the Commander-in-Chief under the Constitution, he of course exercises all authority that Congress may delegate to any military commander whatever, by reason of the axiom that the power of the greater includes that of the less. Many of the functions, thus devolved by the Constitution on Congress, in most governments belong to the Executive. The King of Great Britain makes rules and articles for the government of armies raised by him with the consent of Parliament. Congress, with us, both raises and governs armies. An army raised in Great Britain is the King's army; with us it is the Army of the United States. These most essential distinctions should cause Congress to give more of its attention to the army. It should be borne in mind that our rules for the government of the army have been borrowed almost entirely from Great Britain; that the relation of the army to the people is in the two countries entirely distinct; therefore, that rules adapted to an aristocratic government may not be entirely suited to democratic forms.

Martial law must be distinguished from both military law and military government. The last denotes the rule of a conquered or insurrectionary district by military authority, while military law is that branch of the law which regards military discipline and the government of persons employed in the military service. Martial law, says Kent, supersedes and suspends the civil law, but military law is superadded and subordinate to the civil law. It will be seen that martial law is in the highest degree arbitrary and capable of abuse. It may be decreed at will by competent military authority, and the only rule as to the propriety of its being established is the test of necessity. The Duke of Wellington, from his place in the English House of Lords, deprecated its employment, except under the most urgent pressure, and then only with great modifications. In a celebrated Ceylon case the late Lord Chief-Justice Cockburn was very reluctant to admit that civil law could be superseded by Court-Martial, *except* where, as in India, the military government was absolute; but in the same case Blackburn, J., laid down the dictum universally accepted in the United States, that martial law is derived from statutory provisions and founded on paramount necessity. Thus the question as to its *nature* is closely connected with the *manner* of its exercise, and this again with the *responsibility* for such exercise. As to its extent, we may refer to a decision of the U. S. Supreme Court in the case of *Neal Dow* v. *Bradish Johnson*, October term, 1879. It was *held:* that an officer of the United States, while in service in an enemy's country, was not liable to an action in Civil Courts for acts done in pursuance of a Superior's orders; and when any portion of an enemy's country was in the military possession of the United States, the municipal laws were to be continued in force and administered through the ordinary channels for the protection and benefit of the inhabitants and others not in military service, but not for the protection and control of army officers or soldiers. In the Supreme Court of Missouri it has been held that the Act of Congress making the order or authority of the President a good defense for acts done or left undone during the Rebellion, is unconstitutional. The whole subject of the relations of the civil and military authorities in time of war, and especially the constitutionality of Acts passed distinctly as war measures, is of great interest, and, while much may be *res judicata*, there are many points not yet clearly determined. See *Martial Law*.

MILITARY NECESSITY.—Military necessity, as understood by modern civilized nations, consists in the necessity of those measures which are indispensible for securing the ends of the war, and which are lawful according to the modern law and usages of war.

It admits of all direct destruction of life and limb of *armed* enemies, and of other persons whose destruction is incidentally *unavoidable* in the armed contests of the war; it allows of the capturing of every armed enemy, and every enemy of importance to the hostile government, or of peculiar danger to the captor; it allows of all destruction of property, and obstruction of the ways and channels of traffic, travel, or communication, and of all withholding of sustenance or means of life from the enemy; of the appropriation of whatever an enemy's country affords necessary for the subsistence and safety of the Army, and of such deception as does not involve the breaking of good faith, either positively pledged, regarding agreements entered into during the war, or supposed by the modern law of war to exist. Men who take up arms against one another in public war do not cease on this account to be moral beings, responsible to one another, and to God.

Military necessity does not admit of cruelty, that is, the infliction of suffering for the sake of suffering or for revenge, nor of maiming or wounding, except in fight, nor of torture to extort confessions. It does not admit of the use of poison in any way, nor of the wanton devastation of a district. It admits of deception, but disclaims acts of perfidy; and, in general, military necessity does not include any act of hostility which makes the return to peace unnecessarily difficult.

MILITARY ORDERS.—Religious Associations which arose from a mixture of the religious enthusiasm and the chivalrous love of arms which almost equally formed the characteristics of medieval society. The first origin of such Associations may be traced to the necessities of the Christian residents of the Holy Land, in which the monks, whose first duty had been to serve the pilgrims in the hospital at Jerusalem, were compelled, by the necessity of self-defense, to assume the character of soldiers as well as of monks. The Order of the Templars was of similar origin. Those of Alcantara and Calatrava in Spain had for their immediate object the defense of their country against the Moors. These Orders, as well as that of Avis in Portugal, which was instituted with a similar view, followed the Cistercian rule, and all three differed from the Templars and the Knights of St. John in being permitted by their institute to marry once. The same privilege was enjoyed in the Savoyard Order of Knights of St. Maurice and the Flemish Order of St. Hubert. On the contrary, the Teutonic Knights, who had their origin in the Crusades, were bound by an absolute vow of chastity. With the varying conditions of society, these Religious Associations have at various times been abolished or fallen into disuse; but most of them still subsist in the form of Orders of Knighthood, and in some of them, attempts have recently been made to revive, with certain modifications, the monastic character which they originally possessed. See *Order*.

MILITARY PITS. Rows of pits in the form of inverted cones or pyramids made before a work, and having a strong palisade or stake in the center of each. To prevent the enemy's riflemen from making use of them, they should be made either too deep or too shallow, that is, either 8 feet or 2½ feet deep. The diameter of the pits at the top is 6 feet, and 1 foot at the bottom; that of the shallow pits, 3 feet square at the top, and not more than 2½ feet deep. The usual position for military pits is beyond the counterscarp, and principally opposite the salient angles. They would form an obstacle to cavalry. One man can construct two deep pits per day in easy soil, and ten shallow pits under the same circumstances.

MILITARY POLICE.—A few steady soldiers who are chosen from a regiment or regiments to maintain order and regularity within the lines of a camp or garrison. They are under the superintendence of the Provost-Sergeant, and their number varies according to circumstances. When on duty, they wear a badge round their right arm marked M. P.

When an army is in the field, it is recommended that a troop of police should be attached to each division, and one to the head-quarters of each army corps, to preserve civil order as distinct from military discipline. This body of men to be under the Provost-Marshal, who, during war time, is vested with exceptional powers.

MILITARY POSITION.—An officer, to be able to select a suitable position for an army, should know the distances taken up by troops in order of battle; the tactical combinations of the different arms, and their placing for mutual support to derive the greatest advantages from their respective action in battle, the qualifications of each for the defensive and offensive, and the nature of the ground best adapted to their maneuvers. In selecting a position for an army, regard must be had not only to the ground in the immediate vicinity of the field of battle; but also to the nature of the surrounding country in its relation to the position to be chosen; whether the latter lends itself in every respect to advantage to the particular ground in question.

The following are the principal points to be held in view in selecting a position:

1st. The extent should be in proportion to the number of troops in hand to occupy it; its general direction being such as to present an unbroken front throughout, from which a strong direct fire may be brought to bear upon all the approaches leading to it. If too extended, weak points will have to be left in the line; if too contracted, all the troops available cannot be placed to bring their fire to bear upon the enemy. An allowance of one thousand yards for every five thousand to six thousand men of all arms will generally be made. This provides for two lines and a reserve. Cavalry in line requires one yard to each file, infantry two feet, and artillery from eighty to one hundred and ten yards for each battery of six pieces, depending upon the intervals. Every position should have a depth of at least five hundred to one thousand yards, to permit the free movements of troops of all arms. No position should be taken up which does not present ample means for retreat, allowing the troops to be marched off the field without confusion from crowding.

2d. Good communications should exist throughout the whole extent of the position, permitting the troops to move freely from point to point to re-enforce the line where necessary; good *débouches* to the front, to allow the offensive to be promptly assumed; good roads leading to the rear, to facilitate the safe withdrawal of the troops in case of disaster. As a passive defense will never lead to any decisive results, a position should always present every facility necessary for the army to assume the offensive at any favorable period of the battle.

3d. Good command over the ground by which the enemy must approach, thus providing for a strong, direct fire, and facilitating shelter for the troops, which, if not afforded by the natural features of the ground, should be supplied by the construction of the best protections possible under the circumstances.

4th. There should be natural obstructions along the front of the position within effective rifle range, as a marsh or a stream. These serve to break the enemy's line and delay him in his advance at a time when the most damage may be inflicted. If these obstacles do not exist, the weak points of the line should be strengthened by abattis, slashed timber, entanglements, etc. The obstacles should not, however, be of a nature to afford shelter to the enemy, but simply cause a delay in his advance. A pond, marsh, or a narrow, deep stream, are good examples of what is most favorable to fulfill this condition. An obstruction parallel to the front, and between one hundred and three hundred yards from it, is very favorable and adds to the strength of a position, provided always, that it does not afford shelter to the enemy's troops. Any position with obstacles perpendicular to the front, as hills, wooded ground, etc., should be avoided, as they afford shelter for the enemy and conceal his movements. If, however, these obstructions cease some distance in advance of the line, they are not so unfavorable. Any position along a small stream flowing into the sea or a large river, would be a desirable one, as it presents the features of an obstruction in the front, and at the same time a strong support for one flank.

5th. Strength on the flanks is particularly important at the present time, as, with the improved weapons, a front attack will not offer many chances of success without severe losses. Measures must then be taken to turn a flank and thus render the position untenable, at the same time having a strong force in front to prevent the enemy from re-enforcing the flank attacked, or extending his line to meet the turning movement. If the flanks do not rest on some natural obstacles, as a village, extended marsh, an unfordable river, etc., they must be strengthened by all the means at hand, as fortifications, accumulations of troops, etc. The flanks should not be commanded by any ground in the vicinity, nor should there be facilities of any kind in the neighborhood which would allow the enemy to approach unseen.

6th. The location should be healthy, and the requisite wood and water should be near at hand and easy of access.

7th. Conditions two and four cannot be satisfied at one and the same time. In case an active defense is intended, condition too will govern, in order to have good *débouches* by which to fall upon the enemy at the proper time. For a passive defense, which is generally imposed when the forces are much inferior to the enemy in numbers or discipline, the third condition should be fulfilled.

In a defensive position, if the flanks are well protected, the concave front is the strongest; for the enemy while moving forward to the attack exposes both his flanks to a strong fire of artillery posted at the extremities of the line. If, however, the flanks are not strong naturally, or are liable to be turned, a convex front is desirable; for it gives short lines of communications, allowing supports to be moved quickly to either wing when threatened. The general case will be a combination of the two above mentioned, presenting alternately salients, re-entering angles, and straight lines joining them.

MILITARY POSITIONS.—Isolated positions, occupied by small detachments, for the purpose of guarding particular points which are of importance during the operations of a campaign, or for the longer or shorter period. These positions are frequently villages, farm houses, etc. The officer charged with placing a village in a defensive attitude, should first proceed to a careful examination of its environs, for the purpose of ascertaining what natural obstacles, and what facilities, they present to the approach of the enemy. Very slight accidents of ground may be greatly improved by trenches of trifling depth, to place troops speedily under cover. When the surface is undulating it should be particularly examined with this view, the officer taking a position at different points and directing men to approach him, and occasionally stooping to observe how much they will be masked from a fire at various heights above the surface. The side slope of a ridge from the enemy will be the best position for the trench to obtain speedy cover, provided the ground in advance of it can be well swept from its crest. The next points to be considered are the walls, hedges, etc., of enclosures, which may be turned to a useful account for the defense, or which might serve as a shelter to the enemy. After having finished this examination, he will next proceed to lay out his works; arranging their plan so as to draw every possible advantage from the natural and artificial obstacles at hand, to render certain points inaccessible, and to procure a shelter for troops snd flanking arrangements by means of the walls, hedges, etc. If there should be danger of an attack before these works can be completed, the roads leading to the village, by which the enemy might approach, should be broken up; and cannon should be placed in the best position to guard the most accessible points. The streets of the village should by barricaded, and the houses and walls, in the vicinity of tbe barricades, should be placed in a defensive attitude. In taking these preparatory measures against a sudden attack, any means that will afford the troops a cover from the enemy's fire should be resorted to; bales of cotton or wool, casks set side by side, and filled with earth, piles of timber, etc., have been used with great success under such circumstances. As the various arrangements called for under such circumstances will demand great activity on the part of the garrison, care should be taken to distribute the work among the men most conversant with it, placing the men who have any skill in the handling of tools at preparing the wooden and stone defenses, and common laborers at throwing up the earthen works, etc. The works that surround the village should be placed so far from the houses that the troops shall not be incommoded either by the splinters occasioned by the enemy's artillery, or by the flames and smoke, should the houses be set on fire. The communications from all the exterior defenses to some central rallying point should be carefully arranged, to avoid confusion in retreat, and check the pursuit of the enemy. The garrison should be made perfectly familiar with them and with the resources they may afford, in case of need. Short-cuts should be made for this purpose by breaking through garden walls, the party walls of houses, etc., and by the erection of barricades at all suitable points to make a stand.

MILITARY POST.—A Military "Station" is synonymous with Military "Post." In each case it means not an ordinary residence, having nothing military about it except that one of its occupants holds a military commission, but a place where military duty is performed or stores are kept or distributed, or something connected with war or arms is kept or done. The interchange of official compliments and visits between foreign Military or Naval Officers and the authorities of a Military Post are international in character. In all cases it is the duty of the commandant of a Military Post, without regard to his rank, to send a suitable officer to offer civilities and assistance to a vessel-of-war (foreign or otherwise) recent-arrived. After such offer it is the duty of the Commanding Officer of the vessel to send a suitable officer to acknowledge such civilities, and request that a time be specified for his reception by the Commanding Officer of the Post. The Commanding Officer of a Military Post, after the usual offer of civilities, is always to receive the first visit without regard to rank. The return visit by the Commanding Officer of the Military Post is made the following day, or as soon thereafter as practicable. Whan a Military Commander officially visits a vessel-of-war he gives notice

Abraham Lincoln, Fort, D. T., Dept. Dak.
Adams, Fort, R. I., Dept. East.
Alcatraz Island, Cal., Dept. Cal.
*Andrew, Fort, Mass., Dept. East.
Angel Island, Cal., Dept. Cal.
Apache, Fort, Ariz., Dept. Ariz.
Assinaboine, Fort. Mont., Dept. Dak.
Barrancas, Fort, Fla., Dept. East.
*Baton Rouge Barracks, La., Dept. East.
Bayard, Fort, N. M., Dept. Mo.
Benicia Barracks, Cal., Dept. Cal.
Bennett, Fort, D. T., Dept. Dak.
Bidwell, Fort, Cal., Dept. Cal.
Bliss, Fort, Texas, Dept. Mo.
Boise Barracks, Idaho, Dept. Columbia.
Bowie, Fort, Ariz., Dept. Ariz.
Brady, Fort, Mich., Dept. East.
Bridger, Fort, Wyo., Dept. Platte.
Brown, Fort, Texas, Dept. Texas.
Buford, Fort, D. T., Dept. Dak.
Canby, Fort, Wash. T., Dept. Columbia.
*Carroll, Fort, Md., Dept. East.
*Caswell, Fort, N. C., Dept. East.
Clark, Fort, Texas, Dept. Texas.
*Clark's Point, Mass., Fort at, Dept. East.
*Clinch, Fort, Fla., Dept. East.
Cœur d'Alene, Fort, Idaho, Dept Columbia.
Columbus Barracks, Ohio.
Columbus, Fort, N. Y. H., Dept. East.
Concho, Fort, Texas, Dept. Texas.
*Constitution. Fort, N. H., Dept. East.
Craig, Fort, N. M., Dept. Mo.
Cummings, Fort, N. M., Dept. Mo.
Custer, Fort, Mont., Dept. Dak.
D. A. Russell, Fort, Wyo., Dept. Platte.
Davids Island, N. Y.
Davis, Fort, Texas, Dept. Texas.
*Delaware, Fort, Del., Dept. East.
Douglas, Fort, Utah, Dept. Platte.
*Dutch Island, R. I., Fort on, Dept. East.
Elliott, Fort, Texas, Dept. Mo.
Ellis, Fort., Mont., Dept. Dak.
*Finn's Point, N. J., Battery at, Dept. East.
*Foote, Fort, Md., Dept. East.
Fred Steele, Fort, Wyo., Dept. Platte.

*Gaines, Fort, Ala., Dept. East.
Gaston, Fort, Cal., Dept. Cal.
Gibson, Fort, Ind. T., Dept. Mo.
*Gorges, Fort, Me., Dept. East.
Grant, Fort. Ariz., Dept. Ariz.
*Griswold, Fort, Conn., Dept. East.
Hale, Fort, D. T., Dept. Dak.
Halleck, Fort, Nev., Dept. Cal.
Hamilton, Fort, N. Y., Dept. East.
Hays, Fort, Kans., Dept. Mo.
Huachuca, Fort, Ariz, Dept. Ariz.
*Independence, Fort, Mass., Dept. East
Jackson Barracks, La., Dept. East.
*Jackson, Fort, Ga., Dept. East.
*Jackson Fort, La., Dept. East.
Jefferson Barracks, Mo.
*Jefferson, Fort, Fla., Dept. East.
*Johnston, Fort, N. C., Dept. East.
Keogh, Fort, Mont., Dept. Dak.
*Key West Barracks, Fla., Dept. East.
Klamath, Fort, Oreg., Dept. Columbia.
*Knox, Fort, Me., Dept. East.
*Lafayette, Fort, N. Y. H., Dept. East.
Lapwai, Fort, Idaho, Dept. Columbia.
Laramie, Fort, Wyo., Dept. Platte.
Leavenworth, Fort, Kans., Dept. Mo.
Leavenworth Military Prison, Kans.
Lewis, Fort, Colo., Dept. Mo.
Little Rock Barracks, Ark., Dept. East.
*Livingston, Fort, La., Dept. East.
Lowell, Fort, Ariz., Dept. Ariz.
Lyon, Fort, Colo., Dept. Mo.
Mackinac, Fort, Mich., Dept. East.
*Macomb, Fort, La., Dept. East.
*Macon, Fort, N. C., Dept. East.
Madison Barracks, N. Y., Dept. East.
Maginnis, Fort, Mont., Dept. Dak.
Marcy, Fort, N.M., Dept. Mo.
*Marion, Fort, Fla., Dept. East.
Mason, Fort, Cal., Dept. Cal.
*McClary, Fort, Me., Dept. East.
McDermit, Fort. Nev., Dept. Cal.
McDowell, Fort, Ariz., Dept. Ariz.
McHenry, Fort, Md., Dept. East.
McIntosh, Fort, Texas, Dept. Texas.
McKinney, Fort, Wyo., Dept. Platte.
Meade, Fort, D. T., Dept. Dak.
*Mifflin, Fort, Pa., Dept. East.
Missoula, Fort, Mont., Dept. Dak.
Mojave, Fort, Ariz., Dept. Ariz.
Monroe, Fort, Va., Dept. East.
*Montgomery, Fort, N. Y., Dept. East.
*Morgan, Fort, Ala., Dept. East.
*Moultrie, Fort, S. C., Dept. East.
Mount Vernon Barracks, Ala., Dept. East.
Myer, Fort, Va.
Newport Barracks, Ky., Dept. East.
Niagara, Fort, N. Y., Dept East.
Niobrara, Fort, Neb., Dept. Platte.
Omaha, Fort, Neb., Dept. Platte.
*Ontario, Fort, N. Y., Dept. East.
Pembina, Fort, D. T., Dept. Dak.
*Phœnix, Fort, Mass., Dept. East.
*Pickens, Fort, Fla., Dept. East.
*Pike, Fort, La., Dept. East.
Plattsburg Barracks, N.Y. Dept. East.
*Popham, Fort, Me., Dept. East.
Poplar River, Camp, Mont., Dept. Dak.
Porter, Fort, N. Y., Dept. Eas..
Preble, Fort, Me., Dept. East.
Presidio of San Francisco, Cal., Dept. Cal.
*Pulaski, Fort, Ga., Dept. East.
Randall, Fort, D.T., Dept. Dak.
Reno, Fort, Ind. T., Dept. Mo.
Riley, Fort, Kans., Dept. Mo.
Ringgold, Fort, Texas, Dept. Texas.
Robinson, Fort, Neb., Dept. Platte.
San Antonia, Texas, Dept. Texas.
San Diego Barracks, Cal., Dept. Cal.
*Sandy Hook, N.J., Fort at, Dept. East.
*Scammel, Fort, Me., Dept. East.
Schuyler, Fort, N. Y., Dept. East.
Selden, Fort, N.M., Dept. Mo.
*Sewall, Fort, Mass., Dept. East.
Shaw, Fort, Mont., Dept. Dak.
*Ship Island, Miss., Dept. East.
Sidney, Fort, Neb. Dept. Platte.
Sill, Fort, Ind. T., Dept. Mo.
Sisseton, Fort, D.T., Dept. Dak.
Snelling, Fort, Minn., Dept. Dak.
Spokane, Fort, Wash. T., Dept. Columbia.
*Standish, Fort, Mass., Dept. East.
Stanton, Fort, N.M., Dept. Mo.
Stevens, Fort Oreg. Dept. Columbia.
Stockton, Fort, Texas, Dept. Texas.
St. Francis Barracks. Fla., Dept. East.
*St. Philip. Fort. La., Dept. East.
Sullivan, Fort, Me., Dept. East.
Sully, Fort, D. T., Dept. Dak.
*Sumter, Fort, S. C., Dept. East.
Supply, Fort, Ind. T., Dept. Mo.
*Taylor, Fort, Fla., Dept. East.
Thomas, Fort, Ariz., Dept. Ariz.
*Thornburgh, Fort. Utah. Dept. Platte.
Totten, Fort, D. T., Dept. Dak.
Townsend, Fort Wash. T., Dept. Columbia.
Trumbull, Fort, Conn., Dept. East.
Uncompahgre River, Cantonment on, Colo., Dept. Mo.
Union, Fort, N. M., Dept. Mo.
Vancouver Barracks, Wash. T., Dept. Columbia.
Verde, Fort, Ariz., Dept. Ariz.
Wadsworth, Fort, N. Y., Dept. East.
Walla Walla, Fort, Wash. T., Dept. Columbia.
Warren, Fort, Mass., Dept. East.
Washakie, Fort, Wyo., Dept. Platte.
*Washington Barracks, D. C., Dept. East.
Washington, Fort, Md., Dept. East.
Wayne, Fort, Mich., Dept. East.
West Point, N. Y., U. S. Military Academy.
Whipple Barracks, Ariz., Dept. Ariz.
Willets Point, N. Y.
Winfield Scott Fort, Cal., Dept. Cal.
Wingate, Fort, N. M., Dept. Mo.
*Winthrop, Fort, Mass., Dept. East.
*Wolcott, Fort, R. I., Dept. East.
Yates, Fort, D. T., Dept. Dak.

of his visit to the vessel previously thereto, or sends an officer to the gangway to announce his presence, if such notice has not been given. He is then received at the gangway by the Commander of the vessel, and is accompanied there on leaving by the same officer. The officer who is sent with the customary offer of civilities is met at the gangway of a vessel-of-war by the Officer-of-the-Deck; through the latter he is presented to the Commander of the vessel, with whom it is his duty to communicate. A vessel-of-war is approached and boarded by Commissioned Officers by the starboard side and gangway, when there are gangways on each side. In entering a boat the *junior* goes first and other officers according to rank; in leaving a boat, the *senior* goes first. The latter is to acknowledge the salutes which are given at the gangway of naval vessels. Naval vessels fire personal salutes to officers entitled to them when the boat containing the officer to be saluted has cleared the ship. It is an acknowledgment for his boat to "lie on her oars" from the first until the last gun of the salute, and for the officer saluted to uncover, then at the conclusion to "give way." The exchange of official visits between the Commanding Officers of a Post and vessel opens the door to both official and social courtesies among the other officers.

The foregoing list comprises the Military Posts occupied by troops of the United States on the 1st of January, 1884. Those not garrisoned are marked *.

MILITARY PUNISHMENT.—In a military sense, the execution of a sentence pronounced by a Court-Martial upon any delinquent. The Romans punished crimes committed by the soldiery with the utmost rigor. On the occurrence of a mutiny, every tenth, twentieth, or hundredth man was sometimes chosen by lot, but generally only the ringleaders were selected for punishment. Deserters and seditious persons were frequently, after being scourged, sold for slaves, and occasionally the offender was made to lose his right hand, or was bled nearly to death. Among the nations of Western Europe, the punishments for military offenses were, till lately, no less severe than they were among the Romans. Besides the infliction of a certain number of lashes with cords, soldiers convicted of theft, marauding, or any other breach of discipline which was not punishable with death, were sentenced to run the gantlope. In Russia the knout was extensively used. (See KNOUT.) It is often necessary to punish to maintain discipline, and the Rules and Articles of War provide ample means of punishment, but not sufficient rewards and guards against errors of judgment. In the French Army degrading punishments are illegal, but soldiers may be confined to quarters or deprived of the liberty of leaving the garrison; confined in the guard-room, in prison, or in dungeon; required to walk or to perform hard labor; and officers may be subjected to simple or rigorous arrests. Every officer who inflicts a punishment must account for it to his superior, who approves or disapproves, confirms, augments, or diminishes it. If an inferior is confined to the guard-room, he cannot be liberated except upon application to a superior. Any officer who has been subjected to punishment must, when relieved, make a visit to him who ordered it. The French Code has, in a word, been careful to provide for both the security of its citizens and the strength of authority. The punishments established by law or custom for U. S. soldiers by sentence of Court-Martial, are embodied in the Articles of War. (See Articles of War.) It is regarded as inhuman to punish by solitary confinement or confinement on bread and water exceeding fourteen days at a time, or for more than eighty-four days in a year, at intervals of fourteen days.

MILITARY REGULATIONS.—The rules and regulations observed in one uniform system, and by which the discipline, formations, field-exercises, and movements of the whole army are directed. See *Army Regulations* and *Articles of War*.

MILITARY SCHOOLS.—Establishments for the education of officers, non-commissioned officers, and men of the army. In the United States, schools are established at all posts, garrisons, and permanent camps at which troops are stationed, in which the enlisted men are instructed in the common English branches of education, and especially in the history of the United States. The Secretary of War details such officers and enlisted men as may be necessary to conduct them. It is the duty of every post and garrison commander to set apart a suitable room or building for school and religious purposes. The United States Military Academy, the Artillery School, and the School of Application for Cavalry and Infantry are discussed in detail under the appropriate heads.

The military schools of foreign countries deserve considerable attention, especially those of France, where a military commission is one of the best scholastic prizes looked forward to. In France no attempt is made to impart general education at the military seminaries; a boy is required to have a thorough general knowledge before he can be admitted to these institutions. Being open to universal competition, and being the only channel—or nearly so—to the best employment under the state the great military schools by the high standard required for them, give great impetus to general education throughout the empire and the lycées, or public schools, adapt their course of instruction to the anticipated competition. In the army, two-thirds of the line commissions and one-third of those for the scientific corps are given to non-commissioned officers, but very few of these rise beyond the rank of Captain; the remaining commissions in the line and scientific corps, and all appointments to the Staff, are given by competion after a careful course of professional education. The candidates in open competition are placed according to merit either in the Infantry School of St. Cyr or the celebrated Polytechnique; at both colleges they have the right, if they need it, to partial or entire state support. From the School of St. Cyr the more promising pupils pass to the Staff School, and thence, after a thorough course, to the État Majeur of the army; the remaining students pass as subalterns in to the Line. The pupils of the Polytechnique, which is entered after the age of 17 years, have annually about 160 valuable prizes open to them. The first 30 to 40 candidates usually select civil employment under the state, such as the "ponts et chausées;" those next in merit choose the artillery and engineers, and pass through a technical course at the School of Application. The remaining students either fail to qualify and leave the school, or have to content themselves with commissions in the line, subordinate situations in the government, civil or colonial service, or they retire into civil life altogether. In actual service there are schools for the men, who are also taught trades and singing. The standard of education among French soldiers is far higher than among their English brethren, as the conscription draws the men from all classes of society.

The Prussian system of military education differs from that of France in that competition is but sparingly resorted to; and the object is to give a good general and professional education to all the officers, rather than a specially excellent training to a selected few. Aspirants for commissions must enter in the ranks, and within six months pass a good examination in general and liberal knowledge; if however, the candidate has been educated in Cadet House—which is a semi-military school for youths—and has passed properly out of it, this examination is dispensed with. After some further service, the aspirant goes for nine months to one of three "Division Schools", where he completes his professional education. If he pass the standard here required, he is eligible for the next vacancy, but cannot be commissioned unless the officers of the corps are willing to accept him as a comrade. The Artillery and Engineer Schools do for those services what the Division Schools do for the line. The culmination of Prussian military education is the Staff School, open to competition for all the officers of the army, and presenting the highest prizes in the profession. In all the schools, the candidates study at the expense of the state, or receive great auxiliary grants.

The Austrian system is very elaborate, and commences at an early age; boys intended for military service beginning their professional almost contemporaneously with their general education. There are schools for training for non-commissioned officers and for officers, and senior departments for imparting more extended instruction to both classes. Candidates for appointment as non-commissioned officers pass by competition through the lower houses, where they remain till 11 years old; the upper houses, which detain them till 15; and the school companies, whence, after actual apprenticeship to service, a few pupils pass to the academies for aspirants for commissions, and the others are drafted into the service as non-commissioned officers. For officers, boys are pledged to the service by their parents at the age of 11, when they are placed in Cadet Schools; after which the state takes charge of them. At about 16 the boys pass, according to qualification, to the line or scientific corps academies, and four years later into those services themselves. The young officer's chance of entering the Staff School—and therefore the Staff—depends upon his place at the final academic examination. The competition observed throughout the course of military education is said to impart great vigor to the tuition.

In the Italian army the system so nearly approaches that of France that a separate description is unnecessary. It need only be stated that the educational status of the Italian officers is considered high. In the British army the schools are of several varieties. 1. Those for the education of the officers already in the service, as the *Staff College* and the establishment at Chatham for training engineer officers. 2. Professional schools common to officers and men, as the SCHOOL OF GUNNERY and the SCHOOL OF MUSKETRY. 3. Schools for the professional education of candidates for commissions; as SAND HURST MILITARY COLLEGE and the ROYAL MILITARY ACADEMY. 4. The schools for men in the ranks and for their children, or the REGIMENTAL SCHOOLS; and the instruction provided for their sons or orphans, as at the ROYAL MILITARY ASYLUM. See *Military Colleges*.

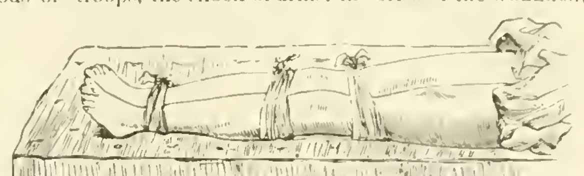
MILITARY SCIENCE.—War is both a *science* and an *art*. All investigations which have for their object the determination of the great principles which should govern a General in conducting his military operations; all analyses which are made to show the important and essential features which characterize a campaign or battle, and comparisons made with other campaigns and battles; all deductions and formations of rules which are to be used in military operations; all these belong to the "*Science of War*." The practical application of these great principles and rules belong to the "*Art of War*."

In the science of war as in the other physical sciences, the facts must precede theory; and although the number of known facts is steadily increasing the number of general principles upon which the theories of the science are based, is constant, if not decreasing. These general principles are deduced by a close and critical examination of such methods of waging war as have been adopted by those great Generals who are known as eminent in their profession. It is evident then that an intimate connection exists between military history and the science of war. Napoleon said, "Alexander made eight campaigns: Hannibal, seventeen, one in Spain, fifteen in Italy, and one in Africa; Cæsar, thirteen, of which eight were against the Gauls and five against the legions of Pompey; Gustavus Adolphus, three; Turenne, eighteen; Prince Eugene of Savoy, thirteen; Frederick, eleven, in Bohemia, Silesia, and on the banks of the Elbe. The history of these eighty-four campaigns, written with care, would be a complete treatise on the art of war. From this source, the principles which ought to be followed, in offensive as well as defensive warfare, could at once be obtained." To these campaigns, are to be added the battles and campaigns of Napoleon. Jomini, an eminent writer on military art, says: "Correct theories, founded upon right principles, sustained by actual events of wars, and added to accurate military history will form a true school of instruction for generals. If these means do not produce great men, they will at least produce generals of sufficient skill to take rank next after the natural masters of the art of war." The sources of all treatises on *Military Science* are to be found in the military histories narrating the events and results of the battles and campaigns just enumerated.

MILITARY STORES.—The arms, ammunition, clothing, provisions, etc., pertaining to an army. In the United States all public stores taken in the enemy's camp, towns, forts, or magazines, is secured for the service of the United States. The clothes, arms, military outfits, and accouterments furnished by the United States to any soldier can not be sold, bartered, exchanged, pledged, loaned, or given away; and no person not a soldier, or duly authorized officer of the United States, who has possession of any such clothes, arms, military outfits, or accouterments, so furnished, and which have been the subject of any such sale, barter, exchange, pledge, loan, or gift, can have any right, title, or interest therein; but the same may be seized and taken wherever found by any officer of the United States, civil or military, and thereupon be delivered to any Quartermaster, or other officer authorized to receive the same. The possession of any such clothes, arms, military outfits, or accouterments by any person not a soldier or officer of the United States is presumptive evidence of such a sale, barter, exchange, pledge, loan, or gift.

MILITARY SURGERY. Restricted to its rigorous signification, *Military Surgery* is the surgical practice in armies; but in its broad and ordinary acceptation embraces many other branches of art comprehending the practice of medicine, sanitary precautions, hospital administration, ambulances, etc.

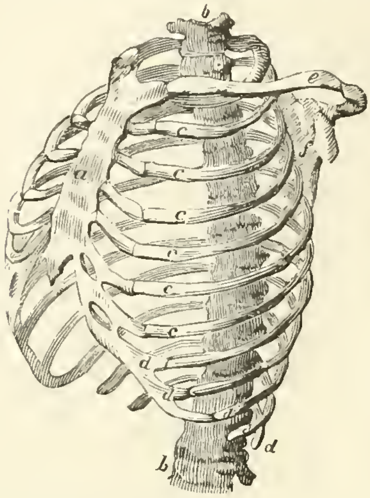
The military surgeon must not only be a skillful physician and surgeon, but he must have a constitution sufficiently strong to resist the fatigues of war, and all inclemencies of weather; a solid judgment and a generous activity in giving prompt assistance to the wounded without distinction of rank or grade, and without even excluding enemies. He must have the courage to face dangers without the power, in all cases, of combating them; he must have great coolness in order to act and operate in the most difficult positions, whether amidst the movement of troops, the shock of arms, the cries of the wounded,



in a charge, in a retreat, in intrenchments, under the ramparts of a besieged place, or at a breach. He must have inventive ingenuity which will supply the wants of the wounded in extreme cases, and must be prepared for all emergencies.

Frequently the surgeon is not immediately available. In anticipation of such an event, it is incumbent upon all who take the field to possess a sufficient knowledge of medicine and practical surgery to enable them to relieve the sick and wounded (both men and horses) until professional aid can be secured.

The fracture or dislocation of a limb is the most frequent of all accidents attending a campaign in a rough or mountainous country. A mis-step of the soldier, or a fall of the horse, often results in this mishap. When fractures occur and there are no splints at hand, they must be improvised from such materials as may be found. If the thigh be fractured, a rifle may be used for a splint, placing its butt in the axilla, and allowing it to pass along the outside of the limb, being secured by bandages around the trunk and ankle. A fractured leg may be secured with a splint of any description placed along its outside and the whole then wrapped in a coat or blanket and made fast by straps, or strings of soft material. It is a good plan to tie the fractured leg, at the ankles and convenient points, to the uninjured leg, and rest them on coats, blankets, or a mattress. In this manner the two legs will move as one, and the broken bone will not injure the flesh. A fracture may be "put up" with a gun stock or sword scabbard—even a roll of straw or grass makes a good temporary splint. A fracture of the arm may be "put up" with a bayonet scabbard, or with thin bundles of straw or grass. Light pieces of board, bark, or even the soles of shoes or boots are often useful for splints. The fore-arm should be carefully supported in a sling. Often a severe shock or collapse from pain or nervous fear follows the fracture, in



which case a stimulant (whisky and water) should be administered.

Dislocated and broken ribs are frequently the results of falls and other accidents. The drawing shows the normal position of the ribs and adjacent bones—*a* is the breast-bone; *c. c. c.* the ribs, which are fastened at one end to the spine *b. b.*, and at the other end are attached to the breast-bone by means of strips of cartilage, *d. d. d.*; *e* is the collar-bone. There are twelve (12) ribs on each side, all of different lengths—the shortest are at the top and have the smallest curves; descending they increase in lengt to the seventh, which is the longest, then decrease. The last two have no cartilages, are very short, and are attached to the spine only.

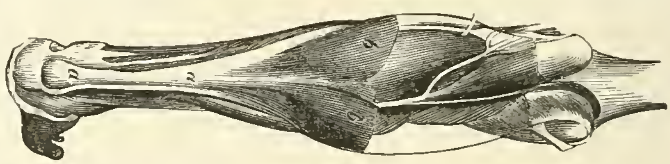
In this connection it would be well to carefully note the formation of the pelvis, and the sacrum which supports the spine. The pelvis is frequently

injured by thrusts and gun-shots, all of which wounds demand the most careful and cautious treatment. The drawing shows its form, with the location of the iliac fossae, *a. a.*, and the anterior surface of the promontory of the sacrum, *b*. To know how to arrest bleeding is all important, as life may often be saved by promptly adopting simple means. Bleeding may be from veins or from arteries. In the first case the blood is of a dark color, and flows slowly in a stream towards the heart; in the second case it is of a bright red color, forcibly issues in jets, and is in a direction from the heart. In ordinary venous hemorrhage, such as the bursting of a varicose vein, the bleeding may be stopped by pressure or elevation of the limb. Should there be any difficulty in checking it, ligatures should be applied. When the bleeding is arterial, the limb should be firmly grasped by both hands above the wound, so as to cut off the current from the heart by firmly compressing the wounded vessel against the bone, until a tourniquet may be applied.

A temporary tourniquet may be adjusted by placing a flat or roundish stone over the course of the artery and above the wound, between it and the center of circulation, holding it *in situ* by means of a band, handkerchief, string, or thong, the ends of which are securely tied. A stick or bayonet is then passed through the band or thong and twisted round and round several times, until the band is so tightened as to press the stone forcibly on the artery, which, being compressed against the main bone of the limb, will cut off the passage of blood through the vessel. If the bleeding be from the hand, fore-arm, or arm, apply the tourniquet or bandage near the shoulder. If from the foot, leg, or thigh, apply it between the knee and hip.

As a rule the main arteries are so placed that they are not likely to be reached and injured; they are deep in the flesh, and follow the courses of the inner seams of the coat sleeves and pants. Thus the main artery of the arm runs from the axilla down the inner side of the arm, at the lower edge of the biceps muscle, to the end of the elbow; that of the thigh runs from midway the groin, down the inner side of the thigh, under the deeper muscles to the back of the thigh near the ham.

Ice, if convenient, may be applied to wounds of small vessels, with good results, causing a rapid congelation of the blood. Hot water will accomplish the



same, and is far preferable if the patient be feeble. When the patient becomes faint and insensible from loss of blood, he should be placed flat on his back, with his head low. Cautery may be resorted to when the tourniquet fails to do its work. The accompanying drawing shows the manner of the attachment of the muscles, a, b, to the bone, the functions of ligaments about the joints, and the manner in which the arteries are covered and protected by the muscles, etc. In reseting a strong and muscular limb it is often necessary to keep up a great strain on the muscles in order to weary them and cause them to relax, when the bone may be set with less difficulty. See *Field Remedies*, *Medical Supplies*, *Medicine Chest*, and *Wounds*.

MILITARY TENURE.—In England, an accompaniment or immediate consequence of the Feudal System established during the Middle Ages throughout the greater part of Europe. Feuds were introduced by the barbarous tribes who poured themselves into the Roman Empire during the 4th, 5th, and 6th centuries. The chief feature of feuds was, that the lands of the conquered country were parceled out to the leaders, on the condition of bearing arms whenever the Sovereign required them. The relation thus created between Sovereign and Vassal was called a feud. The Grantee held his lands at first for life only, but gradually it was developed into a hereditary character, and also into one which admitted of subinfeudation, i. e., the parceling out of the feudal land among Vassals of the head Vassal, who was the Lord of his own Vassals This kind of relation between Lord and Vassal gradually was extended to all kinds of land, for the owners of allodial land voluntarily surrendered their land to some Lord, so as to have the same advantages. The Vassal did homage to the Lord, and took the oath of fealty. Besides these characteristics, the holding came to be attended with the following incidents. 1. An aid, which was a payment granted to help the Lord in his necessities. 2. A relief was a tribute paid by a new Tenant on succeeding to his predecessor. 3. A fine was paid by a Tenant to the Lord on alienating the lands to a purchaser. 4. An escheat or forfeiture was the reverting of the estate to the Lord when there was a failure of heirs or some violation of duty on the part of the Vassal. The Feudal System was extended to England by the Norman Barons soon after the Conquest, with the concurrence of William I., much to the dislike of the Saxons, whose grievances grew until they found vent in Magna Charta, which was in fact an attempt to restore their earlier Constitution.—The chief fiction, however, of a relation between the Crown and the holders of land was not got rid of. The Crown was nominally the Lord Paramount, and there were intermediate Lords called Mesne Lords, of whom the Tenants held. Gradually, the kinds of tenure were classed under free and base services—the former being those which a freeman might perform, as serving in war, or paying a sum of money; the latter, such as a Peasant might perform, such as ploughing the Lord's land, etc.

MILITARY TRAIN.—Formerly a highly important corps of the army, of which the function was to transport the provisions, ammunition and all other matériel, together with the wounded in time of battle. It was formed after the Crimean war, on the dissolution of the Land-Transport Corps. It comprised six battalions, in all 1840 officers and men; and its annual cost for pay, etc., was about £71,000. The corps ranked after the Royal Engineers, and was classed as Mounted Infantry, the officers receiving infantry rates, and the men cavalry rates of pay. The commissions were purchasable, as in the line. The men were armed with carbine and sword, but rather for defensive than aggressive purposes. Attached to each battalion were 166 horses, with proportionate wagons and ambulances.

It is proper to observe that the Military Train constituted only the nucleus of a transport service for a large army, and that in time of war it would be expanded by the addition of thousands of horses or mules, and the incorporation of many hundred drivers, etc. The advantage of possessing even a few men ready trained, and capable of directing the movements of others, was amply demonstrated by the failures of the Crimea in 1854-1856; so that Parliament voted ungrudgingly the expense of this corps, although in time of peace it was comparatively without employment. The Military Train was disbanded in 1870, as being too military in its formation. Its functions were transferred to the Transport section of the Army Service Corps, a purely non-combatant organization.

MILITARY WAYS.—The large Roman roads which Agrippa caused to be made through the empire in the reign of Augustus for the marching of troops and conveying of carriages. They were paved from the gates of Rome to the utmost limits of the Empire. The British have constructed a military road throughout India, with wells and other accommodations at certain distances.

MILITIA.—The purpose and opinion of the founders of our government is unequivocally expressed in the second amendment to the Constitution, which declares, "A well-regulated militia being necessary to the security of a free State." The unvaried agreement of all subsequent writers and statesmen with this assertion might well cause us to view with some alarm the fact that all attempts to secure an efficient militia have hitherto signally failed. While all agree that the perpetuity of a republican form of government depends on maintaining a well-regulated militia, the fact has been demonstrated that under no other form of government is it so difficult, owing to the indisposition of the people to submit to the enforcement of military duty in time of peace. Washington, in his annual message to Congress in 1794, said: "The devising and establishing of a well-regulated militia would be a genuine source of legislative honor, and a perfect title to public gratitude." The wisdom of this assertion has been proven by the subsequent failure of all attempts at legislation. Nevertheless, we are certainly convinced that the solution of the difficulties is now easy, not through any superior wisdom of our own, but because time and experience have solved the difficulties for us. This solution we conceive to be to substitute a volunteer militia in place of enforced militia duty, believing that our population has reached such a number that the volunteer militia of the States will be sufficiently large and efficient for all the purposes for which militia can or ever should be used.

No subject, unless it be that of finance, has so long and so often engaged the attention of Congress as that of the militia, and on none have more able and exhaustive reports been written by those whose slightest utterances we have been taught to honor and respect. The records of Congress are filled with messages from Presidents, reports of Executive Officers, reports of Committees of both Houses of Congress, and with plans and bills for the improvement and organization of the militia, to attempt even a brief outline of which would far exceed the proper limits of this article. We cannot, therefore, do more than give a brief outline of the most salient features in the history of the subject.

On July 18, 1775, the Continental Congress passed a series of resolutions recommending "to the inhabitants of all the United English Colonies in North America that all able-bodied effective men between sixteen and fifty years of age in each colony immediately form themselves into regular companies of militia." One of these resolutions is particularly suggestive, as it contains the germ of the volunteer system which has now grown to such proportions. It is as follows:

That one-fourth part of the militia in every Colony be selected for minute men, of such persons as are willing to enter into the necessary service, . . . and as these minute men may eventually be called to action before the whole body of the militia are sufficiently trained, it is recommended that a more particular and diligent attention be paid to their instruction in military discipline.

On the formation of the Federal Government one of the earliest acts of the first House of Representatives, in 1789, was the appointment of a Committee to prepare a bill to organize the militia. The session adjourned before the Committee made a report, but at the following session, in 1790, General Knox, Secretary of War, submitted his celebrated plan for organizing the militia, accompanying it by a letter of transmittal which is remarkable for its terse, striking, and strong arguments. His plan, in brief, was that every boy on arriving at the age of eighteen years should be enrolled in the cadet corps of militia and be obliged to serve in camp of instruction thirty days in each of first two years and ten days in the third year, and that no person arriving at the age of twenty-one years should be entitled to exercise the rights of a citizen unless he could produce his certificate of having so served; all citizens between twenty-one and forty-five years of age were to be enrolled in the main corps of militia and be obliged to drill four days in each year; and between forty-five and sixty years of age to be enrolled in the reserve corps, which should be assembled twice in each year for inspection of arms. Under his plan the general government was to furnish uniform, arms, equipments, and bear all the expenses of the camps of instruction. The features of General Knox's plan were clearly embodied in a bill prepared by a Committee of the House of Representatives, and the subject was discussed in detail on many occasions through the two succeeding sessions until all of its original features were changed or modified, and the Act of May 8, 1792, finally agreed upon and enacted. As this is the law still in force, we reserve a detailed explanation of its provisions, and simply state here that its main feature is that every citizen, between eighteen and forty-five years of age, shall be enrolled in the militia and shall arm and equip himself at his individual expense. This law was found to be so crude and inadequate that it became the subject of criticism immediately after its passage, and of efforts to amend it which have continued to the present time. As well expressed by Washington, after the attempt was made to put it in practical operation it "exhibited such striking defects, as could not have been supplied but by the zeal of our citizens"; and in his annual messages to each succeeding session of Congress, during his two terms of office, he urged that the evident defects of the law be remedied. In the session succeeding the enactment of the law an effort was made to repeal the provision requiring every citizen to arm himself. In the next following session, in 1794, a bill was reported by a Committee of the House of Representatives to organize a "*select corps*" of militia, to be armed and equipped by the general government, and paid for service in annual camps of instruction. Different propositions, having in view these two changes in the militia system, were discussed in successive sessions until 1798, when the threatening condition of our relations with France culminated in the formation of a provisional army and other warlike preparations that temporarily suspended consideration of the militia system.

Our troubles with France having been amicably settled, the militia question again assumed prominence, and Jefferson, in his annual message to Congress, importuned them to take some action. It was chiefly through his earnest efforts that the law of April 23, 1808 (section 1661 Revised Statutes), was passed, making a permanent appropriation of $200,000 a year to provide arms and equipments for the militia. Somewhat curiously, however, the requirement of the old law that every citizen should arm and equip himself was not repealed, and still remains the statute. As the country was rapidly increasing in population the uselessness of requiring active military duty from the whole body of citizens became more apparent, and was felt to be an unnecessary burden. Jefferson in his annual message in 1805, recommended that the militia be classined according to ages, and thought that those from eighteen to twenty-six years of age would form a sufficiently large body to be subjected to any duty in time of peace. This proposition was taken up by Congress, and in various forms was the subject of debate in successive sessions, until the war of 1812 put an end to the discussion without any result having been reached.

Madison was almost as urgent in his appeals to Congress to amend the militia law as Jefferson had been. In his annual message in 1810 he advanced a new proposition in the suggestion that the commissioned and non-commissioned officers of the militia should be assembled in annual camps of instruction at the expense of the general government; and in his last annual message, in 1816, he earnestly recommended a reorganization of the militia, and classifying them according to age. Prompted by the recommendations of Madison, the Fourteenth Congress, in 1816, directed the Secretary of War to prepare and report a plan for the organization of the militia. Secretary of War Graham reported to the following Session, recommending very forcibly that the militia be divided into three classes according to age, and that the two younger classes be detailed and required to assemble annually in large camps of instruction and be armed, equipped, and subsisted at the expense of the general government. This report was referred to a committee of which General Harrison (then a Representative from Ohio) was chairman. Harrison took a deep interest in the subject, and presented a careful report. He deemed it essential that the whole body of the people should be instructed in military matters, and for this purpose recommended that military instruction be made a branch of education in every school in the country. Believing that it would entail too great an expenditure of time and money to subject the whole enrolled militia to drill and military training, he revived the old propositions first made by President Madison, and recommended that the Officers and Sergeants be assembled annually in camps of instruction, be paid for their time, and be thoroughly drilled and instructed at the expense of the general government, which he estimated would amount to about one and a half million dollars a year. Harrison continued the agitation of the subject while he remained in Congress, and made reports in 1818 and 1819 urging action.

In 1825 Secretary of War Barbour addressed a circular letter to the Governors of all the States and to many citizens most prominent in military and civil life, setting forth that it had long been apparent that some change in the militia law was necessary, and asking their views on the subject. He then convened a Board composed of some of the most distinguished officers of the army and militia for the purpose of considering the question, and submitted to them the voluminous correspondence that had resulted from his circular letter. It is worthy of note that the president of this Board was Winfield Scott, then a Major General in the Army, and that Zachary Taylor, then a Lieutenant-colonel of Artillery, was one of the members. The militia were represented on the Board by General Cadwalader of Pennsylvania, General Sumner, of Massachusetts, and General Daniel of North Carolina. The report of this Board, together with all the papers and correspondence connected with it, was transmitted to Congress by the President. The Board reported that they considered the primary defect of the militia law to be in the excess of numbers which it held to service. They recommended that a select corps of militia be formed, to consist in each State of one brigade for every Congressional Representative, and that the officers of this select militia be assembled in camps of instruction ten days in each year, and be paid by the general government for their time and traveling expenses. They also recommended that the office of Adjutant General of militia be created, and that, on the application of State Executives, the United States should furnish officers to instruct the annual camps.

In 1835 President Jackson, in his annual message urged Congress, in his usual forcible style, to give their attention to the subject, and among other things recommended that volunteer organizations be encouraged and inducements held out for their formation. The Secretary of War (General Cass), in his annual report, gave his views on the subject, and represented the necessity of some legislation. Urgent effort was made in Congress to secure agreement to some plan, but without success.

In 1840 Secretary of War Poinsett submitted a plan to Congress. Apparently despairing of securing agreement to any plan that simply changed and perpetuated the existing system, he proposed a radical reform that stretched the constitutional powers of the general government to such an extent as to cause opposition to it on that ground. His plan was to divide the militia into three classes—the active, reserve, and mass. The active militia to consist of 100,000 men, apportioned to the respective States, and each State to be required to keep its quota filled at all times, either by voluntary enlistment or draft. One-fourth of the active militia to go out of service annually and be enrolled in the reserve corps. The mass of the militia not to be subject to any duty in time of peace. He proposed that Congress should by law authorize the President to order the active militia into the service and pay of the United States for thirty days in each year for the purpose of placing them in camps of instruction. This appears to have been the last decided attempt to save the decaying system from dissolution, with the exception of an effort in 1846, when a bill was reported to remedy the excess of number of the militia by limiting the enrollment in time of peace to those between twenty-one and thirty years of age, who should be formed into a legion of active militia in each State, the officers of which should serve annually in camps of instruction at the expense of the general government.

The militia system, by this time, was virtually dead; during the many years devoted to debating a remedy for its defects it had gradually sunk, until it no longer existed except on the Statute-book. In the mean time, in all the States, by a process of "natural selection," there had sprung up volunteer organizations of militia, and the States, by fostering and encouraging them, had supplied the deficiencies of the general law. These volunteer organizations made possible and gave efficiency to that splendid body of volunteers whose soldierly qualities and deeds of valor in the Mexican War gave such renown to our arms. After that war still greater interest was manifested in the volunteer militia; the States devoted to them the meager supply of arms and equipments obtained annually from the general government, which in many instances they supplemented by large appropriations of their own, and the volunteer militia continued to increase in numbers and efficiency until the breaking out of the "War of the Rebellion." Of that fearful struggle it is safe to say that the magnificent armies which were so quickly formed on both sides were only made possible by the facts that the efforts of regularly educated officers in drilling and disciplining them were supplemented by those who had received a partial military training in the volunteer militia.

Just before the war, in 1860, an earnest effort was made in the House of Representatives to increase the annual appropriation for furnishing arms and equipments to the militia. In urging the measure, Mr. Vallandigham reviewed the militia system and spoke of the volunteer system replacing it, asserting that they would "in time become the National Guard of America."

After the close of the War of the Rebellion, another most decided effort was made, both in the House and Senate, to reorganize the militia, or rather to create a new militia system, and several bills for that purpose were introduced in the Thirty-ninth Congress. Although none of these bills were passed, they contained provisions that are interesting and suggestive, and some that went to the extreme limit, if they did not go beyond the constitutional power of Congress in the premises. It was, however, a purpose common to all the bills to form an active volunteer militia, and that seemed to be accepted as the true solution of the militia question.

This closes the history of the efforts to achieve a satisfactory militia system, with the exception of an interesting report by the Chief of Ordnance, and a report by the Senate Committee on Military Affairs (S. Report 56, second session Forty-fifth Congress), both recommending that the permanent appropriation for providing arms and equipments for the militia be increased to $1,000,000 a year.

The three following points are at present urged as the proper remedy for the defects in the Militia system:

First. To substitute a volunteer militia, limited in number in time of peace, for the existing compulsory system that applies to the whole body of the people, and which has become so inapplicable as to be utterly disregarded.

Second. To make such provisions as will aid and encourage the formation of volunteer organizations, remove the disparity in their numbers and discipline that exists between different States, and promote their efficiency to a common standard that will make them available for all the purposes for which a militia is required.

Third. To abolish the present system of a permanent appropriation to provide arms and equipments for the militia, and substitute provisions prescribing with what arms and equipments the militia shall be furnished, and on what conditions—leaving it to the discretion of Congress to regulate the annual appropriations for that purpose.

In relation to the first feature, the substitution of the volunteer system, the brief sketch we have given of the history of the militia law will have made it apparent that the chief defect of the existing system was early recognized to be in the excess of numbers held to militia duty by it. As the country increased in population this excess of numbers correspondingly increased, until the law has now become a practical absurdity by requiring to-day actual militia service from six and one-half millions of men. We have seen that for more than half a century the best and wisest statesmen of our country endeavored to procure agreement to some plan that would limit the militia to a practicable number, in order that it might be made an effective body. The more the country increased in population, and the more the population became absorbed in the pursuit of wealth and material prosperity, the more impracticable became the provisions of the militia law, until finally it sank into such utter contempt that all pretense of regarding it ceased. The "cornstalk militia" and the annual "trainings," with all their accompanying parodies on military efficiency, remain only as recollections of our boyhood days. Volunteer organizations gradually increased as regard of existing law decreased, and, though unrecognized by the general law, and without any of the aids or requirements necessary to secure efficiency, they have managed to maintain a precarious existence, and have unquestionably been of great and essential service to the country. We think it good policy and true statesmanship to acknowledge the changes and avail ourselves of the results which time and the force of circumstances have brought about, and we therefore assent to the proposition that the volunteer militia of the State—the militia in fact—should be recognized as the militia of the law, and provided for accordingly. On the second feature, the provisions made for promoting the efficiency of the volunteer militia and securing a uniformly high standard in all the States, we believe there can be no disagreement. The unorganized levies which, under the name of militia, have been called into service in all the great wars of the country, while they occasionally performed some brilliant service, have not only shown the inefficiency of existing law, but have also served to make the term "militia" one of contempt and derision. It is not denied that great disparity exists in the character and efficiency of the existing volunteer organizations between the States and even within the States. During the "Labor Riots of 1877" some volunteer organizations proved utterly undisciplined and unreliable, while others performed conspicuous and valuable service. Congress has never exercised its constitutional power "to provide for organizing, arming, and disciplining" the volunteer militia. On the contrary, the volunteer organizations have maintained themselves at their own expense, with such aid as by unwearied exertions they may have been able to procure from their respective States. It is due solely to the want of support and of uniform requirements as to drill and discipline that the volunteer organizations have not all reached the same efficiency that characterize a part of them. The men who constitute the volunteer organizations are naturally those who have some love or aptitude for military affairs, and we therefore see no reason why, under the proper regulations for their discipline and training, they cannot attain a high and uniform efficiency. That they have been or are in any particular inefficient is not an argument against the possibility of making them all that we desire. We therefore consider the suggestions made, to aid and encourage the volunteer system and to exact certain requirements of them, as both politic and wise. We deem them politic, for the reason that the aid they offer is conditioned on the volunteers complying with the provisions which are deemed essential to their efficiency. We deem them wise, for the reason that we believe that under their operations a volunteer militia will be created, which, although remaining under the exclusive control of the States, will, when its services are required by the general government, be found ready and equipped for instantaneous service and fully efficient to perform the duties of militia, which Jefferson defined to be "not only to meet the first attack, but, if it threatens to be permanent, to maintain the defense until regulars can be engaged to relieve them." It is also worthy of consideration that in encouraging the volunteer system you provide for disseminating military knowledge and a partial military training among those who would be most likely to respond to a call for volunteers in time of war. It has been agreed by all who have preceded us in considering the subject that, whatever might be the expense of securing an efficient militia, it would be so small, as compared with the benefits to be derived from it, that it should not be considered, and would, in fact, be covered by indirect savings of expense which it would render practicable in other directions. While the States have applied all the existing permanent appropriation for the militia to providing the volunteer militia, the issue of property under that appropriation is limited to arms and equipments. This has been not only the greatest obstacle to the advancement of the volunteer militia, but has also prevented them from being useful on the occasions when their services have been required, Tents and camp equipage are absolutely necessary to enable the volunteers to go into camps of instruction and learn the elementary duties of soldiers. A plain, serviceable, and unostentatious uniform, over-

STATES.	Organized strength.								Number of men available for military duty (unorganized).
	Year.	General Officers.	General Staff Officers.	Regimental, Field and Staff Officers.	Company Officers.	Total Commissioned.	Total Non-commissioned Officers, Musicians and Privates.	Aggregate.	
Maine	1878	1	10	9	41	61	814	875	78,458
New Hampshire	1879	1	8	27	107	143	1,805	1,948	48,770
Vermont	1879	1	14	12	38	65	605	670	44,366
Massachusetts	1879	2	17	95	215	329	3,699	4,028	225,461
Rhode Island	1878	4	35	76	99	214	1.764	1,978	42,969
Connecticut	1879	7	15	37	134	193	2,895	3,088	73,961
New York	1879	19	205	264	851	1,339	18,941	20,280	567,669
New Jersey	1878	3	35	67	130	235	2,988	3,223	248,127
Pennsylvania	1879	6	56	174	451	687	9,063	9,750	422,371
Delaware	1879	3	4	1	6	14	76	90	24,073
Maryland	1879	1	8	6	66	81	1,164	1,245	89,344
Virginia	1879	1	1	22	161	185	2,450	2,635	215,200
West Virginia	....	....	....	....	....	....	....	....	100,000
North Carolina	1879	7	18	41	196	262	2,521	2,783	200,000
South Carolina	1879	16	162	67	748	993	10,812	11,805	95,856
Georgia	....	....	....	....	....	....	....	....	180,000
Florida	1878	8	50	100	215	373	5,130	5,503	25,903
Alabama	....	....	....	....	....	....	....	....	170,000
Mississippi	1879	7	2	....	....	9	....	9	135,178
Louisiana	1879	5	5	47	149	206	2,551	2,757	137,973
Texas	1879	1	1	1	84	87	1,119	1,206	150,000
Arkansas	1877	14	32	197	710	953	15,424	16,377	100,000
Kentucky	1879	....	1	4	43	48	674	722	218,000
Tennessee	1876	1	6	....	72	79	1,205	1,284	239,564
Ohio	1879	1	16	114	400	531	7,343	8,374	500,000
Indiana	1879	....	8	....	72	80	1,464	1,544	320,546
Michigan	1879	5	12	23	71	111	1,688	1,799	300,000
Illinois	1879	3	51	107	387	548	6,846	7,394	350,000
Missouri	1879	1	4	5	67	77	1,270	1,347	300,000
Wisconsin	1879	3	6	5	78	92	1.732	1,824	250,000
Minnesota	1879	1	3	1	8	13	191	204	120,000
Iowa	1877	1	11	50	269	331	4 250	4,581	197,456
Nebraska	1879	1	1	....	36	38	658	696	46,000
Kansas	1879	5	5	11	106	127	1,920	2.047	121,070
Nevada	....	....	....	....	....	....	....	....	20,000
Oregon	1878	3	24	....	32	59	582	641	14,878
California	1879	7	88	42	120	257	2,340	2,597	114,565
Colorado	1878	6	7	....	36	49	553	602	29,000
Grand aggregate	....	145	921	1,605	6.198	8.869	117,037	125,906	6,516,758

coats, blankets, haversacks, canteens, etc., are essential to the outfit of the volunteer, that he may be called into service at a moment's warning, and that his services may be effective when called for.

On page 356 is an abstract of the militia force of the United States (organized and unorganized), according to the latest returns received at the office of the Adjutant General, United States Army, furnished for the information of the Congress of the United States in compliance with section 232 of the Revised Statutes.

The existing volunteer militia are provided with what is essential. Some of the States have made very large appropriations to supplement the amount heretofore allowed by the General Government, and many of the States, as we have before mentioned, have now in possession considerable amounts of arms and equipments that have been issued to them by the general government. It is therefore difficult to estimate what would be the cost of making up deficiencies, and of completing the arming and equipment and of providing uniforms and camp equipage for the volunteer militia in the manner contemplated, but we judge that three million dollars would be ample for that purpose, and that its appropriation might be distributed into the budget of three successive years. After the volunteer militia should be once completely armed and equipped, we judge that an annual expenditure of $750,000 would maintain it in proper condition. These sums are comparatively very small, scarcely large enough to excite either opposition or comment, being smaller than was frequently contemplated and advocated in the early days of the Republic. The annual expenditure would be less than is required to sustain a regiment of cavalry in the regular service, and it cannot for a moment be questioned that a standing force of 150,000 thoroughly armed, equipped, and well-drilled volunteers, ready to take the field at the first moment of danger, would be as effective in the national defense as one regiment of regulars, and that the existence of such a force would be seriously considered by any Nation contemplating an attack on us. In this connection it is not improper for us to observe that the Senate Committee on Military Affairs in the Forty-fifth Congress recommended that the annual appropriation for the militia be increased to $1,000,000, very pertinently observing that "if $200,000 was none too much in 1808, certainly $1,000,000 is none too much now"

There is no feature in our form of government in which the powers of the general government and the rights of the States are so intimately interwoven as in the jurisdiction over the militia. One of the stated primary causes for forming the Union was to "provide for the common defense." In the opinion of the framers of the Constitution, a well-regulated militia was the essential means of providing for the common defense, and they accordingly framed the clause to provide that Congress shall have power—to provide for organizing, arming, and disciplining the militia, and for governing such part of them as may be employed in the service of the United States, reserving to the States respectively the appointment of the officers and the authority of training the militia according to the discipline prescribed by Congress.

The purposes and provisions of this clause are clearly and distinctly stated and scarcely admit of misinterpretation. The States are expressly limited to the appointment of the officers and to training the militia, and in training it, it will be observed, according to the discipline prescribed by Congress If the certain power conveyed to Congress by the words "organizing, arming, and disciplining" could be doubted, the debates of the Federal Convention are sufficiently clear to remove them. The Committee that reported the clause, on being asked the scope of the powers that they intended to convey, replied that they meant by "organizing" proportioning the officers to the men; by "arming," not only to provide for uniformity of arms, but the authority to regulate the modes of furnishing them, either by the militia themselves, the State governments, or the national Treasury; and by "disciplining," to prescribe the manual exercise, evolutions, etc., and that laws for disciplining must involve penalties and everything necessary for enforcing penalties.

The debates of the Federal Convention on adopting the clause, though short, are pertinent. Mr. Mason, who introduced the subject, thought that all powers over the militia should be vested in the general government, which he subsequently modified by suggesting that this absolute power should be limited to a portion of the militia at a time, so that by serving in rotation the whole body would finally be disciplined. Mr. Madison thought that the regulation of the militia naturally appertained to the authority charged with the public defense, that it did not seem in its nature divisible between two distinct authorities, and that the discipline of the militia is evidently a national concern, and ought to be provided for in the national Constitution. The clause as reported by the Committee had but little opposition, it being conceded, as stated by Mr. Randolph, that reserving to the States the appointment of the officers was all the security they needed. Mr. Dayton and Mr. Ellsworth expressed themselves in favor of placing greater limitation on the power of Congress, but a motion made for that purpose received only one vote, that of Mr. Ellsworth, who moved it, and the clause, as it now stands, was therefore adopted with a marked unanimity in sentiment and vote.

We have only adverted to the question of the constitutional power of Congress as a matter of historical interest in connection with the general subject, for whatever question there may be as to the constitutionality of the existing law, or of some of the plans heretofore suggested for reorganizing the militia, none can possibly arise on the proposed reorganization, for it is a happy solution of all the constitutional questions involved. There is not a compulsory feature presented. It simply says to the States that if they will by their own laws provide for and enforce such requirements as Congress deems necessary to secure an efficient militia, Congress will exercise its unquestioned constitutional power, and provide for arming such militia out of the national Treasury.

From this review of the subject we are satisfied that time has solved those difficulties of the militia system for which the wisdom of our predecessors could find no acceptable remedy, and that the great increase in the population of the country now makes it not only practicable but desirable to substitute the volunteer system for enforced militia duty in time of peace. The subject is one on which there never have been any political differences, and on which none should exist. Washington, as the exponent of the Federalists, was unceasing in his efforts to procure legislation, and Jefferson, as the leader of the Anti-Federalists, was even more importunate in urging it. In view of these facts, and of the fact that we now have practically no militia system, and that the strength and perpetuity of our republican form of government largely depend on the existence of a well-regulated militia, we indulge the hope that the subject will receive the earnest consideration which it deserves, and that some decisive action will be taken on it. See *State Troops*.

MILITIA ADJUTANT.—An officer appointed to each regiment of militia to superintend the drill and instruction of the regiment. He is taken from the regular army. The following are the regulations recently issued relative to the duties of Adjutants of Militia:

"1. The Militia Adjutant will be, during the non-training period, the representative at the brigade depot of the officer commanding the militia battalion or battalions.

"2. He will raise and enroll all recruits for the militia battalion or battalions, and superintend the out-station recruiting for the army and the militia as required.

"3. He will have military charge of the militia staff during the non-training period, and the military charge and supervision of the drill of the militia recruits when they are trained in large bodies; militia recruits, when they come up singly or in small numbers, will be attached to squads of line recruits, and they will in that case be under the supervision of the officer of the brigade depot.

4. The duties specified in the foregoing paragraph will have priority over all others, but when Militia Adjutants are not employed upon them, they will be liable to perform such other depot and sub-district duties as the officer commanding the brigade depot or sub-district may direct.

MILITIA ARTILLERY.—Forms a large body of artillery in addition to that of the regular forces of Great Britain. Formerly the militia artillery was called upon to exercise with all kinds of ordnance, but since 1873 they only practice with garrison and coast guns. Each regiment, however, has some Armstrong guns for the drill of recruits; but, from the absence of horses, its organization into batteries remains incomplete. The places of meeting chosen for the yearly drills (two months for recruits, and one for a regiment) are some fortified points of the coast, where the men are taught to exercise with garrison and field pieces. There are 30 regiments of artillery, composed of 796 officers, 66 surgeons, 15,978 men.

MILITIA RESERVE.—A force created by the Act of 1867; its numbers not to exceed one-fourth of militia quota; the men to be enlisted for 5 years, during which time they remain on the strength of militia regiments, but are liable to be drafted into the army in time of war.

MILLAR GUNS.—Guns introduced into the English service by General Millar in 1827. The thickness of metal at the breech is considerable, and comparatively slight in the chase. Two of his 8-inch guns are still in the service. Besides these guns, General Millar also introduced the 10-inch and 8-inch iron howitzers and the present L. S. S. B. iron mortars.

MILLAR HIND SIGHT.—A sight consisting of a block of gun-metal, with a thumb-screw, lead packing, a brass scale, and two screws. The blocks are of five different patterns. The scale differs for each nature. It is tightened by a thumb-screw working against a brass spring in the block, and is in every case graduated to $\frac{1}{4}$ degrees. It is attached to the rear of the base ring at an angle of 76°.

MILLBANK.—A large prison, situated on the banks of the Thames, Chelsea. All soldiers under sentence of Courts-Martial for lengthened terms of imprisonment in England are committed to the military division of this prison. Soldiers also sent from abroad under punishment for lengthened periods are generally sent to Millbank, or to the military prison in the district in which they disembark.

MILL-CAKE. The incorporated materials for gunpowder, in the form of a dense mass or cake, ready to be subjected to the process of granulation. As the process of incorporation approaches completion, the charge requires to be carefully watched, in order to insure each finished charge leaving the mill in as nearly as possible the same state as regards moisture. The appearance of the powder when finished depends mainly on the state in which the charges leave the mill. The finished charge usually has from two to three per cent. of moisture. If too much moisture be present as the incorporation draws to a close, the charge must be repeatedly pushed up with a *shover*; if too little, some more must be added from the watering-pot. The color of the charge gives a very good indication of the amount of moisture present. When the process is finished, the charge, now known as *mill-cake*—being partly in the state of soft cake, and partly of dust—is scraped and swept up from the mill-bed, placed in wooden tubs, and transferred to the charge-house to await inspection. If the charges are found to be of a proper color and consistency, samples from each are taken, which, after being roughly granulated by hand and dried, are flashed on a glass-plate to ascertain the thoroughness of the incorporation they have undergone. This flashing is more a matter of form than anything else, for the mill-cake seldom fails to give satisfactory results. See *Gunpowder*.

MILLER MAGAZINE-GUN.—This gun is an adaptation of a magazine to the United States service Springfield rifle. The alterations are as follows: The original receiver and breech-pin are replaced by a receiver alone the tang being solid with it. The upper rear part of the receiver gives the bearing for the cam, while the space ordinarily filled by the breech-pin if utilized as a channel through which the cartridges are fed from the magazine in the butt-stock. The ejector-stud is replaced by one beveled on its rear as well as its front, in order that the cartridges may slip easily over it into the chamber. The magazine, is a tube slotted through its whole length. To the upper side of the side of the tube flat springs are screwed. At the end of each spring and riveted to it is a lug, beveled on its rear service; all these lugs pass through holes cut in the magazine and serve to separate the cartridges. A ratchet works in the slot in the magazine-tube. It is operated by a slide attached to the guard-plate. When the slide is drawn back the teeth of the ratchet pass in the rear of the heads of the cartridges. On being returned to position each tooth moves a cartridge forward, the lugs on the springs being pressed out of the way by the cartridges themselves. At the front of the ratchet is a cartridge-stop, held up by a spring. The stop is prevented from rising too far by a pin. When the ratchet is withdrawn the stop-spring yields—since the cartridge cannot move backward on account of the shoulders of the lugs on the springs—the stop descends and is drawn under the first cartridge, which is then free to leave the magazine and enter the chamber, gravity being the motive force, the gun being held muzzle downward. When the ratchet is moved forward the 2d cartridge occupies the place of the 1st, the 3d of the 2d, and so on. The ratchet is prevented from entering the tube by two pins which bear against the outer surface of the tube along the edges of the slot. It is held in contact with the tube by a spring, which is kept from slipping off the bottom of the ratchet by two forks. The magazine is loaded through a gate in the butt-plate. A projection on the breech-block hooks over a pin and prevents motion of the ratchet when the piece is locked. As a magazine-gun, five motions are necessary to operate it, viz: cocked, opened, loaded (by operating the ratchet by the slide), closed, fired. The same number of motions is necessary as a single-loader. This gun carries six cartridges in the magazine and one in the chamber. The last cartridge will not feed from the magazine, however, until forced down by others when the magazine is reloaded. See *Magazine-gun*, and *Springfield Rifle*.

MILLING.—The term "milling" as generally understood, means the cutting of metals by aid of serrated revolving cutters, each having a suitable number of cutting-teeth. Milling cutters have been used in this country for many years, but until recently with only a limited amount of success, owing to the expense and difficulty of producing their cutting edges and keeping them in order. This was next to impossible before the introduction of a small emery-wheel and compound slides, etc., for carrying the milling cutter while being re-sharpened. Hence in the old system of milling, which did not permit of the re-sharpening of the hard teeth, the results were, that after much expense and time had been bestowed on a cutter (including a quantity of hand-labor spent upon it while in its unsharpened state), the whole was as it were upset by the process of tempering; the accuracy which had previously been imparted to it being usually quite destroyed by the action of the fire and sudden cooling. In some cases the cutter would be found slightly warped or twisted; in others it would be oval or eccentric; and most frequently, when set to work on a truly-running mandrel in the milling machine, not more than one-third of the number of its teeth were found to be cutting at all, the others not coming in contact with the work. This really meant that not more than one-third of the proper feed per revolution could be applied, and not more than one-third of the proper work produced. Nor was this the only drawback: the quality of the workmanship produced by such a milling cutter was not of the best, and deteriorated hourly from blunting and wear. Such a cutter would probably not work for more than two whole days before it would require to be again softened by being heated red-hot and allowed to cool gradually. The expensive and unreliable process of re-sharpening by hand-filing had to be gone through once more; then the re-tempering, which caused the cutter again to become warped, swelled, or eccentric; and each time it was subjected to the heat of the fire, it ran the risk of being destroyed by cracking when plunged into a cold bath.

We represent in Fig. 1 the Brown and Sharpe universal milling machine, which has all the movements of a plain milling machine, and the following in addition:—the carriage moves and is fed automatically, not only at right angles to the spindle, but at any angle, and can be stopped at any required point. On the carriage, centers are arranged in which reamers, drills and mills can be cut either straight or spiral. The head which holds one center can be raised to any angle, and conical blanks placed on an arbor in it, cut straight or spiralling. The

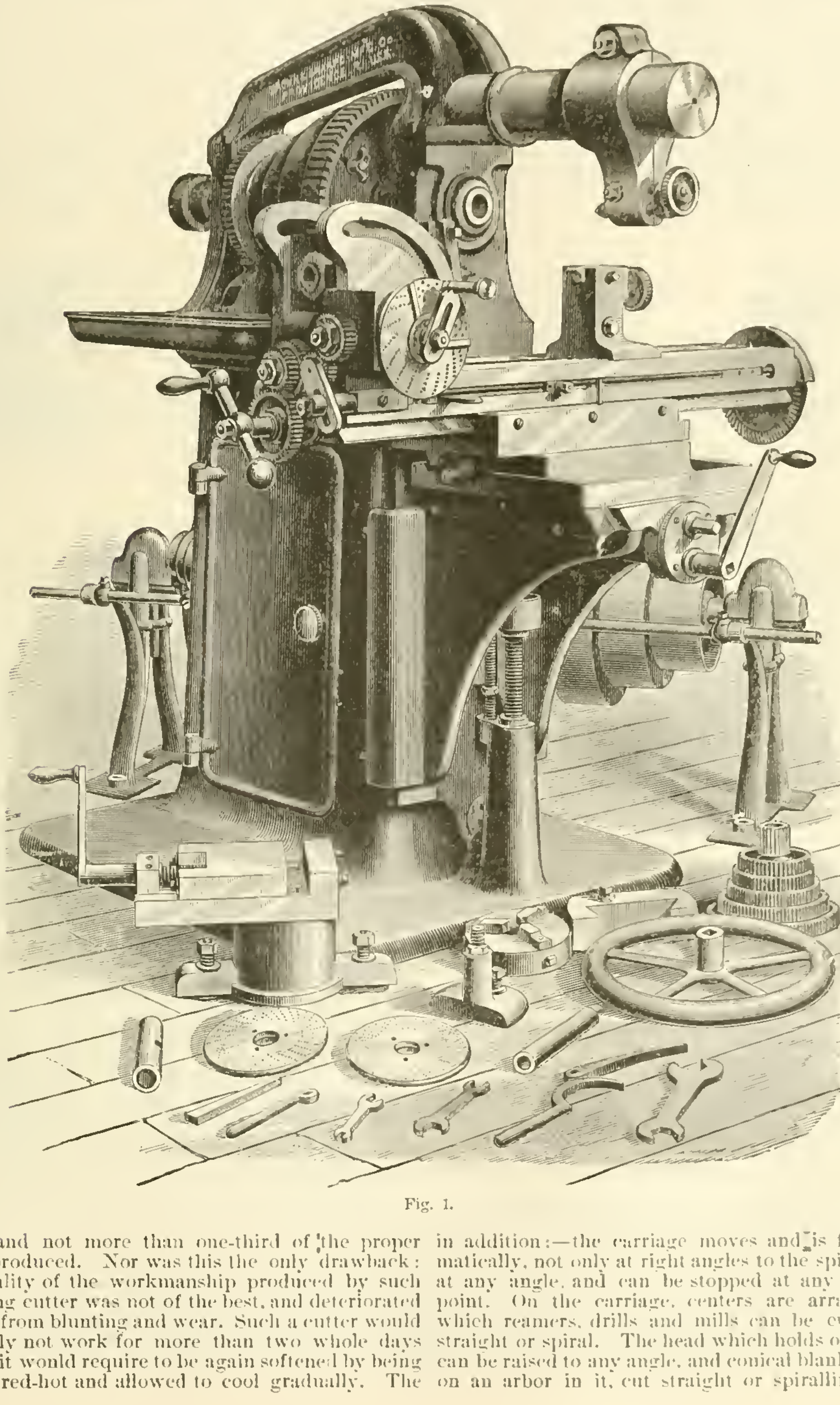


Fig. 1.

cone has three diameters, each $3\frac{1}{2}$ inches face. In addition, the cone is strongly geared, thus making six changes of speed. There are, also, the same number of changes of feed. The spindle boxes are of hardened cast steel, and, together with the spindle bearings, are carefully ground, and are provided with means of compensation for wear. The spindle will carry a cutter arbor projecting 15 inches, which is supported by an adjustable center at the outer end. Cutters of eight inches or less diameter can be used. The horizontal movement of the spiral clamp bed upon the knee, in a line with the spindle of the machine, is $6\frac{1}{2}$ inches, and the vertical movement of the spiral bed centers below the spindle centers is 11 inches. The spiral bed can be set at angles of 35° each way from center line of spindle, and can be fed automatically 22 inches, taking also 22 inches between the centers, and will swing $11\frac{1}{2}$ inches. The hole through the chuck and spiral head is $1\frac{1}{2}$ inches. In addition to all the more common kinds of plain surface milling, this machine is applicable to a great variety of work, among which may be mentioned the following: cutting of bevel and spur wheels, worm wheels and racks; milling of circular arcs and slots; squaring of bolt heads and nuts; fluting of tops, reamers, &c., cutting the teeth of mills, either straight or spiral; slotting of screw-heads; making of twist drills; drilling of holes on the periphery or face of plates; die-sinking, milling key-ways in spindles, &c., &c.; proving as its name indicates, a machine adapted for universal application to milling purposes.

It is proper now to describe the modern system of making and maintaining the improved milling cutters. A cast-steel forging, or blank as it is usually styled, is bored, and then turned to its proper shape in a lathe. The teeth are then machined out of the solid to the required forms, in a universal milling or other machine. The work is so accurately produced, direct from the machine, that no costly hand-labor need be expended upon the milled cutter, which is taken direct from the milling machine to the hardening furnace, and tempered. The hole in the center of the cutter is then carefully ground out to standard size, so that it may fit accurately and without shake on the mandrels both of the grinding machine and of its own milling machine. The cutter or mill is now placed on a mandrel of the small cutter-grinding machine; the mandrel itself is adjusted vertically and horizontally by ordinary slides, and by means of a worm and worm-wheel, to its required angular position; and each tooth is ground or re-sharpened by passing at once rapidly forward and backward under a small revolving emery-wheel. The mandrel fits easily into the cutter which is being ground, so that the latter may be readily turned round by the thumb and finger of the operator. Milling cutters are made of the required form to suit the various shapes they are intended to produce; and all the ordinary forms can be used in any milling machine either of the horizontal or vertical class. The face-milling cutters, Fig. 2, are of disk form, and are among the most useful. They are constructed to cut on one face and on the periphery; and they produce very perfect finish, especially on cast-iron. This form is also very useful for all kinds of stepped work, which even when not of the simplest form, can be readily and reliably finished to standard breadths and depths; so that the pieces may be interchangeable, and fit together without the slightest shake or play, just as they leave the machine, and without any hand-labor bestowed on them. Another ordinary and useful form is the cylindrical cutter, with teeth cut spirally over its circumference. This is largely employed for cutting flat, vertical, or horizontal surfaces, for finishing concave and convex curves, and for complicated forms made up of straight lines and curves. With this spiral arrangement of the teeth, and with reliable means of re-grinding or re-sharpening them, very high-class machine work can be produced. Some experiments have been made by cutting a spiral groove or thread into the outer surface of one of this class of mills, and thus reducing the aggregate length of its cutting surface. Other mills again are made in the form of small circular saws, varying from $\frac{1}{4}$ to $1\frac{1}{2}$ in. or more in thickness. The teeth in some of these are simply cut around the circumference; others have these teeth extending some distance down each side, their edges radiating from the center of the mill. Toward the center they are reduced in thickness so as to clear themselves. These cutters are useful for a great variety of work; for instance the cutting of key-ways, parting off or cutting through pieces of metal, and making parallel slots of various widths, for the broad-

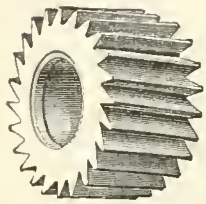


Fig. 2.

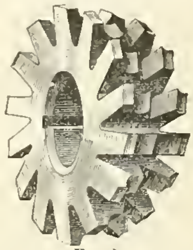


Fig. 3.


Fig 4.

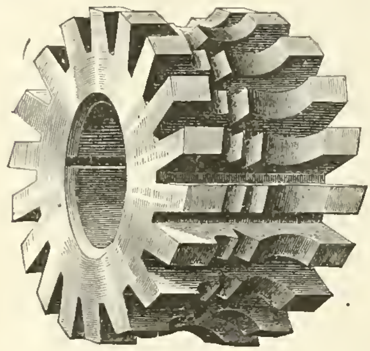


Fig 5.

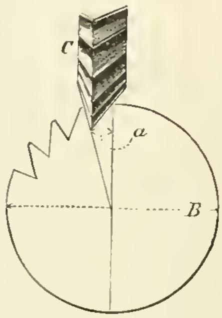


Fig. 6.

er of which two or more cutters may be used side by side. Conical and angular milling cutters are much employed for a great variety of work, such as the cutting of rimers, the making of milling cutters themselves, beveling, cutting the serrated part of hand and thumb-screws, nuts, etc. Any complex forms, such as the spaces between the teeth of spur, miter, and other wheels, can be machined by using what are known as the patent cutters, which can be re-sharpened as often as required by simply grinding the face of each tooth. They are so constructed that, however often they are re-ground, they never lose their original curved forms, and always produce the same depth of cut. One of these cutters, for instance, will cut the same standard shapes of teeth in a spur-wheel, after it has been used for years, as it did the first day it was started. Figures, 3, 4, and 5 illustrate some forms to which these cutters are adapted. There is risk of fracture in making large milling cutters out of one solid cast steel blank, the principal difficulty being in the tempering. In practice it is found that if they are required of larger diameter than about 8 ins. they are better made of wrought-iron or mild-steel disks, with hardened cast-steel so securely fitted into them that they do not require to be removed. The cutting-edges can then be re-sharpened in their own places, as in the case of the ordinary milling cutters; thus insuring that each shall have the same angle of cutting and clearance, run perfectly concentric, and therefore do a maximum amount of cutting in a given time. It must however be borne in mind that the smaller the diameter of the milling cutter, the better finish it will produce; and cutters of large diameters should only be used to reach into depths where one of smaller diameter could not, or to do the heavier classes of work. Again, the smaller the cutter, the less does it cost to make and maintain.

Fig. 6 represents a cutter in connection with the work, showing the position required in cutting the teeth of a spiral cutter. The distance a=one tenth of B. The hole in the cutter is ⅞ inch. Fig. 7 shows Garvin's spiral attachment, designed for use with the milling machine, and which will cut with the proper charge gears, spirals with pitch varying from one turn in 1.66 inches to one turn in 60 inches. Fig. 8 shows the swivel vise, mounted upon a graduated base 2½ inches high. This vise is useful for a variety of work, is quickly adjusted, and may be securely fastened at any angle, by two square head screws, one of which is shown in the drawing. Fig. 9 shows a *dividing head and tail* Stock, well adapted to the uses for which it is designed. It has a compensating wedge for adjusting the halves of the spacing worm gear, and an alteration of the usual tail stock pattern so that milling cutters, adjusted close to the center, pass clear across. With it gears can be accurately spaced, mills cut of straight, conical or irregular forms, taps and reamers fluted and worm wheels gashed. The slots in the stock allow the head to be elevated from a horizontal to a vertical position, and by supplemental slots in the elevated head, in which the T heads of clamp bolts slide, the head can be depressed to 30 degrees below a horizontal line, and 5 degrees beyond a vertical, making 125 degrees of change, all determined by graduations on stock. The spacing worm gear is made in halves, and all points liable to wear are provided with means of compensation for wear. Three index dials go with the head, dividing all numbers up to 50, and as many others as an every day machine shop practice may demand.

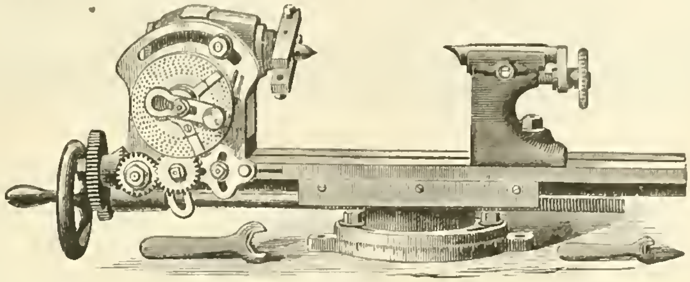


Fig. 7.

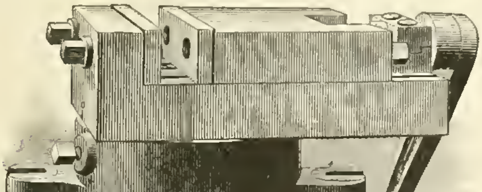


Fig. 8.

The spindle of the elevating head has a taper hole clear through, and the end of the spindle is threaded to receive the chuck, allowing pieces of any length less than 1 and 1-16 inch diameter to be milled. The tongues under the base of the head and tail stock are of steel, and can be removed to allow swivelling of the head, so that work held in the chuck, such as hollow mills, etc., can be cut under or hooking. The tail stock has a milled head adjusting screw, and screw to bind the spindle central in any position. These centers are designed to be used on milling, shaping and planing machines.

The cutting speed which can be employed in milling is much greater than that which can be used in any of the ordinary operations of turning in the lathe, or of planing, shaping, or slotting. A milling cutter with a plentiful supply of oil, or soap and water, can be run at from 80 to 100 ft. per minute when cutting wrought iron. The same metal can only be turned in a lathe, with a tool-holder having a good cutter, at the rate of 30 ft. per minute, or about one-third the speed of milling. Again, a milling cutter will cut cast-steel at the rate of 25 to 30 ft. per minute. The increased cutting speed is due to the fact that a milling cutter, having some thirty points, has rarely more than three of these cutting at the same time. Each cutting point therefore is only in contact with the metal during one-tenth of each revolution. Thus, if we suppose it is cutting for one second, it is out of contact, and therefore cooling, for the succeeding nine seconds, before it has made a complete revolution and commences to cut again. On the other hand, a turning tool while cutting is constantly in contact with the metal: and there is no time for it to cool down and loose the heat imparted to it by the cutting. Hence, if the cutting speed exceeds 30 ft. per minute, so much heat will be produced that the temper will be drawn from the tool. The same difficulty to a great extent applies to the cutting tools in planing, shaping, and slotting machines. The speed of cutting is governed also by the thickness of the shaving and by the hardness and tenacity of the metal which is being cut: for instance, in cutting mild steel with a traverse of 3-8 in. per revolution or stroke, and with a shaving about 5-8 in. thick, the speed of cutting, must be reduced to about 8 ft. per minute. A good average cutting speed for wrought or cast-iron is 20 ft. per minute, whether for the lathe, planing, shaping, or slotting machine.

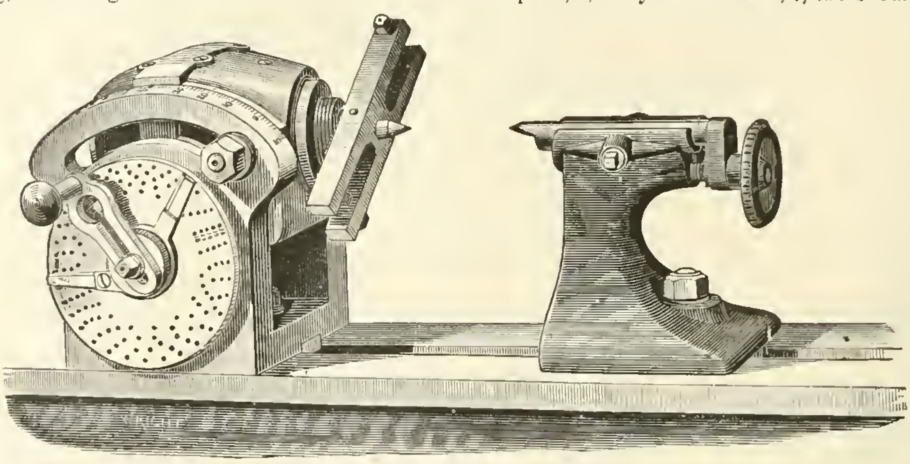
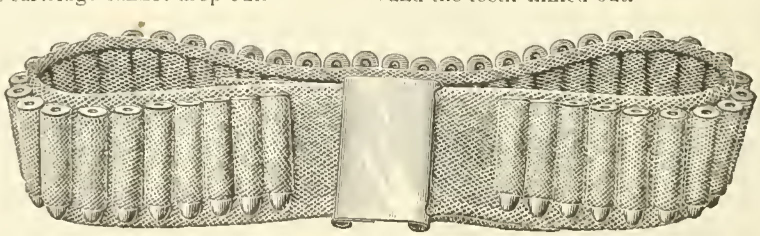


Fig. 9.

Millrind.

MILLRIND.—MILLRIND, or FER DE MOULIN in Heraldry; a charge meant to represent a mill-iron originally a mere variety in designating the cross moline, but accounted a distinct charge by some heralds. See *Heraldry*.

MILLS CARTRIDGE-BELT. This belt in its main features is not unlike what has been for a long time known as the "Prairie Belt," its distinguishing characteristic being that it is not only made entirely of heavy cotton fabric, but that the whole belt—the main fabric or body of the belt, as well as the loops or thimbles which hold the cartridges—are woven in one solid piece, at one and the same time, in the same loom, there being no sewing whatever in the entire belt. The cylindrical loops are taken from and returned to the main web at the same point, so the cartridge is held in place by friction produced by contact with its whole circumference, and are of such accurate form that, aided by the cord at the top of the belt, the cartridge cannot drop out.

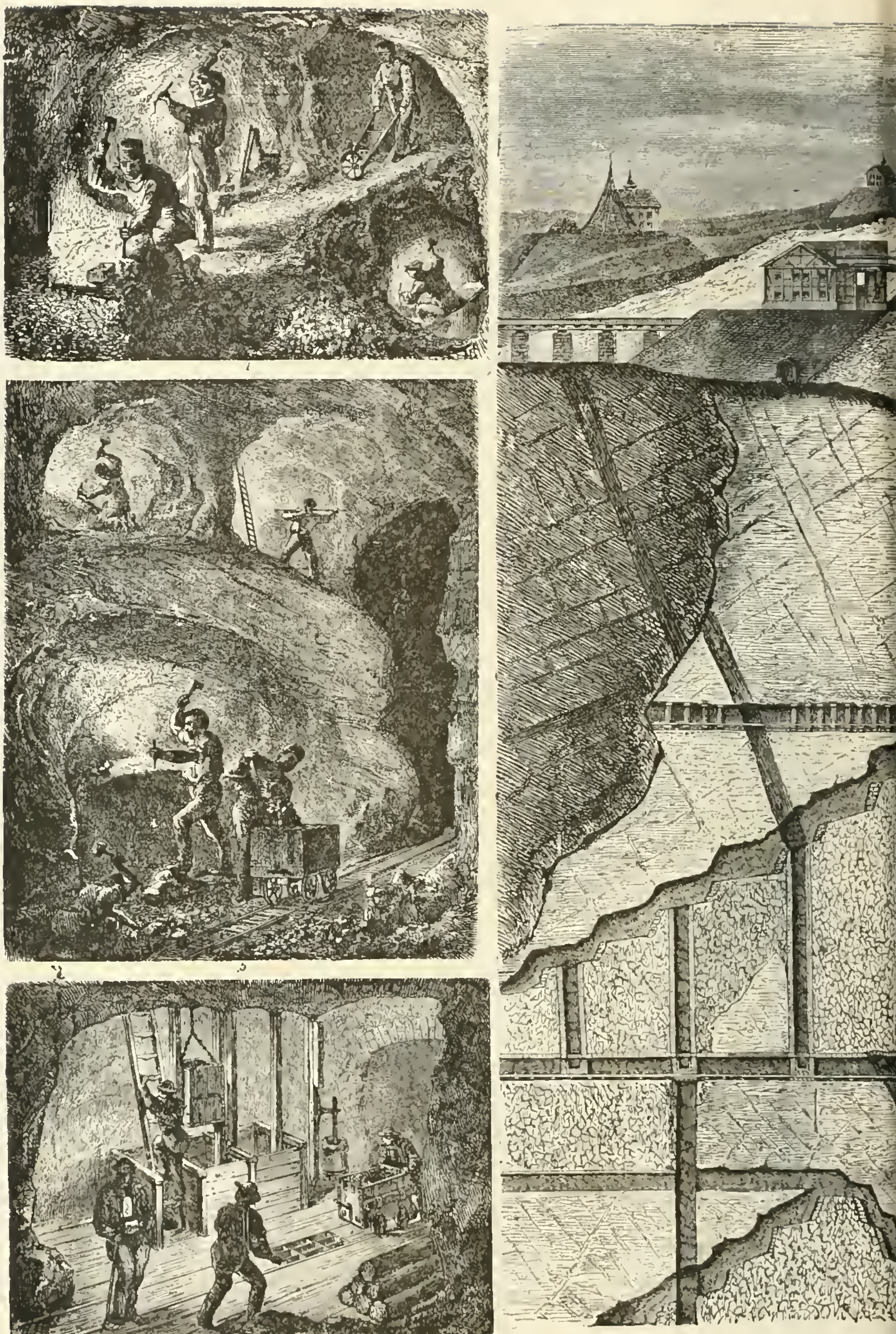


As seen in the drawing, the belt has a suitable margin above and below the cartridge and loop which prevents the wearing of the former by rubbing against the clothes of the wearer. Handsome and durable buckles are furnished, so formed that the wearer may adjust the length of the belt to his person without sewing or cutting, and can also adjust the buckle midway between the cartridge loops. This belt was recommended by the Equipment Board of 1879, was very fully approved by the General of the Army, and adopted by the Secretary of War, and is now the Regulation Belt for the United States Army. See *Pooler-Jones Belt*.

MILLS SPUR.—This spur, the invention of Colonel Anson Mills, United States Army, and shown in the drawing, is composed of a heel-strap, *a*, or "main leather band," as it is called by the inventor, to which the rowel-plate, *b*, is riveted, a lower strap, or under strap, *c*, passing under the boot; and a spur-strap, *d*. The metallic parts of the spur are the rowel-plate, *b*, the yoke or frame, *e*, the shoulder, *h* (all of brass in one piece), the rowel, *f*, of steel, the rowel-pin of steel, the buckle, *k*, of brass, eyelet, *l*, and the brass rivets and burs, marked 1, 2, and 3. The buckle is fastened to the understrap by means of a small projection, which is twined over the bar of the buckle and riveted, the tongue passing through the slot. The eyelet, *l*, is intended for the insertion of a button attached to a steel wire double loop for strapping down the trowsers.

The different steps in the process of manufacture of the rowel-plate and yoke are very simple. The plate and yoke are first punched out flat in a rotary press. The middle slot and the holes for the rivets and rowel-pin are then punched. The branches of the yoke are next rounded and bent up by means of a punch and die of proper shape. The shoulder is then formed and by the next operation set firmly down on the rowel-plate. The holes are then drilled, and the finished rowel-plate and yoke are pickled and polished. The hole for the rivet is drilled or punched, and the rowels are strung on a wire passing through the hole, placed in the milling machine, and the teeth milled out.

The rowel is riveted in the yoke with a rotary press. The rivet is increased in diameter throughout its entire length by this operation, and the hole in the rowel is made $\frac{1}{16}''$ larger than the rivet to allow for this increase. The rowel-plate is riveted to the heel-strap by the same press, as it is not easy to do the riveting by hand without the plate. The leather parts are assembled after the rowel-plate has been riveted. The spur-strap and heel-strap are placed together and the eyelet inserted; the heel-strap and under-strap on the other side are assembled in the same manner; the end of the under-strap with the slot in it is then carefully inserted between the heel-strap and the spur-strap, and the whole securely riveted.



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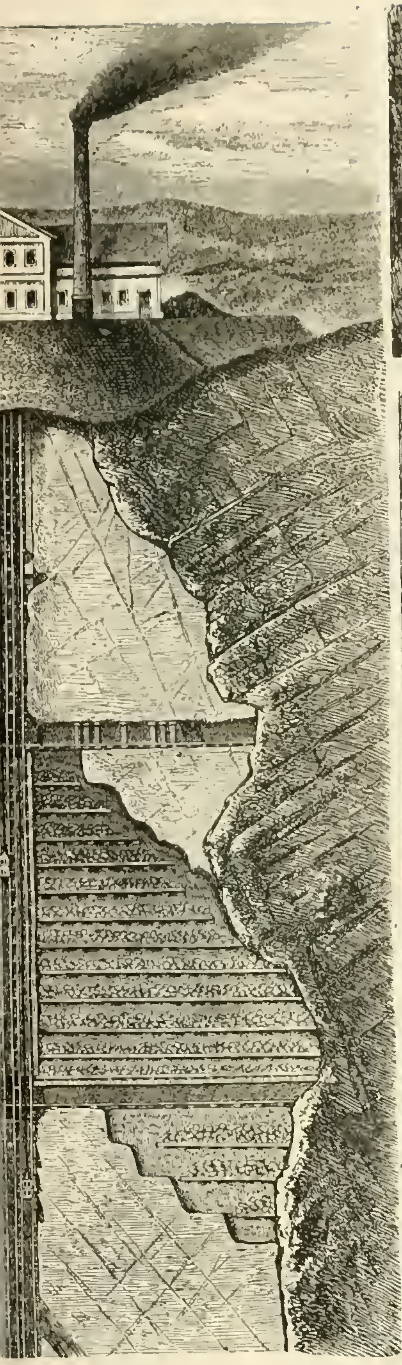
MINING. 1. Miners at work. 2. Scaffolding. 3. Filling ore-cart.



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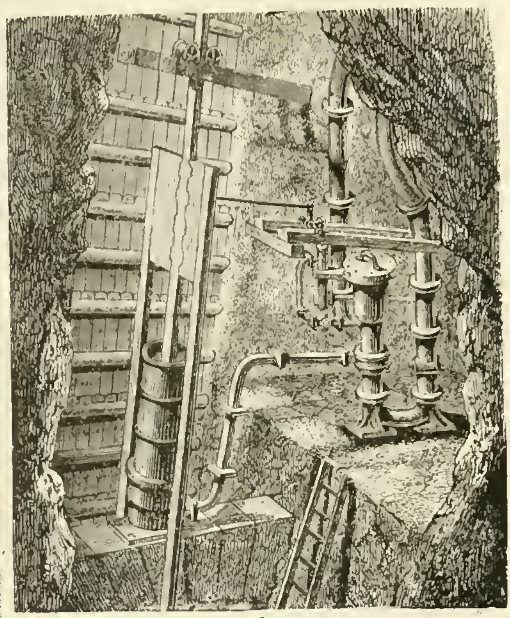

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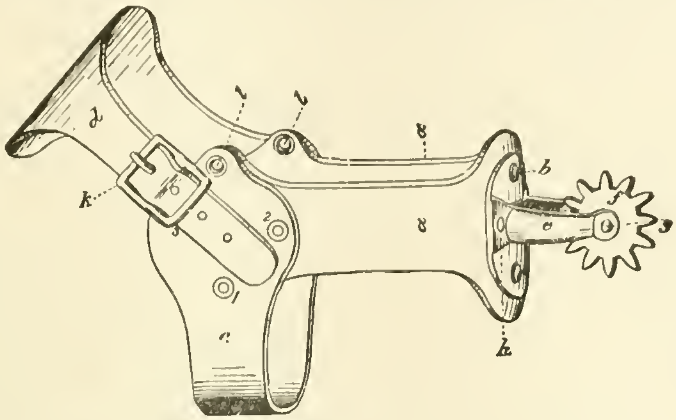
4

of mine. 5. Miners in Strassfurt salt-mine. 6. Steam-pump. 7. Ideal section of a mine.

MIM BASHY.—In the East Indies, a commander of one thousand horse.

MINER'S TRUCK.—In low galleries and branches, where wheelbarrows cannot be used, small wagons or *miner's trucks*, resting on short cast-iron wheels, answer the same purpose, a man pushing behind, assisted by another pulling with a rope in front, when the gallery is descending.



Mills Spur.

MINES.—Military mines constitute at once one of the most important departments in military engineering, and a very formidable accessory both in the attack and defense of fortresses. A military mine consists of a gallery of greater or less length, run from some point of safety under an opposing work, or under an area over which an attacking force must pass, and terminating in a chamber which, being stored with gunpowder, can be exploded at the critical moment. Mines are of great use to the besiegers in the overthrow of ramparts and formation of a breach; the *countermines* of the besieged in undermining the glacis over which the assaulting column must charge, and blowing them into the air, or in destroying batteries erected for breaching, are equally serviceable. But far above the actual mischief wrought by the mine often very great is its moral influence on the troops, and especially on the assailants. The bravest soldiers, who advance without flinching to the very mouth of the cannon *which they see*, will hesitate to cross ground which they suppose to be undermined, and on which they may be dashed to destruction in a moment, without the power of averting the *unseen* danger. The first employment of mines was very ancient, and merely consisted in obtaining an entrance to the interior of towns by passing beneath the defenses; but this soon fell into disuse, the chances of success being merely those of introducing a body of men before the besieged discovered the mine. The next use occured during the Middle Ages, and was more destructive. The miners went no further than beneath the wall, then diverged to either side, and undermined the wall, say for about 100 feet. During the process, the wall was sustained by timber props; and these being ultimately set on fire, the wall fell; and the besiegers, who had awaited the opportunity, rushed in at the breach. This use of mines of *attack* necessitated those of *defense* which obtained in mediæval times and have ever since kept the name of "*counter-*

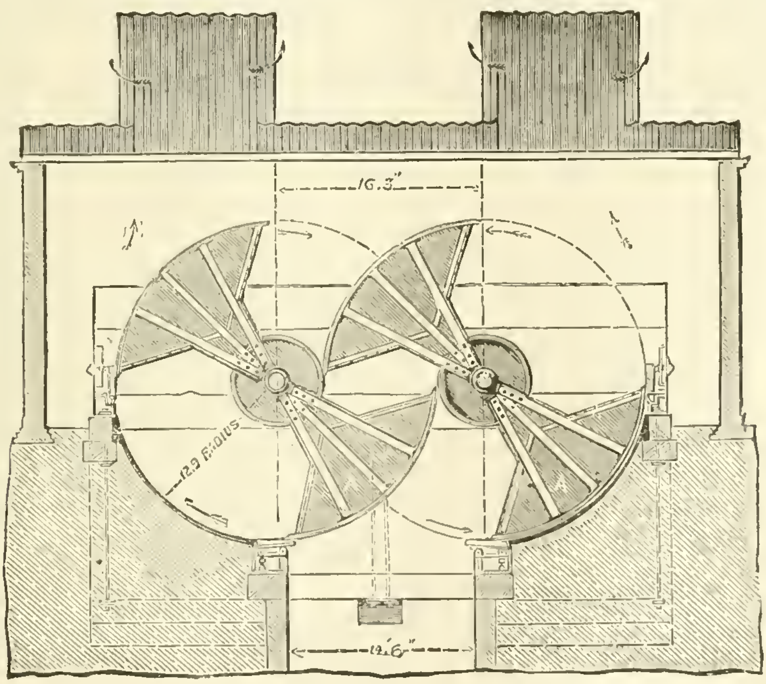


Fig. 1.

mines." The earliest subterranean defense consisted of a gallery surrounding the fort in advance of the foot of the wall, and termed an enveloping gallery. From this the garrison would push forward small branches of tributary galleries, whence they could obtain warning of the approach of hostile miners, and by which they succeeded, at times, in overthrowing the battering-rams or towers of the besiegers.

Two centuries appear to have elapsed between the introduction of gunpowder into European warfare and its application to subterranean operations. The first instance of this occurred in 1503, at the siege of the Castello del' Uovo, in the bay of Naples, which a French garrison had succeeded in holding for three years against the combined Spanish and Neapolitan forces. At length a Spanish Captain, Pedro Navarro, devised a gallery into the rock, which he stored with powder, whereof the explosion, hurling portions of the rock and many of the besieged into the sea, caused the immediate capture of the place. At once the use of mines of attack spread throughout Europe; and so irresistible were they soon considered by all military engineers, that it was not at all unusual for the besieger, after preparing his mine, to invite the besieged to inspect it, with the view of inducing the latter at once to surrender. Defense soon availed itself of the new power, and, retaining the enveloping gallery as a base, ran small countermines in many directions, to ascertain, by hearing, the approach of the enemy's sappers—his work being audible, to a practiced ear, at a horizontal distance of 60 feet. Small charges were then exploded, which, without creating surface disturbance, blew in the approaching gallery, and buried the sappers in its ruins. Thus commenced a system of subterranean warfare, requiring the greatest risk and courage, in which the operator was in constant danger of being suffocated. Of course, in such a system, the balance of advantage lay with the besieged, who had ample opportunities, before the siege commenced, of completing his ramifications in every direction, and, if desirable, of revetting them with masonry, which much diminished the chance of being blown in; while the assailant, no longer able to cross the glacis by an open zigzag trench, was compelled to engage in a most uncertain subterranean advance. The French engineer, Belidor, in the 18th century restored the advantage to the attack, by demonstrating that the explosion of a very large mass of powder in a mine which had not yet entered the labyrinth of defensive mines, effected the destruction of the latter for a great space round, clearing the way with certainty for the hostile advance. Although the primary purpose of a mine is the explosion of a charge of powder, they are often used as a means of communication between different works, or between different parts of the same work, some being constructed of size sufficient to permit the passage of four men abreast, of horses, and of artillery.

It is, of course, impossible, in such a work as this to give even an outline of the professional part of military mining; but the article would be incomplete without some allusion to the main principles. Mines are either vertical (*shafts*), horizontal, or inclined, in either of which latter cases, they are *galleries*, the word "ascending" or "descending" being added if there be inclination. The dimensions range from the *great gallery*, 6 ft. 6 in. by 7 ft., to the *small branch*—the last diminutive of the gallery—which has but 2 ft. 6 in. height, with a breadth of 2 feet. The most frequent work is the *common gallery*, 4 ft. 6 in. by 3 ft., which is considered the easiest for the miner. The sapper's tools are numerous, but most in request are his shovel, pickaxe, and, above all, his push-pick, he has, besides, a barrow, a small wagon, a lamp, and other accessories. As he advances, it is necessary to line his gallery, always at the top, and almost always at the sides. This he does either by frames—which resemble door-frames, and serve to retain horizontal planks or sheeting in position against the earth—or by cases somewhat resembling packing-cases, of little depth, which are used to form the sides and top. With cases, galleries are supposed to advance one foot and a half per hour; while with frames, the progress is barely more than half that amount. When a mine is exploded, the circular opening on the surface is called the *crater;* the *line of least resistance* is the perpendicular from the charge to the surface; the half diameter of the crater is its radius; and the *radius of explosion* is a line from the charge to the edge of the crater, on the hypothenuse of the triangle, the revolution of which would form the cone. When the diameter equals the line of least resistance, the crater is called a one-lined crater; when it doubles that line, a two-lined crater; and so on. The common mine for ordinary operations is the two-lined crater; and for this the charge of powder should—in ground of average weight and tenacity—be in pounds a number equal to one-tenth of the cube of the line of least resistance in feet, for example, at a depth of 18 feet, the charge should consist of 583 pounds. In surcharged mines, or globes of compression, as introduced by Belidor, vastly greater charges are employed, and craters of six lines are sometimes produced. The rules, in these cases, for computing the charges vary exceedingly, according to different engineers, and in every case are very complicated. Previous to the explosion, the gallery is filled up behind the charge, or *tamped*, with earth, sand-bags, etc., to prevent the force of the powder wasting itself in the mine. This tamping must extend backwards for one and a half or twice the length of the line of least resistance. The mine is commonly fired by means of a powder-hose, composed of strong linen, inclosed in a wooden pipe laid carefully through the tamping, or by wires from a voltaic battery.

One of the most important subjects engaging the attention of the engineer is the proper ventilation of the mines. With the progress of civilization, this subject is assuming, every day, aspects of more and more importance, not only in relation to safety and health, but in a great measure from its vital connection with some of the great enterprises of the day. The entire inadequacy of any of the present arrangements or systems to give any thing like a thorough and perfect ventilation becomes more and more apparent as they proceed to greater depths and distances under ground; which, taken in connection with the unhealthiness, great risk and fearful loss of life from explosions, now of such common occurrence, suggest the alarming contingency of being compelled to abandon them at no very distant day. The consequences of even a slight interference with the mining interests of Europe are dreadful to contemplate. And in some parts of our own country the subject is one of great importance. Sometimes, in connection with high chimneys above ground, additional shafts have been sunk. Fires have been kept in the mines and chimneys, in order to rarefy the air and thus produce draught. This is not only dangerous, but to a great degree ineffectual. And further, it has been demonstrated that the power resulting from the combustion of one pound of coal will give more ventilation than thirty to fifty pounds consumed in the way spoken of. May we not, therefore, on the whole, pronounce this system a failure? The only remaining plan of note to be considered is the fan. Of late they have received considerable attention. Enormous fans of from twenty to fifty feet in diameter, have been constructed at great expense, and requiring a vast amount of power to run them. But these considerations would not be of so much consequence, if they accomplished the purpose; but this, in mines of any considerable depth and extent, they do not and can not. Within a certain range, fans would undoubtedly be beneficial, but fans do not have a positive action either for pressure or exhaustion. Their capabilities are thus limited. The deeper and more extensive the mine, the greater the necessities for thorough ventilation. Here they must always fail.

The Root's positive blower appears to be the most satisfactory machine ever used by the mining engineer. With this apparatus placed at the mouth of the shaft we can exhaust the damps and foul air in any required quantity, and discharge it entirely out of and away from the mine, where it can do no harm whatever. The foul air thus displaced will be replaced by pure air, which will rush in from the surface in a volume equal to the air displaced. Thus the most distant parts of the mine will be equally as well ventilated as any other part and the mine throughout its entire extent may be said to be washed out with pure air. By this method, the foul air resulting from blasting in mines and tunnels is exhausted at the point where the gases are formed, and entirely removed from the tunnel and replaced with pure air. This ventilator is shown in section in Fig. 1. It consists of two rotary pistons, which are each 25 ft. diameter and 13 ft. wide, and are built upon steel shafts. Upon each of the shafts are keyed five cast iron disc plates, having flanges at their circumference which are all turned to exactly the same diameter. In each disc plate there are three wrought iron bars fixed on each side of the center, and reaching to the outside of the rotary piston; planed recesses are provided in the disc plates to receive the bars, which are also secured to the disc plates by bolts turned to fit. The outer ends of the bars are widened, and marked off and slotted to the radius of the outer circle. Angle irons bent to the radius of the outer circle are riveted to the extremities of the bars, and are covered with $\frac{1}{4}$ in. sheet iron plate; the center circles are also covered with $\frac{1}{4}$ in. sheet iron plates on the turned flanges of the disc plates. The sides of the pistons are covered with wood, and the ends with sheet iron. These rotary pistons revolve in bearings fixed upon deep cast iron girders, which form the framework of the ventilator pit, and are connected together at each end of the ventilator by cross girders. The girders and the cast iron side plates above them are planed on their inside surfaces, and the stonework of the ventilator pit is dressed off level with the planed girders. The engines to drive the ventilator are a pair of 28 inch cylinders with 4 ft. stroke, and provided with adjustable cut-off valves. They are placed at right angles to the ventilator, and are connected to it with bevel wheels 9 ft. $2\frac{3}{4}$ in. diameter, two bevel wheels being fixed upon the crank shaft, each gearing into a bevel wheel keyed upon the end of the ventilator shafts. The engine beds are carried along and fixed upon a stay girder, securely keyed and bolted to the main girder. The main girders are fixed 13 ft. $\frac{1}{4}$ in. apart, therefore, the clearance between the rotary pistons of 13 ft. and the sides of the ventilator pit is only $\frac{1}{8}$ in. on each side. At each end of the ventilator pit, and at the bottom on each side of the inlet from the upcast shaft, adjustable packing blocks of timber are fixed upon hinged iron frames, and can be adjusted with screws and nut; these blocks are set up quite close to the periphery of the rotary pistons within $\frac{1}{8}$ inch. The clearance between the periphery of one of the rotary pistons and the center circle of the other is also the same, and thus in any part of the ventilator the clearance for loss by the returning of the air is not much more than $\frac{1}{8}$ inch.

The arrangement of the engine-house and ventilator building is shown in the engraving; the discharged air escapes through perforated openings in the roof, and, owing to the very large area of outlet from the ventilator—the top of the ventilator casing being left entirely open—the air that is being exhausted from the pit must necessarily be delivered into the atmosphere at a lower velocity than is usual with other ventilating machines. The range of this blower, when employed as an exhauster, is certainly in advance of any of the previous mechanical ventilators; and in the writer's opinion this would be a decided advantage in the case of an explosion. When the air-doors become disarranged, the ventilation of the mine is interfered with at the moment when it would be of the greatest service, and this owing to the limited power of fan ventilation, which can only be depended upon up to about 3 in. water gauge; but in a case of emergency, with a Root's ventilator similar to the one described, the machine could be instantly driven at its maximum power, and would speedily clear the workings of the choke-damp, fire-damp, or after-damp. Since explosions cannot always be prevented, it is of importance that the deadly gases should be drawn out in the shortest possible space of time, and replaced with pure air; and from present experience this ventilator appears to be well fitted to suit these requirements.

Fig 2. shows the adaptation of the Cameron mining pump for sinking and recovering shafts. It frequently happens in sinking a shaft that it makes water so rapidly that it is very difficult to remove it as fast as necessary, and for the same reason great trouble is experienced in lowering an ordinary horizontal pump from one level to another; and in attempting to recover old mines that have been "drowned out," the difficulty is the more serious, because of the large surface below to make water. This machine is held in suspension in the shaft, and being vertical, requires but little room, and can be raised and lowered as required. There is no danger of its being submerged. Being compact and strongly made, without any of the working parts exposed to injury, they are well adapted for the rough usage incidental to the work for which they were designed. Adjustable wrought-iron dogs are provided to fasten the pump to the shaft timbering, although they will work equally as well when hanging by the tackle, or will operate perfectly when placed at an angle or horizontally. The general features are exactly the same as in an ordinary horizontal machine, except that they are arranged to work vertically. Iron pipes or flexible hose may be employed as best suits the situation.

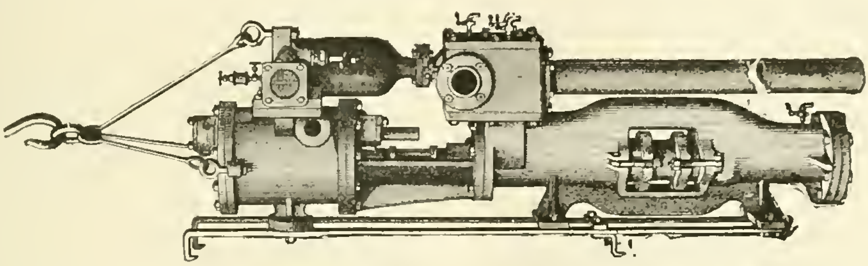


Fig. 2.

It is but rare that, in the defensive arrrangements of a field work, any combination for a war of mining is provided for; although in many, and those but recent cases of a stubborn and protracted defense of field works against regular siege operations, mines have been employed with great success, although not made before the works of the assailant were under way. As the end to be attained is the same in conducting the defense of a work by mines, whether it be a temporary or a permanent one, the same principles in the arrangement of a combination of mines for this purpose are equally applicable to the two cases; the most essential of which are as follows: As the galleries of a system of mines serve the purpose of underground communication, they should be subjected to the same conditions as other communications. A condition of primary importance is, that no combination shall be made which might compromise the safety of the work. To this end, no gallery beyond the ditch should lead to the interior of the work; for should the enemy get possession of such a gallery he might either penetrate into the work, or else barricade the gallery and hold possession of it long enough to blow up the works under which it leads. The galleries should not offer any facilities to the besiegers for carrying on their works. Those galleries, therefore, which, communicating with the ditches, might serve the besiegers for their descent of the ditch; also a continued counterscarp gallery, which may not only facilitate the descent of the ditch to the besiegers, but also, when in their possession, give them that of the whole system of mines, and, besides, serve to protect their passage of the ditch, and to prevent sorties in it, should be rejected. A gallery behind a portion of the counterscarp not favorable to the enemy's works, is very useful as a depot for the implements of the miners, and also as a communication. A complex system of mines should not be used for works that can be carried by storm; for the reason that the besiegers might easily get possession of the system before it could be brought into play. The entrance to a sytsem from the ditch must be revetted, to offer a sufficient obstacle to prevent the enemy from getting possession of the system by surprise; hence, a revetted counterscarp is a necessary condition in the establishment of the system. The galleries should not be run out to any considerable distance beyond the covered-ways, both on account of procuring a good circulation of air, and because very advanced galleries are easily destroyed by the besiegers. The distance to which the galleries may extend should be so much the less as the ground above them is well protected by the collateral defenses. The soil must be suitable for the establishment of a system; wet, marshy ground, shifting sand, and hard rock, present almost insuperable obstacles; whereas a dry, firm soil, soft rock, or ordinary earth, under a thin superstratum of hard rock, are very favorable circumstances. If the sub-soil is wet, but presents a firm and dry superstratum 12 ft. thick above the level at which the water collects, mines may still be placed with advantage.

Besides the above general conditions, there are certain special ones to be attended to in arranging the galleries and chambers. The galleries should be placed as far below the surface as practicable, to withdraw them from the effect of the globes of compression of the besiegers. To drain the galleries they should have a slight inclination, about $\frac{1}{50}$, towards the ditches; or, if the ground descends towards a hollow, the inclination may be given in that direction. The chambers, on the contrary, should be near the surface; by this arrangement the powder is economized, and all danger to the galleries from the explosion avoided, whilst the object of the mines, which is to destroy the enemy's works, can be as fully attained by small mines as large ones. The galleries should not be placed nearer to each other than twice the line of least resistance of the heaviest charged mines, and not much less than four times the line of least resistance of the smallest charges. This arrangement will readily admit of a combination of mines in two tiers, the line of least resistance of the lower being at least double that of the upper, the chambers of which may be so arranged that the explosions of one tier shall not affect either the galleries or the mines of the other. Twice the line of least resistance of the largest mines is the least distance that can be allowed between the galleries, in order that the mines of the lowest tier, which, being placed near one gallery to destroy a part of it, shall not injure those parallel to it. By placing the galleries at this least distance apart, the branches for the service of the upper tier will be as short as possible, effecting thus a saving of time and labor; and for the same reason, the galleries on any one point being as many as can be placed, there will be less chance of all being destroyed by an explosion, but that some one of the galleries will be found serviceable. The galleries and branches for the service of the different groups of mines should be independent of each other, so that there may be no confusion in the service, and that no group may be rendered unserviceable by the destruction of the communications to another. The same principle should be attended to in combining the different groups of mine chambers. The galleries and branches should never present their flanks or sides to the globes of compression of the besiegers. This rule leads to the rejection of enveloping galleries. See *Blower*, *Countermines*, *Firing-battery*, *Gallery*, and *Shaft*.

MINIE BALL.—A ball or bullet of peculiar construction. It is cast hollow for nearly two-thirds of its length, and into the opening of the internal cylinder there is introduced a small concave piece of iron, which the powder at the moment of firing forces into the slug, spreading it open, and causing it to fit perfectly to the barrel. Hence, a great increase in the precision of aim and the extent of range. See *Bullet*.

MINIE RIFLE.—A rifle introduced some years ago and adapted for firing the Minie bullet, the peculiarity of which bullet was that it had an iron cup placed in a cavity at the base, which, on the rifle being fired, expanded the lead into the grooves of the barrel. In 1851 a rifle musket of the Minie pattern was supplied to the English Army, but only to a limited extent; it was used in the Crimea, at the battles of the Alma and Inkerman. Notwithstanding its many advantages, it was found to be defective in practice, and was superseded by the Enfield rifle in 1853.

MINION.—An ancient form of ordnance of small size, the caliber of which was about three inches.

MINISTER.—I. Functionary Diplomatic. By the American system Ministers to exercise diplomatic functions near Foreign Courts are appointed by the President and confirmed by the Senate of the United States. They are accredited by letter to the Sovereign of the country to which they are appointed, and are permitted certain immunities and privileges, being entitled to be addressed as "Excellency," and conceded exemption from the operation of municipal law. The United States send no Envoys of the rank of Embassadors, permanently accredited to Foreign Courts; but have not infrequently conferred the rank and authority in the case of special missions. II, Functionary Executive, In the United States Government, the executive officers are under the immediate official direction and control of Heads of Departments, including those of State, Treasury, Interior, War, Post-Office, Navy, Justice, and Agriculture. Seven of these Officials have seats in the Cabinet or Council of Advisers of the President, and are termed "The Cabinet." They are the Secretaries of State, War, the Treasury, the Navy, and the Interior; the Postmaster-General, and the Attorney-General, or the Head of the Department of Justice. These Officials are appointed by the President, and confirmed by the Senate; their duty is to administer or execute the functions of their respective offices under the direction of the President; to whom they are immediately responsible and to whom they report annually; and from time to time on special subjects if so desired by him. They hold their offices at the will of the President, who may request their resignations if the good of the public service shall seem to require it. As an Advisory Council, they assemble at the call of the President, or at stated times, for conference, to enunciate opinions or to answer questions. There is nothing, however, in the Constitution or elsewhere in American law which renders it obligatory on the President to employ them in this manner, though custom has made it usual and convenient so to do. Excepting to the President for the proper performance of their official duties, they have no responsibilities; and in no particular except in the nature of these duties do they resemble the Ministers of Great Britain or those of the European Powers

MINOR BARONS.—The word baron, in the earliest period of Feudalism, signified one who held lands of a superior by military tenure. The superior might be the Sovereign, or he might be an Earl or other eminent person, who held of the Sovereign. According as he was the one or the other, the Baron was, in the earliest sense of the distinction, a Greater or Lesser Baron. At the Conquest a large part of the soil of England was parceled by William the Norman among his military retainers, who were bound in return to perform services, to do homage, and to assist in administering justice, and in transacting the other business done in the Court of the King. 400 of these Tenants-in-Chief of the Crown are enumerated in Domesday, including among them "Vice-comites" and "comites", who together constituted the body of men called the Barons of England. As the Sovereign was entitled to demand from the Baron's military service, homage, and attendance in the Courts, so, many of the principal Barons, particularly, such of them as were Earls, had Military Tenants, from whom they in turn received homage and assistance in administering justice in their Baronial Courts. These Tenants were Barons of the Barons, or, in the earliest sense, Minor Barons; but by the usage of England, from the Conquest downwards, they were seldom called Barons, that term having been generally restricted to the former class, the holders of land direct from the Crown, who were next to the King in dignity, formed his army and his legislative assembly, and obtained the great Charter from King John. The subinfeudation which produced the Minor Barons was checked by a statute of Edward I., directing that all persons acquiring lands from a subject, should hold not of that subject, but of his superior.

MINUTE GUNS. Guns fired on the interment of an officer of rank, or of some high personage of the realm. The officer to whom these honors are paid must have been above the rank of Colonel in the Army, or of Commodore in the Navy, and have died on service. Minute guns are also fired as signals of distress.

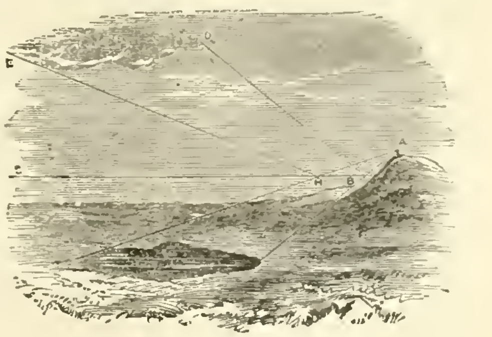
MINUTE MAN.—A man enlisted for service wherever required, and ready to march at a moment's notice. The term was first used in the American Revolution.

MINUTES.—A brief or rough report of the proceedings of a Society or Council drawn up by the Secretary or Recorder. They are so called from being taken down shortly, and in *minute* or small writing, to be afterwards engrossed.

MINUTES OF COUNCILS IN THE MILITARY DEPARTMENT.—The notification of orders and regulations, which are directed to be observed by the British Army in India. These minutes receive the sanction of the Governor-General in Council, and are the results of previous communications from the Court of Directors in Europe. The answer to the French word, *Resultat*, which was prefixed to all orders and regulations that were occasionally issued by the Military Boards, or *Conseils de Guerre*, for the government of the Army. The term, *Jugement d'un Conseil de Guerre*, corresponded with minutes of a General or Garrison Court-Martial, and expressed not only the minutes, but the sentence of the Court.

MIQUELETTI.—A small body of mountain fusiliers, who formerly belonged to the Neapolitan Army. The term *Miquelets* is applied to Bandits, who have infested the Pyrenean Mountains; the name is also borne by the Captain-General's Guard. In 1808, Napoleon organized a corps of *Miquelets Francais*, who rendered good services.

MIRAGE.—A phenomenon extremely common in certain localities, and as simple in its origin as astonishing in its effects. Under it are classed the appearance of distant objects as double, or as if suspended in the air erect or inverted, etc. One cause of the mirage is a diminution of the density of the air near the surface of the earth, produced by the transmission of heat from the earth, or in some other way; the denser stratum being thus placed *above*, instead of, as is usually the case, *below* the rarer. Now, rays of light from a distant object situated in the denser medium (i. e., a little above the earth's level), coming in a direction nearly parallel to the earth's surface, meet the rarer medium at a very obtuse angle, and instead of passing into it, are reflected back to the dense medium, the common surface of the two media acting as a mirror. Suppose, then, a spectator to be situated on an eminence, and looking at an object situated like himself in the denser stratum of air, he will see the object by means of directly transmitted rays; but besides this, rays from the object will be reflected from the upper surface of the rarer stratum of air beneath to his eye. The image produced by the reflected rays will appear inverted, and below the real object, just as an image reflected in water appears when observed from a distance. If the object is a cloud or portion of sky, it will appear by the reflected rays as lying on the surface of the earth, and bearing a strong resemblance to a sheet of water; also, as the reflecting surface is irregular, and constantly varies its position, owing to the constant communication of heat to the upper stratum, the reflected image will be constantly varying, and will present the appearance of a water surface ruffled by the wind. This form of mirage, which even experienced travelers have found to be completely deceptive, is of common occurrence in the arid deserts of lower Egypt, Persia, Tartary, etc.



In particular states of the atmosphere, reflection of a portion only of the rays takes place at the surface of the dense medium, and thus double images are formed, one by reflection, and the other by refraction—the first inverted, and the second erect. The phenomena of mirage are frequently much more strange and complicated, the images being often much distorted and magnified, and in some instances occurring at a considerable distance from the object, as in the case of a tower or church seen over the sea, or a vessel over dry land, etc. The particular form of mirage known as *looming* is very frequently observed at sea, and consists in an excessive apparent elevation of the object. A most remarkable case of this sort occurred on July 26, 1798, at Hastings. From this place the French coast is fifty miles distant; yet, from the sea-side the whole coast of France, from Calais to near Dieppe, was distinctly visible, and continued so for three hours. In the Artic regions it is no uncommon occurrence for whale-fishers to discover the proximity of other ships by means of thier images seen elevated in the air, though the ships themselves may be below the horizon. Generally, when the ship is above the horizon, only one image, and that inverted, is found; but when it is wholly, or in great part below the horizon, double images, one erect and the other inverted, are frequently seen. The faithfulness and distinctness of these images at times may be imagined from the fact, that Captain Scoresby, while cruising off the coast of Greenland in 1822, discovered the propinquity of his father's ship from its inverted image in the sky. Another remarkable instance of mirage occurred in May, 1854, when, from the deck of H. M. screw-steamer Archer, then cruising of Oesel, in the Baltic, the whole English fleet of nineteen sail, then nearly thirty miles distant, was seen as if suspended in the air upside down. Besides such phenomena as these the celebrated *Fata Morgana* of the Straits of Messina sinks into insignificance. The *Specter of the Brocken* in Hanover, is another celebrated instance of mirage. Its varieties are indeed numberless, and we refer those who wish for further information to Brewster's *Optics*, Biot's *Traite de Physique*, and for the mathematical theory of the mirage to the works of Biot, Monge, and Wollaston.

MIRE.—In the French artillery, a piece of wood about 4 inches thick, 1 foot high, and 2½ feet long, which is used in pointing cannon.

MIREUR.—An instrument employed in coast batteries for ascertaining whether the enemy's ships are within the range of the guns, and thus to prevent the gunners from expending their shot unnecessarily.

MIRMILLONES.—A variety of Roman gladiators, said to have been so called from their having the image of a fish on their helmets. Their arms were like those of the Gauls; hence we find that they were also called Galli. They were usually matched with the Retiarii.

MIRROR.—An instrument used in the inspection of cannon. The interior of the bore is examined by reflecting the rays of the sun into it from the mirror or mirrors; or, if the sun is obscured, and there can be no delay, by means of a spirit-lamp or of a wax taper on the end of a rod, taking care not to smoke the surface of the bore. See *Inspection of Ordnance*.

MISBEHAVIOR BEFORE THE ENEMY.—The Articles of War declare that any officer or soldier who misbehaves himself before the enemy, runs away, or shamefully abandons any fort, post, or a guard which he is commanded to defend, or speaks words inducing others to do the like, or casts away his arms or ammunition, or quits his post or colors to plunder or pillage, shall suffer death, or such other punishment as a Court-Martial may direct.

MISCELLANEOUS.—An item or charge in the Estimates of the British Army, and so distinguished as *Miscellaneous Services;* the same as our *Contingent Expenditures.*

MISCONDUCT AT DIVINE SERVICE.—In the Articles of War, it is earnestly recommended to all Officers and Soldiers diligently to attend divine service. Any officer who behaves indecently or irreverently at any place of divine worship is brought before a General Court-Martial, there to be publicly and severely reprimanded by the President thereof. Any soldier who so offends, for his first offense, forfeits one-sixth of a dollar; for each further offense he forfeits a like sum, and is confined twenty-four hours. The money so forfeited is deducted from his next pay, and is applied, by the Captain or Senior Officer of his troop, battery, or company, to the use of the sick soldiers of the same.

MISCONDUCT IN TIME OF WAR.—All Officers and Soldiers are to behave themselves orderly in quarters and on the march; and whoever commits any waste or spoil, either in walks or trees, parks, warrens, fish-ponds, houses, gardens, grain-fields, inclosures, or meadows, or maliciously destroys any property whatsoever belonging to inhabitants of the United States (unless by order of a General Officer commanding a separate army in the field), shall, besides such penalties as he may be liable to by law, be punished as a Court-Martial may direct.

In time of war, insurrection, or rebellion, larceny, robbery, burglary, arson, mayhem, manslaughter, murder, assault and battery with an intent to kill, wounding, by shooting or stabbing, with an intent to commit murder, rape, or assault and battery with and intent to commit rape, shall be punishable by the sentence of a General Court-Martial, when committed by persons in the military service of the United States, and the punishment in any such case shall not be less than the punishment provided, for the like offense, by the laws of the State, Territory, or District in which such offense may have been committed.

MISERICORDE.—A very short sword, in early times, attached to the right side, corresponding with the position of the regular sword on the left side. This weapon is so called because it was habitually used to stab the fallen and vanquished foe, when in such extremity either that mercy would be sought, or that it would be a merciful deed to put an end to the sufferer's agonies.

MISNOMER.—The mistaking of the true name of a person. If any prisoner plead a *misnomer* before a Court-Martial, the Court may ask the prisoner his real name, and call upon him to plead to the amended charge.

MISSILE.—A weapon thrown, or intended to be thrown, for doing execution; as, a lance, an arrow, or a bullet.

MITER.—The miter, as an ornament, seems to have descended in the earliest times from Bishop to Bishop. Among the Cottonian MSS. is an order dated July 1, 4 Henry VI., for the delivery to Archbishop Chichely of the miter which had been worn by his predecessor. It was in some cases a very costly ornament. Archbishop Pecheham's new miter, in 1288, cost £173 4s. 1d. In England, since the Reformation, the miter is no longer a part of the Episcopal costume, but it is placed over the shield of an Archbishop or Bishop, instead of a crest. The miter of a Bishop has its lower rim surrounded with a fillet of gold; but the Archbishops of Canterbury and York are in the practice of encircling theirs with a ducal coronet, a usage of late date and doubtful propriety. The Bishop of Durham surrounds his miter with an Earl's coronet, in consequence of being titular count palatine of Durham and Earl of Sedburgh. Before the custom was introducod of Bishops impaling the insignia of their sees with their family arms, they sometimes differenced their paternal coat by the addition of a miter. Miters are rare as a charge in Heraldry, but are sometimes borne as a crest, particularly in Germany, to indicate that the bearers were feudatories, or dependencies of ancient Abbeys.

MITFORD PERCUSSION BULLET.—An ordinary Enfield bullet, having a chamber, down its longer axis, to within ⅛ inch of the hollow; this chamber contains 4½ grains of detonating composition; and the bottom is closed with wax. It is intended to explode ammunition wagons.

MITIGATE.—To diminish the severity of punishment. Every officer who is authorized to order a General Court-Martial has power to pardon or mitigate any punishment adjudged by it, except the punishment of death or of dismissal of an officer. Every officer commanding a regiment or garrison in which a Regimental or Garrison Court-Martial may be held, has power to pardon or mitigate any punishment which such Court may adjudge.

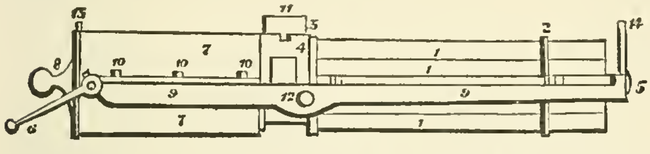
MITRAILLE.—Small pieces of old iron, such as heads of nails, etc., with which pieces of ordnance are sometimes loaded.

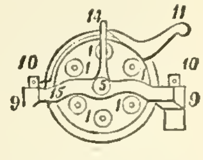
MITRAILLEUR.—A machine-gun in which numerous large bored rifles are combined with breech action, by means of which a shower of bullets may be rapidly projected by one man. It was invented in Belgium, and adopted by the French Emperor soon after the Prussian-Austrian war of 1866. It was the chief cannon of the French artillery during the Franco-German war of 1870. The mitrailleuse existed in a primitive form as early as the 14th century, and well-preserved specimens may be found in the arsenals and museums of Vienna, Rome, Berlin, Moscow and Constantinople. A late form of the weapon, used by the French, has 37 barrels, and ammunition chests alongside the gun on the same axle. The 37 cartridges, intended for the charge, are contained in a small box. A steel plate with corresponding holes is placed on the open box, which is then reversed, and the cartridges fall, points foremost into their respective holes. They are prevented from falling through by the rims at their bases. The loaded plate is then introduced into the breech-slot, and when the breech is closed by a lever, a number of steel pins, pressed by spiral springs, are only prevented from striking the percussion arrangement in the cartridges by a plate in front of them. When this case is moved slowly by a handle, the cartridges are fired one by one. If the plate be withdrawn rapidly, they follow each other so quickly that their discharge is almost simultaneous. The projectile weighs 37 grammes, or a little over an ounce. The charge of powder is from 6 to 8 grammes. The last amount is that counseled by the inventors. This mitrailleur weighs 180 kilogrammes, or 400 pounds without the carriage, and it can be worked by two men. It was found, however, at Vienna, in December 1869, that to obtain the most rapid firing, or 48 balls per minute, five men were necessary to work the piece. The front carriage contains from 48 to 56 boxes for loading, and the two caissons hold 16 breech-plates furnished with cartridges. The piece is, therefore, provided with 2368 cartridges; and a battery of 8 mitrailleurs can hurl on an attacking column 3848 effective projectiles per minute.

The description and nomenclature of the one-inch mitrailleur (Gatlin Gun), a piece much used in the United States Army, is as follows: The breech loading rifled *barrels* (1) are fastened together by a *front barrel-plate* (2) and a *rear barrel-plate* (3). The *carrier-block* (4),a hollow cylinder which carries the cartridges, is directly behind the barrels. The *lock-cylinder*, another cylinder behind the carrier-block, contains the *locks* (one to each barrel). The barrels, carrier-block, and lock-cylinder, revolve around a common axis called the *mainshaft* (5), which is turn by the *hand-crank* (6). The lock-cylinder revolves within a *breech-casing* (7), forming the body of the gun and closed in rear by the *cascabel plate* (8) The breech-casing is fastened to the *frame* (9) by the *casing-screws* (10). The cartridges are inserted in the *hopper* (11), and pass successively into the *channels* of the carrier-block, whence they are thrust into the barrels by the *lock-tubes* or *plungers*, and held there until exploded by the *firing-pins*. The *cartridge-shell stop* is attached to the hopper. The other parts are the *trunnions* (12); *rear-sight* (13); *front-sight* (14); *face* (15); *socket*, for head of elevating-screw; *socket guide-plate* and *screw*; *locking-block* for locking bolt; *plug* for removing locks; *traversing-screw*; *regulating nut*, on traversing-screw; *thumb-spring* for regulating nut; *crank-stop*; *hinges*; *hopper-spindle*; *hopper-grooves*; *hopper-spring*. See the drawing below The following parts are within the breech-casing *lock-cylinder*; *rear-guide nut*; *cocking-ring*; *cocking knob*; *cocking-device*; *cocking-ring clamps*; *spiral cam*; *diaphragm*; *diaphragm-plug*; *gear-wheel*; *pinion*; *rear cam screw*; *crank-shaft*; *worm*; *worm-gear*. Each lock consists of a *lock-butt*, *lock-tube* or *plunger*, *lock-hammer*, *lock-spring*, *firing-pin*, and *extractor*.

To take the mitrailleur apart Block up frame and barrels; take off hopper; take off cascabel plate; take pin out of pinion, turn crank downward, and then remove crank-shaft; take out rear-sight, and then remove large gear-wheel; take out rear plug in diaphragm, and gently revolve the piece until a lock presents itself on a line with the hole in the diaphragm, through which the locks are successively removed; take out large screws on sides of breech-casing, and remove casing to the rear. Be careful to have the lock-cylinder and piece supported so as to keep the center-line of main-shaft parallel to top of frame; this is necessary to prevent the inner breech or rear of the piece from dropping when the casing is removed. The large rear nut, on the shaft in rear of the lock-cylinder, and which serves as a guide for the rear-ends of the locks, is made fast by a tapered pin and a *left-handed screw*; to remove this nut, the pin is taken out and the *nut turned to the right*. The lock-cylinder and carrier-block are then taken off. The spiral cam need not come out of the casing in taking the mitrailleur apart.

To put the mitrailleur together—Put main-shaft in place, through the plates which hold the barrels, and then replace carrier-block, lock-cylinder, and large rear nut; screw up this nut tightly,and put tapered pin through the nut and shaft; place the mitrailleur in the frame, and let front end of main shaft rest in the hole designed for it, in the front of frame; take care to keep the center of main-shaft in the plane of top of frame. When the piece is in this position, push the cocking-ring over the lock-cylinder and let it hang loosely round the carrier-block; raise the breech slightly, and push the breech-casing over the lock-cylinder, etc., to its place; screw casing to frame and put cocking-ring in its proper place: revolve the piece to the right or left, so that the places for the locks will come on a line with the hole in the diaphragm, through which the locks are successively inserted and placed in a proper position; then insert screw-plug to close the hole through diaphragm; put on cog-wheel; replace crank-shaft, pinion, and tapered pin; then put on rear-sight, and screw on butt-plate and hopper.





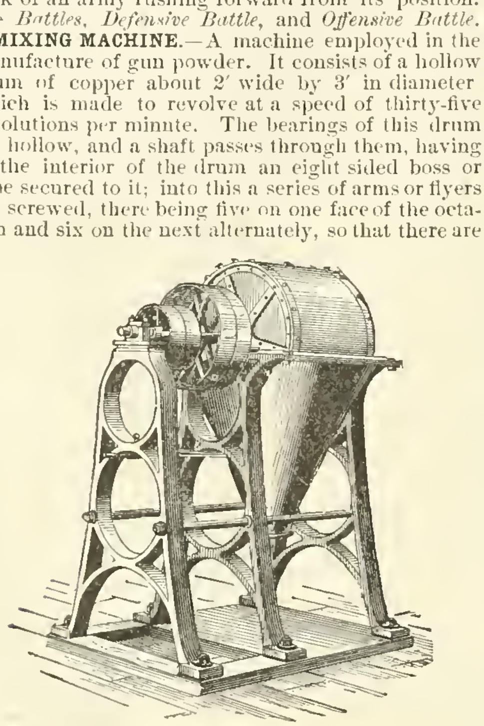
The following is the nomenciature of the gun-carriage for the mitrailleur: *Stock*; *head*; *groove*; *trail*; *rounding of trail*; *trail-plate*; *lunette*; *pointing-ring*; *pointing-socket*; *trail-handles*; *wheel-guard plate*; *elevating-screw*; *elevating-screw box*; *elevating-screw bed*; *rondelles*; *cheeks*; *washer-hooks* for handspike; *under-straps*; *handspike-rings*; *cap-squares*; *cap-square chains*; *key-chains and keys*; *trunnion-beds*; *trunnion swivel*; *trunnion-swivel friction-bed*; *frame for traversing-apparatus* or *traversing-arm*; *traversing-fork*; *traversing-fork spring*; (spiral); *traversing-fork handle*; *traversing-fork clamp-screw*; *traversing-fork case*, with slot for handle; *locking-bolt* connected with traversing-fork by a *locking-lever*; *locking-bolt case*; *stock-seat*, with *hinge* and *prop*; *drag-hooks*; *elevating-screw nut*; *elevating-nut handle*; *elevating-clamp screw*; *rod-case* and *keys*; *axle*; *wheels*. See *Gatling Gun*, *Machine-gun*, and *Piece*.

MITTEN.—A hand-covering which superseded the gauntlet in the 15th century. It was made of thin plates of steel, with joints, to enable the hand to move freely. It is of this mitten that Bayard says,—"Ce que gantelet gagne, gorgerin le mange."

MITTLERER.—One of the three parts of which the enciente is formed, in the German system of fortification.

MIXED BATTLE.—A combination of defensive and offensive battles. The most common case of this class is that in which a position is selected before hand where the army awaits the attack of the enemy, and at a suitable moment moves from it and attacks the assaulting columns. This case is sometimes known as a "defensive-offensive" battle. Where the ground is favorable and the troops are in good condition, these battles offer peculiar advantages, since the assaulting columns, being exhausted by their first efforts are not in the best condition to repel the attack of an army rushing forward from its position. See *Battles*, *Defensive Battle*, and *Offensive Battle*.

MIXING MACHINE.—A machine employed in the manufacture of gun powder. It consists of a hollow drum of copper about 2′ wide by 3′ in diameter which is made to revolve at a speed of thirty-five revolutions per minute. The bearings of this drum are hollow, and a shaft passes through them, having in the interior of the drum an eight sided boss or tube secured to it; into this a series of arms or flyers are screwed, there being five on one face of the octagon and six on the next alternately, so that there are



forty-four flyers altogether. They are made of a flat section, but forked at the ends, and provided with holes through their flat sides, and each one is set at a different angle to the next: their points just clear the inside of the drum, and they revolve in the opposite direction to it at the rate of seventy revolutions per minute. The three bags of ingredients (50 lb. in all) are emptied one at a time through a door into the copper drum, and after the machine has been five minutes at work they will be found to be thoroughly mixed. The door in the drum is now opened, and the composition falls down a shoot into a tub, and after being spread out, is carefully examined, and then placed in the receiving bags. When the bags are filled, they are tightly tied up, and it is very essential that this operation be carefully performed, for should the composition be allowed to remain loose in the bags (the ingredients having very different specific gravities), the saltpeter would fall to the bottom, the charcoal rise to the top, and the sulphur occupy the center, thereby undoing the mixing; and as any vibration caused by the working of adjacent machinery would be much against the composition retaining the thorough mixture given to it by the machine, the bags are put into small magazines separate from all buildings containing machinery, and there laid on their sides, so that the weight of the saltpeter may affect the mixture as little as possible. The composition is now ready for the next operation, and this is performed in the incorporating mill. See *Gunpowder*.

MOAT.—The ditch round the ramparts of a fortress, may be either wet—i. e., full of water—or dry. In the latter, which is the commoner case, the depth should not be less than 12 feet nor the width under 24. The more perpendicular the walls, so much the greater will be the obstruction to the enemy. In regular works the walls are usually revêted with masonry, that at the foot of the rampart being the scarp or escarp, and that below the covered way the counterscarp. See *Ditch* and *Fortification*.

MOBILISATION—MOBILIZATION.—The act of preparing troops for war. The process consists in augmenting a regiment from its peace to its war complement, in calling in men on furlough, in organizing the staff of divisions and brigades, constituting the commissariat, medical, artillery, and transport services, and in accumulating provisions and munitions. As the work of mobilizing an army causes great and inevitable expense, it is only resorted to when hostilities appear imminent. The rapidity with which armies can be mobilized has been of late years great. In 1859, it took thirty-seven days for France to collect on the river Po, a force of 104,000 men, with 12,000 more in Italy. In 1866, the Prussian armies (220,000 in number) were placed on the Frontiers of Saxony and Silesia in a fortnight; and in 1870, Germany was able to mobilize her forces in nine days, and to send in eight days more to the French frontier an army of 400,000 soldiers and 1200 guns. The mobilization of the British army has been provided for under orders issued by the War Office and Horse Guards. By this scheme, which is not only based upon defensive requirements, but also adapted for offensive warfare as well, 300,000 men will be available within a few days for the defense of the country, and if necessary, a certain portion of the force can be embarked for a war in foreign countries.

MOBILITY.—Lightness, facility in moving. In warfare it is of the highest importance that the artillery and transport of the army should be as light and movable as is consistent with efficiency. Not only does this term apply to the particular branches above adverted to, but mobility expresses also the facility and rapidity with which an army can traverse a country, when called upon to do battle with the enemy, which, combined with concentration of force, is likely to bring matters to a successful issue.

MODEL.—A pattern or imitation of anything on a small scale, in wood, stone, wax, or any other convenient substance. Models are not only made for the reduction in size of articles of all sorts, and for possession of fac-similes of all such works as are either too large to be moved or too expensive to be bought, but they are valuable in a military point of view in giving, in a handy and instructive form, the elevation of ground sketched out in topographical maps, and which is also applicable to fortifications, etc. Under the name of *model* an apparatus has been lately invented by Captain E. Padmore Clark (Instructor of Musketry, Herefordshire Militia), for the purpose of instructing officers and men in the cavalry and infantry drill. The infantry model consists of a miniature regiment of infantry, in metal, and is so formed that the ranks can be simultaneously turned in any direction, and the position of officers and markers is clearly defined. This apparatus, which is called "Drill Model Apparatus," consists of a battalion of six companies, with mounted and other officers, color-party, band, and pioneers, complete. Two of the companies are divisible into half-companies, for the purpose of showing the movement of the side-face companies in the formation of a two-deep square in a battalion of *four* companies. There are six small stands to attach to the right or left, or the center, of each company, for the leading guide in formations of fours to a flank, or for the right guide in retiring in line. This apparatus will, doubtless, prove very useful in imparting to young officers practical knowledge in this important branch of their profession, and will assist them in clearly understanding the different movements which companies and battalions are called upon to perform on the drill-ground or in the field. The drill model for cavalry is similar, and represents a whole regiment, and the troops and squadrons are divisible on the plan of the infantry model.

MODULUS. A constant coefficient or multiplier, by means of which one series or system of quantities can be reduced to another similar series or system. Thus we have the modulus of elasticity, of friction, and of systems of logarithms. The system of logarithms which is universally accepted as the primary is Napier's, and from it all other systems are deduced in the following manner: Let N be a number of which the Napierian logarithm is b, e being the Napierian base, it is required to find the logarithm of N to some other base a. Let x be this logarithm, then, we will find

$$x = \frac{b}{\log._e a}; \text{ i. e., } \log._a N = \frac{\log._e N}{\log._e a} = \frac{1}{\log._e a} \times \log._e N.$$

This multiplier or "modulus," $\frac{1}{\log._e a}$, is independent of N, and is therefore constant for the reduction of all Napierian logarithms to the system whose base is a. If $a=10$, the multiplier becomes $\frac{1}{\log._e 10}$, the modulus of Briggs', or the common system of logarithms, and is equal to $\frac{1}{2.30258509} = .4342944\ldots$

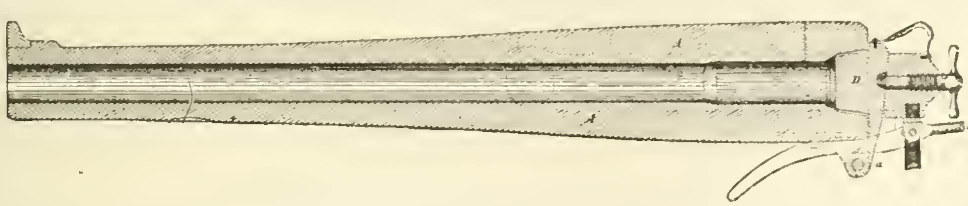
MOENCHS BUCHSE.—A small hand-cannon 11 inches long and 4¾ inches in diameter. It preceded the invention of the wheel-lock, and gave the first idea of it.

MOFFATT GUN.—A breech-loading rifled field-gun. The body A is of steel, and bored through from end to end. The breech-mechanism consists of a conical breech-plug, accurately fitted to the bottom of the bore, and efficiently closing the same through the support afforded by the breech-strap. This strap is attached to the trunnions as an axis of motion, but is enabled to withstand the strain of discharge by locking into lugs on either side of the breech of the gun. The breech-strap rests in rear upon the top of the elevating-screw, to which it is attached by a suitable coupling, to admit of the free movement of the screw. The breech-block is hinged in a fork attached to the under side of the breech. The operation of the mechanism is as follows: The breech is opened by tilting up the breech of the gun, through the medium of a lever E, which has its axis in a stirrup underneath the breech-strap. By this operation the block is raised out of the breech-strap, and falls back by its own weight upon the latter, thus exposing the chamber. To close the breech again the lever is raised, and the gun, owing to its preponderance, falls back into the position for firing; the wedge-shaped back of the breech-block, at the same time, enters a correspondingly beveled recess in the breech-strap, and draws the latter firmly against the lugs, the loops of the strap over the trunnions admitting of a slight play for that purpose.

In the preliminary firings had with the gun, to test the working of the parts, the breech was thrown open by the shock of discharge, closing again during the recoil. To obviate this a locking device was added, consisting of a bolt and key, passing through the breech-strap and into a recess in the breech-block. A half-turn of the handle is sufficient to press the block firmly down into place, and there retain it. A half-turn in a contrary direction disengages the key from the recess in the block, and the breech can be thrown open. Should the breech-block not always fall back on tilting up the breech, a leather strap is provided, which pulls back the block after the breech has been sufficiently raised to disengage it from the strap. The trunnions are screwed into the gun-body, and are furnished with shoulders, by which the loops of the breech-straps are confined to the rimbases.

The rifling of the gun consists of twelve grooves and lands each, the width of the lands being 0″.25, and the depth of the grooves 0″.05. The twist is uniform, and makes one turn in 12 feet. The chamber is concentric with the bore, but of larger diameter, measuring 3″.19, the diameter of the bore through grooves being but 3″.17. Its capacity is such as to accommodate a charge of 1¼ pounds of powder and a lead-coated or a double-bearing Butler projectile of about 10 pounds weight, the projectile being inserted in the rifled portion of the bore as far as the front rib or band. The vent is in the normal position on top of the gun. When the gun was originally finished it was provided with a cup-shaped gas-check of copper; but having failed to give satisfaction under heavy charges, a number of Broadwell rings, of steel, brass, and composition, were tried, several of which gave excellent results. The use of a loose internal Rodman pressure-gauge being precluded in a small breech-loader, and it not being wished to mar the gun by boring for the external gauge, the inner face of the breech-block was bored and tapped for the reception of an interior plug.

The gun-body was manufactured by Messrs. Firth & Sons, Sheffield, England, of the best quality of crucible cast-steel, and forged from a single ingot. As received at the South Boston foundry, it was rough-bored and turned. The steel for the breech-block, strap, etc., were forgings from the Nashua Works, New Hampshire. The final work of fitting, finishing, and assembling, was accomplished at the South Boston foundry, under the supervision of the Inventor.



The following are the dimensions of its principal parts, to wit:

Diameter of bore across lands	3.07 inches
Diameter of bore through grooves	3.17 inches
Diameter of chamber	3.19 inches
Diameter of breech-block cavity at seat of gas-check	3.90 inches
Diameter of breech-block cavity, outer edge	5.23 inches
Diameter of piece at muzzle	5.90 inches
Diameter of piece at trunnions	8.00 inches
Diameter of breech	9.57 inches
Diameter of trunnions	3.67 inches
Length of rifle portion of bore	55.00 inches

Length of beveled junction of chamber and bore	1.00 inches
Length of chamber	9.50 inches
Total length of gun	72.65 inches
Pitch of rifling uniform; one turn in	144.00 inches
Number of grooves and lands	12
Width of lands	0.25 inch.
Weight of gun	1,000 lbs,
Weight of gun-carriage without implements	900 lbs.

The preponderance of the gun at the elevating-screw is such as to render the gun easily operated. The gun is mounted on a United States 6-pounder carriage; the only modifications required being to change the housing for the elevating-screw, and to slightly increase the space between the cheek-pieces. See *Rifled Howitzers*, and *Ordnance*.

MOGRABIAN.—A soldier of a branch of the Turkish infantry composed of the peasants of the northern part of Africa, who sought to better their condition by entering foreign service.

MOGUL.- The popular designation of the Emperor of Delhi, as the impersonation of the powerful Empire established in Hindustan by the Mongols, who were called *Moguls* by the Persians. The first Great Mogul was Baber, the great-grandson of Timur, who founded the Mongol Empire in Hindustan in 1526. In 1803 the Great Mogul was deprived of his throne; in 1827, of even the appearance of authority, becoming a mere pensioner of the British; and in 1858, Mohammed Bahadur, the last of the Dynasty, was condemned, and transported for complicity in the Indian Mutiny.

MOIENNE.-A piece of ordnance, which is now called a 4-pounder, and which is ten feet long. It was formerly used by the French.

MOINEAU.—A small, flat bastion, raised in front of an indented fortification, to defend it against attacks from small-arms.

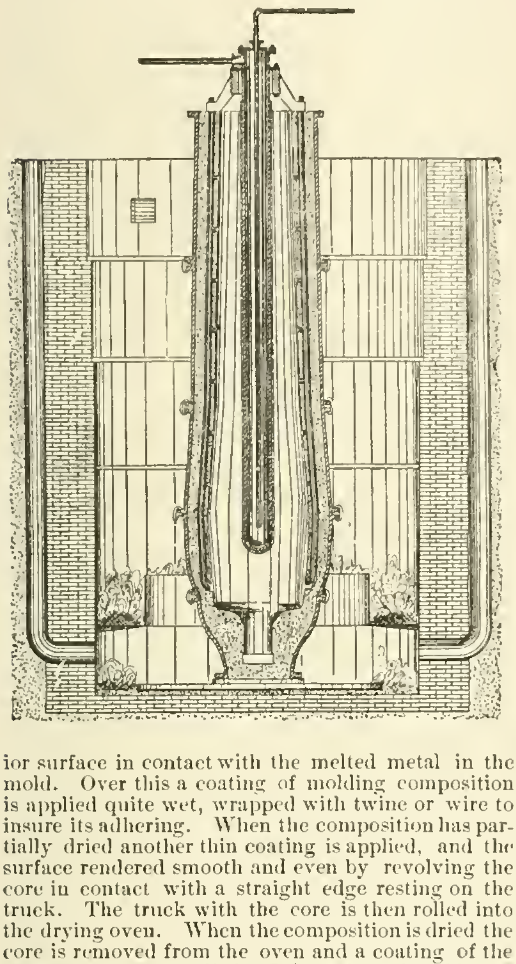
MOLDED POWDER.—A powder having the same ingredients as those of ordinary gunpowder, but each grain is separately molded. Gen. Rodman was the first to propose this variety of powder; the object being to cause the powder to burn on an increasing surface, thus lessening the strain on the gun in the first moments of combustion. See *Gunpowder*.

MOLDING.—The process by which a cavity of the form of the gun is obtained by imbedding a model in sand and then withdrawing it. The model of a gun, technically termed the *pattern*, is usually constructed of wood made in as many sections and parts as may be necessary to admit of its being easily withdrawn from the mold. The sections of the pattern for the breech and reinforce are made with diameters exceeding very slightly those of the finished gun, while the diameters of the sections for the chase are largely in excess. The breech section is provided with a cascabel for supporting the gun in the lathe while being turned and bored. The patterns of the trunnions are attached in their places by wooden pins, which can be easily withdrawn when it becomes necessary to detach the patterns. The several sections of the pattern for the body of the gun are made with a slight taper to facilitate their withdrawal. The pattern for the chase of the gun is made considerably longer than the required length of that part, to provide a "sinking-head" which, when the gun is cast, receives the scoria of the melted metal as it rises to the surface, and also furnishes the metal required to feed the shrinkage caused by the cooling of the casting. The *sand* used for the molding composition should be principally of silex, very refractory, commonly called sharp-sand. When not sufficiently refractory it is vitrified by the high temperature of the melted metal, and protuberances are formed upon the casting which are removed with great difficulty. To prepare the composition for use the sand is carefully sifted, then properly mixed and moistened with water in which clay has been stirred, or with the refuse of distillery wash called "returns." Great care is required in securing the proper degree of cohesiveness in the composition, as it must be sufficient to enable the mold to preserve its form in handling, and not so much as to cause it to be injured by contraction in drying. It is considered sufficiently cohesive when it will retain its form when taken in a moist state and squeezed in the hand. The same composition may be repeatedly used in molding, but as its cohesive property is destroyed by the heat to which it is exposed, it must be reprepared in the same manner as when first formed.

The mold is formed in a cast-iron case called a *flask*, which is usually made in sections corresponding in number and length to those of the pattern. These sections consist of two pieces which, when united, are circular in cross-section, excepting two slight enlargements opposite each other for the formation of the channels or "side gates" for the metal to pass down. The pieces are flanged at the edges, fastened by bolts, and additionally secured by clamps over the flanges. The trunnion sections of the flask are fitted with trunnion boxes which have movable plates at their ends for the purpose of introducing the trunnion patterns and facilitating the formation of that part of the mold. The several sections are so constructed as to be united to each other in their regular order by means of clamps over the flanges at the top and bottom. To form the mold the lower or breech section of the flask is placed upon an iron plate in an upright position, the corresponding section of the pattern introduced and centered: the space between the pattern and the flask filled with molding composition, which is rammed down in thin layers around the pattern until the section is completed. The patterns for the side gates and their branches for conveying the metal into the mold are introduced as the work progresses. After the mold for the lower section is finished the next section of the flask is placed upon it and secured, the corresponding section of the pattern introduced, fitted with dowels, which enter the breech section and hold it accurately in place. The molding is continued with this section as with the first, and when completed it is lifted off, the pattern being left in the mold. The third section of the flask, which is usually the trunnion section, is then placed upon the second and secured, and the pattern adjusted in the same way as before. The trunnion patterns are attached and the molding is continued. When this section is completed the pins attaching the trunnion patterns are removed and the patterns withdrawn. The formation of the remaining sections is continued until the whole is completed, thus insuring a perfect mold throughout, free from irregularities at the junction of the sections.

Care is taken to sprinkle dry sand upon the surface of each section of the mold before continuing the work to prevent adhesion and to admit of the sections being separated without injury. As the work upon the respective sections is finished the patterns are withdrawn. If any portions of the mold are injured in the withdrawal they are repaired. The several sections are placed in the drying oven, where a moderate heat is kept up, until thoroughly dried. They are then removed from the oven, and a wash, composed of German graphite, pulverized anthracite coal, and distillery returns, applied to the interior surface of the mold. The sections are replaced in the oven, and when dried removed, and a second coating of the wash applied while the mold is still warm. This wash is to produce a smooth, hard surface. It prevents the melted metal from mixing with the sand of the mold and forming protuberances on the surface of the casting.

The *core-barrel* or *arbor* consists of a water-tight cast-iron tube, made sufficiently thick to withstand the pressure of the metal in the mold. Its length and diameter are such as to leave a sufficient surplus of metal in the bore of the gun to secure a good finish. It is constructed with a slight taper to facilitate its withdrawal after the casting. The lower end is rounded off and is fitted with several iron pins for securing the extremity of the rope, which is used as wrapping material in the preparation of the core; the exterior of the barrel is fluted from top to bottom to allow the escape of the gases generated by its combustion. Before being used the core-barrel is always subjected to a powerful water pressure to test its soundnes. To prepare the core for casting, journals are fitted at its extremities. It is then placed in a horizontal position upon an iron truck, supported by the journals resting in bearings, and turned by a crank attached to one of the journals. It is first wrapped with white hemp rope so as to cover all of the exter-



ior surface in contact with the melted metal in the mold. Over this a coating of molding composition is applied quite wet, wrapped with twine or wire to insure its adhering. When the composition has partially dried another thin coating is applied, and the surface rendered smooth and even by revolving the core in contact with a straight edge resting on the truck. The truck with the core is then rolled into the drying oven. When the composition is dried the core is removed from the oven and a coating of the same wash again applied. It is again replaced in the oven until thoroughly dry, when it is removed and the journals taken out. The one at the bottom is replaced by a tight fitting screw-plug covered over with molding composition. The top is fitted with a water-tight cap so constructed as to receive the conducting-pipes for the water, and is ready for use.

The *pit* as usually constructed for the casting of guns on the Rodman plan, is cylindrical in form and is surrounded with a brick wall, built in offsets, affording supports for braces to steady the mold in position; grates are arranged around the circumference of the bottom for fires lighted immediately after the casting to retard the radiation of heat from the exterior of the mold. To retain the heat of the fires in the grates the month of the pit is covered with a close-fitting cover of boiler iron. For furnishing air to the fires, flues are made opening into the pit below the grates, while near the top another flue, making suitable connection with a chimney, produces the necessary draught. If the pit has been out of use for any very great length of time, it is thoroughly dried by fires in the grates before placing the molds in position. To prepare the pit to receive the mold, the bottom is covered with a layer of sand. A heavy cast-iron plate is then laid down and carefully leveled. Upon this section the breech section of the mold is placed in an upright position. The other sections are successively lowered and secured in their places, the whole being braced from the sides of the pit to keep it in a vertical position. The core is then lowered into the mold of the gun. To center and secure it in position, a cast-iron frame, usually termed a "spider," is employed. The spider consists of a heavy ring supported upon three legs, each having a projection at the bottom fitted with an adjustable screw resting upon the upper flange of the flask. The core passes through the ring of the spider, is secured to it by bolts through the flange at the top of the barrel, and held firmly, so that any movement of the spider will produce a change in the position of the core. To center the core, a long wooden rod is used, to the end of which a piece of board is fixed to hold a light. The length of this projecting board, previously determined, is the distance which the core should be, when in the center, from the mold at its maximum diameter. Having adjusted the core in the mold by means of the screws in the legs of the spider, it is firmly secured in its position by clamps made to fit under the flange at the top of the flask and over the projections at the end of the legs of the spider. The fuel for the fires in the pit is arranged on the grates in readiness to be kindled. See *Rodman Gun*.

MOLDING COMPOSITION.—The sand most used for this purpose is a kind of loam, which contains a sufficient quantity of clay to render it moderately cohesive when damp. Sand, possessing all the qualities required for molding, is seldom, if ever, found in a state of nature; but when the requisite qualities are known the materials may be selected, and an artificial composition produced without difficulty. The sand should be principally of silex, very refractory, and of the kind commonly called *sharp-sand*. When not sufficiently refractory, the sand is vitrified by the high temperature of the melted metal, and protuberances are found upon the casting which are not easily removed.

The method of preparing the molding-composition artificially, varies according to the kind of casting for which it is to be used. In preparing it for cannon, great care is taken to introduce the exact quantity of clay required. When too litle is used, the composition is not sufficiently adhesive; when too much is used, the mold is injured by contraction in drying. The sand is first carefutly sifted, then properly mixed and moistened with water in which clay has been stirred; the composition is considered sufficiently adhesive when it will retain its form after having been taken in a moist state and squeezed in the hand.

The same composition may be repeatedly used for molding, but as the adhesive property of the clay is destroyed by the heat to which it is exposed in casting, more clay must be added every time, in the same manner as when the composition is first formed. See *Molding*.

MOLLY MAGUIRES.—A secret Order which existed in 1854-77, and probably still exists, in the anthracite coal mining region of north-eastern Pennsylvania. Here 400 collieries employed 60,000 men: Americans, Germans, Welshmen, Englishmen, and Swedes comprising one-half the number, the remainder being Irish. Among the latter half originated, in the locality named, the Order of Molly Maguires, a branch of the "Ribbonmen" of Ireland. The Order, however, had a much wider existence, and is alleged to have been affiliated with the "Ancient Order of Hibernians," elsewhere a peaceable and reputable organization. Until 1865 and '66 the Order of Molly Maguires had not become generally known for the murders and other brutalities which then distinguished it. In 1875, having gained control of a combination which forced a general strike in the coal regions, it succeeded in obtaining an ascendency in the councils of the miners, and from that period was prominent in assassinations and other outrages, committed usually on the persons and against the property of Justices of the Peace, Police Officers, and Mining Bosses. The number of murders increased between 1869 and '71, and fell off after the latter year, and until that of the great strike of 1875. According to some of those who made an investigation into the antecedents of the Molly Maguires, they originated in the trade-unions, and not in the A. O. H. or among the Ribbonmen. None but Catholic Irishmen or their descendants were admitted to membership: the Order was organized in divisions, each having a chief official known as a "Body-Master"; and there were signs and passwords to enable members to distinguish each other. These signs and passwords were given to the members by the Body-Masters, who received them from the County Delegate, who got them from the State Delegate, to whom they were furnished by the National Delegate or National Board in New York City; to the latter they came quarterly from Ireland, by the hands of the Steward of one of the transatlantic steamships. A central and governing organization known as "The Board of Erin" was said to be the origination of the Order, and this held quarterly meetings in England, Scotland, or Ireland. So extended were the ramifications of this Order in Pennsylvania, that it was made known during the trials of the Molly Maguires in 1877 that one of their Body-Masters in the Pottsville district held the high office of County Commissioner. The final exposure, capture, and punishment of the Molly Maguires was largely due to the energy and determination of Franklin B. Gowen, President of the Philadelphia and Reading Railroad Company; through the immediate instrumentality of James McParlan, a detective, who joined the Molly Maguires, he became acquainted with their members and the secrets of organization, and was at length enabled to afford information which disclosed the names of criminals connected with a majority of the murders committed by the Order. A large number were apprehended, tried, and condemned, and their execution—that of a number of them occurring on the same day—so alarmed the members of the Order that it ceased to possess any extended influence.

MOMENT.—The moment of any physical agency is its importance with reference to some special application. Thus the moment of a force applied (perpendicularly) to a lever, is the importance of the force as regards turning the lever about its fulcrum. It is, as we know (see LEVER), proportional to the product of the force by the distance of its point of application from the fulcrum. The moment of a force about any axis (to which its direction is perpendicular) is the product of the force by its least distance from the axis; and a similar definition is laid down for moment of velocity and moment of momentum. It is easy to see (see MOMENTUM) that in any system of mutually acting bodies the moment of momentum about any axis remains constant, since the equal mutual forces measure the momentum transferred from one body to another, and the moments of these forces are in pairs equal and opposite. A particular case of this is Kepler's law, that each planet describes equal areas in equal times about the sun.

In the rotation of bodies round an axis, the moment of inertia is the sum of the products of each particle of the body into the square of its distance from the axis; or if M be the body, m_1, m_2, m_3, etc., the particles composing it, and r_1, r_2, r_3, etc., their corresponding distances from the axis, then the moment of inertia of $M = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 +$ etc., and if a quantity, K, be found such that $MK^2 = m_1 r_1^2 + m_2 r_2^2 + m_3 r_3^2 +$, etc. then K is called the *radius of gyration*. See *Center of Gyration*.

MOMENTUM.—Momentum may be defined as proportional to the mass moving, and its velocity, conjointly. If we assume unit of momentum to be that unit of mass moving with unit of velocity, we shall evidently have, for the momentum of a mass M, moving with velocity V, the expression MV. And such is the unit generally adopted. It is shown by experiment that, when force produces motion in any body, the momentum produced in one second is proportional to the force—and, in fact, *force is measured by the momentum it is capable of producing in unit of time.* Thus, the same force, if acting for one second on each of a number of bodies, produces in them velocities which are *inversely* as their masses. Also when, as in the case of falling bodies, the velocities produced in one second are the same in all, we conclude that the forces are *proportional* to the masses; and, in fact, this is the physical proof that the weight of a body is proportional to its mass. Again, if different forces act, each for a second, on the *same* mass, the velocities produced are proportional to the forces. All these are but different modes of statement of the experimental fact that force is proportional to the momentum it produces in unit of time; which forms a part of Newton's second law of motion. When two masses act on each other, Newton's third law of motion shows that the forces they mutually exert are equal and opposite. The momenta produced by these must therefore be equal and opposite. Thus in attraction or impact of two masses, *no momentum is lost;* since what is lost by one is gained by the other. The momentum of a system of bodies can be resolved (as velocity is resolved) into components in any assigned directions, and the mutual forces of the system may be thus likewise resolved. Applying the previous result, we see at once that in any system of mutually acting bodies (such, for instance, as the solar system), no momentum is, on the whole, either gained or lost in any particular direction; it is merely transferred from one part of the system to another. This fact, called the conservation of momentum, has caused great confusion in the minds of pseudo-physicists, who constantly confound it with conservation of work or energy, a totally different thing. The momentum produced by a force in any period of time is measured by the product of the force and the *time during which it has acted*—the energy or work done by a force is measured by the product of the force and the *space through which it has acted.* Momentum is proportional to the simple velocity of a body, and *can never, by any known process, be transformed into anything else.* Energy, when depending on velocity, is proportional to the *square* of the velocity, and is in the natural world *constantly being transformed from its actual or kinetic form to its potential form, and back again, or to some other kinetic form, such as heat, and finally must become heat.* Momentum, on the contrary, is never altered, either in kind or in amount. In *knocking down* a wall, or in staving in the whole side of a ship, the battering-ram of the ancients (when constructed of sufficient mass, and worked by the proper number of men or animals) was probably nearly as effective as the best modern artillery. But in making a *breach* in a wall, or in punching a hole in the armor of an iron-clad, mere massive shot with low velocities (such as those of the Dahlgren guns), are comparatively ineffective, however great their momentum; while an Armstrong or Whitworth projectile, with a fraction of the momentum, but with greater velocity, and, for its size, much greater kinetic energy, effects the object with ease. In many every-day phenomena, we see most distinctly the difference between these two affections of matter. Thus, a blow delivered from the shoulder by a *heavy* pugilist, even if it be sluggishly given, generally floors its man, without doing much other injury; but a sharp stroke administered by a light weight, while hardly disturbing the adversary's equilibrium, inflicts serious punishment.

MONARCHY.—That form of government in a community by which one person exercises the sovereign authority. It is only when the King, or Chief Magistrate of the community, possesses the entire ruling power that he is, in the proper acceptation of the term, a Monarch. Most of the Oriental Governments past and present, Russia at present, and Spain and France as they were in the last century, are in this strict sense Monarchies. The degenerate form of Monarchy is tyranny, or Government for the exclusive benefit of the Ruler. When the Head of the State, still possessing the status and dignity of royalty, shares the supreme power with a class of Nobles, with a popular body, or with both, as in our own country, the Government, though no longer in strictness monarchical, is called in popular language a Mixed or Limited Monarchy, the term Absolute Monarchy being applied to a Government properly monarchical. The highest ideal of Government would perhaps be attained by an Absolute Monarchy, if there were any security for always possessing a thoroughly wise and good Monarch; but this condition is obviously unattainable, and a bad Despot has it in his power to inflict infinite evil. It therefor becomes desirable that a governing class, composed, if possible, of the wisest and most enlightened in the country, should share the supreme power with the Sovereign. A Limited Monarchy has this advantage over an Aristocratic Republic that, in difficult crises of the nation's existance, Royalty becomes a neutral and guiding power, raised above the accidents and struggles of political life. Monarchy, most usually hereditary, has sometimes been elective, a condition generally attended with feuds and distractions, as was the case in Poland. The elective system is still followed in the choice of the Pope. Constitutional Monarchy may be in its origin elective, or combine both systems, as when one family is disinherited, and the scepter declared hereditary in the hands of another under certain conditions.

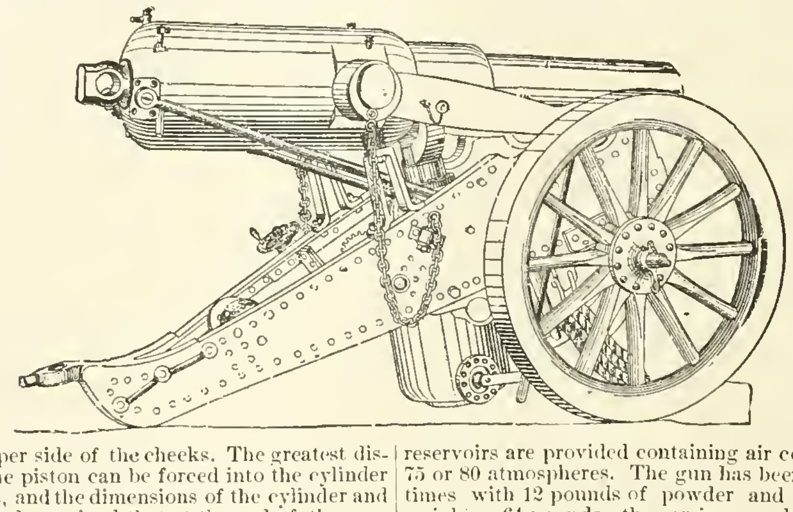
MONCRIEFF DEPRESSION CARRIAGES.—The depressing garrison-carriages have been made to mount guns of 6.3-inch, 7-inch, and 9-inch calibers, the latter being as large as it is thought practicable to work on this kind of carriage. The cheeks are made like those of the heavy carriages, of two ½-inch plates riveted together, with wrought-iron frames 3½ inches wide between them. The cheeks are connected by two transoms of plate-iron. The elevator is made in the same way as the cheeks. The chassis-rails are of girder-iron, 19¾ feet long, 6¾ inches wide on the flange, and 12 inches deep for the 9-inch gun. Six traverse-wheels are used. The carriage has been tested at Shoeburyness by repeated firings, some of which with the 6.3-inch and 9-inch gun we witnessed. The smaller gun comes down to the loading position after firing more smoothly and with less shock than the larger gun, the charge for which was 50 pounds of powder and a projectile weighing 250 pounds. The 6.3-inch gun is designed to fire over a parapet 9 feet 4 inches high, and the 9-inch gun over one 12½ feet high. In the 9-inch hydro-pneumatic carriage the force of the recoil is utilized to compress a certain volume of air contained within a close vessel, and is afterward employed to raise the gun from under cover to the firing position. The gun is supported on two strong lever supports. One end of each embraces the trunnion of the gun, and the other is keyed to a heavy shaft which turns in journals near the foundation-plate. This shaft has two strong cranks which operate pistons fitted to two cylinders. A third lever support is hinged at one end to the breech of the gun,, and the other to a support attached to the elevating-apparatus. The cylinders communicate by means of strong pipes with air-vessels, and a valve is arranged to permit the water to pass from the cylinders to the air-vessels, but does not allow it to return. A sufficient quantity of water is used to assure the valves being always immersed in it. The air in the vessels is compressed by means of the air-pump until it is under sufficient pressure to raise the gun from the loading to the firing position. When the gun is fired, the recoil forces the pistons in the cylinders, and compresses the air in the vessels, which hold it in store until required to raise the gun for the next fire. By turning the valve which allows the water to flow back from the vessels to the cylinders, the water at once presses against the piston-heads, and forcing them back raises the gun to the firing position. The carriage is the same in principle as the hydro-pneumatic siege-carriage, which will be noticed in detail.

Major Moncrieff urges with much force that by the adoption of a depressing carriage for siege-guns, embrazures for earthworks, which are entirely unsuited to modern warfare, may be dispensed with, and a better and safer battery can be used; namely, that in which the guns are planted in pits or trenches where the gunners are entirely protected from the fire of sharpshooters and the direct fire of canister and shrapnel. In his siege-carriage, instead of using the recoil of the gun to raise a counterpoise weight which shall in turn elevate the gun from the loading to the firing position as in his sea-coast carriage, he utilizes the recoil to compress a volume of air, which being brought to act upon the gun shall raise it to the firing position. The same idea, was proposed several years ago by Mr. James Eads, civil engineer of St. Louis, and a carriage made to operate on this principle was patented by him. Moncrieff's carriage is built for a 64-pounder rifled gun. It resembles in its general appearance an ordinary wrought-iron siege-carriage, and differs from it only in the addition of the hydro-pneumatic cylinder and piston, the elevating arms or supports, and a modification of the apparatus for pointing the gun. Between the cheeks of the carriage is placed a cast-iron cylinder with trunnions, which are supported in trunnion-beds in the cheeks. The cylinder hangs in a vertical position, and comes down to within 15 inches of the ground. This cylinder is a compound one, having an inner cylinder in its axis, there being two channels of communication between them, closed by valves. The first is intended to permit the passage of the liquid from the inner to the outer cylinder, and is closed on one side by a valve which works out automatically, and on the other by a regulating-valve for moderating the motion of the piece at the last part of the recoil, and also acting automatically; the other channel allows the liquid in the outer cylinder to pass into the inner one, and is closed by a valve which is operated by means of a lever attached to the left trunnion of the cylinder. A piston fits the inner cylinder closely. Its head is divided into two branches and serves as a transom to the two lever arms, to which it is secured by hinge-bolts. The two lever-arms are strong wrought-iron bars, the lower ends of which are formed in the shape of trunnions, and fit in the trunnion-beds of the carriage, being held in place by the cap-squares. The upper ends have holes bored in them to receive the trunnions of the gun. In the firing position these arms are nearly vertical, and raise the axis of the piece 8 feet above the platform; the recoil brings them nearly horizontal, lowering the trunnions of the gun to about 3¼ feet. Two long iron rods are fastened to one end to the breech of the gun by a hinge-bolt, and the other end to the elevating apparatus.

The inner cylinder is filled with liquid, which also occupies the lower part of the outer cylinder, but only for a short distance, so as to cover the passages between the two cylinders. The liquid is a mixture of one part of glycerine to two of water. The air is the outer cylinder is compressed ,by means of an air-pump before it is put in position. The exact degree of pressure must be determined by experiment. The carriage is held in place behind the epaulement by means of a chain or rope, which is made fast at one end to a hook on the axle at its middle point, and the other to an anchor in the ground in front of the gun. The recoil of the carriage must be prevented in order that the hydraulic apparatus may be made to operate. The regulating-valve of the cylinder is worked by a crank, which is moved by a connecting-rod attached at its upper end by a hinge-bolt to the right lever-arm. The connecting-rod has a slot in its lower end, in which the pin of the crank plays. Supposing the gun to be in the firing position, the regulating-valve is wide open. When the gun is discharged the recoil presses the lever-arms down to the rear, forcing the piston in the cylinder, which turns around its trunions. The pressure on the liquid opens the valve and allows it to pass into the outer cylinder, compressing the air contained therein. The regulating-valve is open during the great part of the motion downward, the length of the slot being so regulated that the pin of the crank will not reach its upper end until the gun is almost down, when it will turn the crank and close the passage between the two cylinders. The trunions strike on India-rubber buffers bolted to the upper side of the cheeks. The greatest distance that the piston can be forced into the cylinder is 28½ inches, and the dimensions of the cylinder and piston are so determined that at the end of the motion this air will have been compressed to about one-third of its original volume. When the piece is loaded, in order to bring it to the firing position, it is only necessary to open the passage between the outer and inner cylinders. To effect this, the gunner on the left turns the key in the left trunnion of the cylinder, and opens the valve which allows the liquid to return to the inner cylinder; the pressure of air drives back the liquid, which raises the piston and the gun. Two chains fastened on the right and left of the piece, one end to the lever-arms and the other to the cheeks, stop the gun when it has reached the firing position. During the upward motion the connecting-rod attached to the right lever turns the regulating-valve and opens it ready for the discharge of the piece. A windlass between the sides of the trail affords the means of bringing down the gun by the aid of ropes to the loading position without firing, or when the trunnions are not brought in contact with the rubber buffers, as will happen when firing with small charges at high angles.

The elevating apparatus consists of two circular racks placed on the inside of the cheeks, and operated by means of an endless screw, which turns a pinion engaging in the teeth of the rack. The two long iron rods attached to the breech are hinged to the upper end of the racks. By turning the handle of the endless screw, the circular racks are raised or lowered, and also the breech of the gun. The circular rack has its center at the point around which the rod is pivoted on the breech of the gun when it is in the loading position, so that the angle that its axis makes with the horizon in this position is the same, no matter at what angle it may be fired. Reflecting sights are arranged on the carriage, so that the gun may be aimed by the gunner without exposing himself to the enemy's fire.

The carriage is mounted on an ordinary siege-platform, and the parapet should be an overhanging one, in order that there should be the necessary space for loading, and to insure the muzzle of the gun when in the firing position being well beyond the crest. If the hydro-pneumatic arrangement be disabled, the gun may be then mounted on the carriage as an ordinary siege-gun. The hydro-pneumatic cylinder should be charged in the park and not in the battery. Air-pumps are provided for this purpose. The mean pressure in the cylinder during the experiments has been 400 pounds per square inch, about 27.2 atmospheres, the piece being in the firing position and corresponds to 500 pounds when it is in the loading position. If it should be necessary for any reason to increase the pressure in the cylinder, portable air-reservoirs are provided containing air compressed to 75 or 80 atmospheres. The gun has been fired many times with 12 pounds of powder and a projectile weighing 64 pounds; the carriage worked well. It has been found that it can be fired at the rate of one round per minute at low angles of elevation. The weight of the carriage complete is 62¼ cwt., the service-carriage being 32¼ cwt. Major Moncrieff believes the weight may be reduced (by making the cylinder of bronze instead of iron, the plunger a hollow cylinder of wrought iron, and the lever-arms of built beams instead of solid) to 50¼ cwt. The great weight of the carriage is still regarded as a serious objection to it. Besides, the complex and delicate nature of the machinery, and the complication of stores required to go with it, induce the belief that it would prove too cumbrous for use in sieges generally. See *Seacoast and Garrison Carriages*, and *Siege Carriages*.



MONGOLIAN CASQUE.—An ancient helmet with peak crest and socket for plume. It was very beautiful, and richly ornamented with damascened work.

MONK. The most common methods of firing mines are by the use of the *monk* and the *box-trap* These two methods require a powder-hose. The monk is a bit of agaric 1½ inches in length. The train to be fired by it, is arranged as follows. Stretch the extremity of the hose upon a sheet of paper and sprinkle some dry, fine powder upon it; cover this powder over with another sheet of paper, secured at its four corners with dry earth or stones; pass the monk through a hole in the upper sheet, and let it project half its length above it, its base being plunged in the powder on the bottom sheet; set fire to the monk at top with another piece of agaric, termed an *informer* of the same dimensions and form as the first, and retire quickly.

Both the use of the box-trap and monk have the inconvenience of requiring a powder-hose, which, from its own explosion, poisons the galleries. They have also, and more particularly the monk, the defect of not producing the explosion always at the instant desired. To avoid these inconveniences a galvanic current has of late been applied to fire mines, and with complete success. This method has been found particularly serviceable in firing charges under water. See *Box-trap*, and *Rocket-trough*.

MONOMACHY.—A single combat or the fighting of two, hand to hand. It is derived from the Greek. A duel may properly be called a Monomachy.

MONTALEMBERT SYSTEM OF FORTIFICATION.—Among the writers on permanent fortification whose works have had an important bearing on the progress of the art, Montalembert holds a conspicuous place, although not educated as an engineer. Struck by the evident defects of the methods of his predecessors, particularly the want of casemates, both for defensive dispositions for artillery and musketry, and the shelter of the garrison and munitions, Montalembert devoted his time, talents, and fortune to bringing about a change in the direction in which it seemed to him called for. His efforts, however, led to no modifications of consequence during his life, which was principally spent in angry controversies with his opponents, except the extension of casemated defenses for sea-coast works; and it is only within a comparatively recent period, in the present century, that a new school of engineers has grown up principally in Germany, based upon the views put forth mainly by Montalembert. The principal propositions of Montalembert consist: 1. In the entire rejection of the bastioned system, as, according to his views, unsuitable to a good defensive disposition; and in its stead he proposed to use either the *tenailled system*, or else the *polygonal system*. 2. In basing the strength of these last systems upon an overwhelming force of artillery fire in defensive casemates. 3. In organizing strong permanent works within, and independent of the body of the place, which are to serve as a secure retreat for the garrison when forced to give up its defense. Montalembert first gave the name polygonal system to a tracé of the enceinte in which all of the angles are either salient, or where the re-enterings are very slight. A description of the polygonal system in its most simple form, the one in which Montalembert presented it for the fortifications at Cherbourg, one of the most important naval stations in France, will be given here as an example. The body of the place consists of the scarp wall, arranged with casemates for artillery and musketry; of a corridor, between these casemates and the earthen rampart and parapet. In rear of the rampart is a high wall, arranged with loop-holes, within which the garrison retired when driven from the defense of the rampart. Casemated caponnières, which are secure from a *coup-de-main*, are placed along the rampart, and so arranged that a fire can be thrown from them over the parapet and also along the terre-plein. The corridor is also swept by a casemated caponnière for musketry; and the front of the wall by a like arrangement. The principal caponnière for flanking the main ditch is in the form of a lunette, and placed at the middle of the exterior side, its flanks joining the casemated gallery of the enceinte. The flanks and the faces of this work, are arranged with two tiers of artillery and musketry fire; each flank carrying ten and each face twelve guns. A wet ditch separates the faces and flanks; a loop-holed wall encloses the portion between the flanks, from which the opposite portion between the faces is swept by musketry. The caponnière is covered in front by a face cover of earth, in the shape of a redan. The scarp of the enceinte is covered in like manner by the continuous face cover of earth, in the re-entering angles of which casemated batteries of two stories, for artillery and musketry, are placed to flank the ditches and sweep the positions for counter batteries around the salients of the covered-way. These batteries are masked in front by earthen works. The whole is covered by the glacis of the covered way, arranged in the usual manner. The better to flank the main caponnière, the portion of the casemated gallery joining it is arranged with two tiers of artillery fire, the remaining portion having but one tier of guns. The communications between the different works are by bridges across the wet ditches. See *Polygonal System of Fortification*, and *System of Fortification*.

MONTER.—A term signifying to rise from one rank to another in the way of promotion, as from Lieutenant to Captain, etc., or from having the command of the youngest company to be promoted to that of the oldest.

MONTERO.—A military cap and hood formerly worn in camp.

MONTIGNY MITRAILLEUR.—A machine gun consisting of 37 rifled steel barrels, hexagonally formed exteriorly, and fitted and soldered into a wrought-iron tube, somewhat in the form of an ordinary piece of artillery. This has a movable breech-piece worked by means of a lever, and containing a spring and striker, corresponding with each barrel. The whole of the barrels can be charged simultaneously by the introduction of a steel plate containing the thirty-seven cartridges; they can be fired independently, and at any interval of time, or the whole may be fired in one second; reloading takes five seconds, and a continuous fire at the rate of ten discharges per minute can be maintained. The gun is provided with both vertical and horizontal adjustments, and may be made to sweep horizontally along a line of adjustment between each discharge, or during the discharge itself. As there is no recoil, the gun once laid will continue to throw 28 lbs. weight of projectiles per minute on the same spot, or at various points of any line requiring the same elevation without any further labor than that involved in the working of the lateral adjustment. It appears from Major Fosbery's account, who was sent to Belgium by the English government to report on this mitrailleur, that at 866 yards the hits were 32·12 per cent. From the report of the Special Committee appointed to carry out comparative experiments with the Montigny and Gatling mitrailleurs, it would seem that the result is in favor of the latter. In the special competition between this gun and the Montigny mitrailleur of thirty-seven barrels, the former made 618 hits in 3 minutes 31 seconds, in 720 rounds at 600 yards; the Montigny, at the same range and with the same number of rounds, scoring 538 in 4 mintutes. With 558 rounds at 800 yards, the result was even more favorable to the Gatling, which made 439 hits in 2 minutes 26 seconds, against the Montigny's 292 in 3 minutes 3 seconds.

MONT-PAGNOTE. In fortification, an eminence where persons post themselves out of reach of cannon, to see a camp, siege, battle, etc., without being exposed to danger. It is also called the *Post of the Invulnerables*.

MOORING.—This is the most difficult operation connected with submarine mines. It is a problem containing so many conditions that it is impossible to give more than general suggestions concerning its solution. In order to possess a maximum of efficiency, no indication of the position of a mine should appear on the surface of the water, and yet the spot, to within a few feet of where it is deposited, must be known to the defenders of the channel in which it is used. In certain cases—as when there is considerable rise and fall of the tide—it is impossible to totally conceal the position of a system of mines. When such is the case, the very smallest indication possible should be allowed to appear on the surface of the water. It has been found that the least current, or so much roughness as only a moderate breeze would cause, renders the placing of even a single mine in a definite position a matter of very considerable difficulty. When a series of mines are to be moored in proper relative position, this difficulty is much increased, and it is, furthermore, augmented in proportion to the depth of the water.

The objects to be obtained in mooring are as follows: 1st. That the charge should be kept as nearly as possible stationary at the point where it is required to act. This is particularly necessary where there is a tide which, flowing first in one direction and then in another, tends to cause the mine to shift its position, and is indispensable in the case of mines intended to be fired by judgment. 2d. The moorings should be so arranged that there shall be as little twisting as possible, which might break or injure the insulation of the electrical cables. 3d. The anchors or heavy weights used should be suited to the nature of the holding ground or bottom. 4th. Mooring cables should be so arranged that they may not be likely to become twisted together or entangled. The best special mooring appartus for general purposes is the *mushroom anchor*. It is decidedly so for a soft, muddy bottom. On a hard, rocky bottom the deadweight of the mooring must be depended upon to keep a mine stationary, and if a heavy mushroom anchor is used, its edges should be furnished with toes or points to catch in the crevices of the rocks. The weight of the anchor would depend on the buoyancy to be overcome, and would usually be from 500 pounds upwards. Ordinary mooring chains and hemp cables may generally be employed in connecting the charges or circuit-closers with the anchors. Where there is any tendency to twist, a wire cable is the best to counteract it. Any considerable amount of twisting must be checked, as it is liable to entangle the moorings and to rub and injure the electric cables.

Next to the mushroom sinker the ordinary anchor is the best. For make-shifts, any heavy-weights—as large stones, pigs of metal, or bars of iron—may be used. These must necessarily be sufficiently heavy to hold a mine in position simply by their deadweight. The material just mentioned can be fastened to frames of wood, and the whole sunk as one mass.

The weight necessary for a mooring, whether anchor, sinker, or other apparatus, will depend upon the buoyant force of the mine, the nature of the bottom, and the currents.

The buoyancy of a mine is in excess of flotation over its weight. This would be measured by the number of pounds required to sink it, and no more. When wooden casks are used the buoyancy may be roughly taken as equal to the weight of the charge of powder. With heavy metallic cases their weight must, in all cases, be taken into consideration. In water free from currents twice its buoyancy is considered necessary to keep the mine in a vertical position over the mooring; this, therefore, would be the weight required for the mooring. Where there is a current, additional weight to keep it from swinging off with it is required, and this increases with the strength of the latter. When the mine is moored by a single cable, a convenient rule, approximating closely to results from experiments, is to allow one additional buoyancy for each mile per hour of current; *i. e.*, two buoyancies being allowed for still water, three would be allowed for a current of one mile; four for two miles; five for three miles, and so on. These represent the weights for the mooring in each instance. In a tide-way where there is a current of more than five miles an hour, two anchors may be advantageously used, placed up and down stream at a considerable distance apart, depending upon the force of the current and the distance from the bottom at which the mine is to float. It is extremely difficult to moor mines in proper lines and depths by this means. When the mine is small, say one containing a charge not greater than 200 pounds, a single large barge may suffice for placing it. The anchors can be let down at a suitable distance apart from the extremities of two out-riggers, one from each end of the barge. The mine, attached to the middle of the cable connecting the anchors, is weighted down by a heavy saddle, which after the anchors are down, is hoisted in and the mine permitted to rise to the proper depth from the surface.

In order to place a large buoyant charge of, say, 1000 pounds and upwards, three of these large boats are required to carry it and its anchors, one for each anchor or mooring sinker, and one for the charge itself. They are connected by a rope, which, if kept stretched, would insure the anchors being placed at the proper distance apart. The sinkers and mine are carried out and lowered from the davits at the stern of each boat. Skillful boatmen and sailors are required for all operations connected with the placing of mines, and a handy steam-tug is the most convenient craft to use. The floating mine is used where the depth of water is so great that, if placed on the bottom, the mine would require for efficiency an excessively large charge. In this case it is held to the bottom by moorings in such position as not to rise to the surface at low tide, nor at high tide be so deep as to be beyond effective range of over-passing vessels. To arrive at this exact point, it is best to haul the mine down towards the sinker. For this purpose there are various contrivances, some one of which would be supplied with the rigging furnished with the mine. When the mines are to rest upon the bottom, they are lashed to some heavy object sufficient to sink and hold them in position, and then lowered to their places. See *Submarine Mines*.

MOORS.—A people who form the great majority of the population of Barbary. Their appearance indicates their origin, which is a mixture of the Mauri, (from whom they derive their name), Numidians, Phenicians, Romans, and Arabs, who have successively held possession of the country. In consequence, they are found to vary considerably in appearance and character in different parts of Barbary, but all show much more or less strongly the symptoms of a considerable infusion of Arabian blood. They are a well-formed race, with fine oriental features, and a mild and melancholy expression of countenance. They are more friendly and sociable than the Bedouins and Berbers, who inhabit the deserts and mountains; but are inferior to them in mental ability, besides being voluptuous and cruel.

As the Arab conquerors of Spain invaded that country from Africa, where they had largely recruited their forces, they were naturally enough called Moors, and in Spanish history the terms Moors, Saracens, and Arabs are synonymous. From this mixed Moorish-Arab race sprang the *Moriscoes* who were permitted by Ferdinand the Catholic to remain in Spain after the expulsion of their countrymen, on condition of their embracing Christianity. A cruel persecution, which was originated by Philip II., drove them to rebellion (1567-70), and in 1571 many of them emigrated to Africa; those who remained being, to the number of 500,000, expelled in 1610 by Philip III.

The Moors first appear in modern history as the Allies of the Vandals in their invasion of Africa, and were continually rebelling against the Byzantine Emperor. They were next, after a severe struggle, conquered and converted by the Arabs in 707. In 1091 they were summoned by the latter into Spain, to aid in stemming the tide of Christian Conquest; and after faithfully supporting the Arab Calif of Cordova, etc., till his dominions fell into the hands of the King of Leon and Castile, they retired in 1238 to Granada, where they founded their kingdom. The Kings of Granada carried on a vigorous, and, at the same time, chivalrous warfare with the Kings of Castile; but at length, weakened by internal discord, were compelled to succumb to Ferdinand the Catholic in 1492. The Moors, or at least that portion of them who refused to adopt Christianity, were then expelled from Spain, and in revenge, founded in 1518 the piratical States of Algiers Tunis, and Morocco.

MOORSOM FUSE.—The body of this fuse is made of bronze, and is screwed into the eye of the shell by means of a key fitted into two mortises made in the head. The lower part is not threaded, and projects into the chamber of the shell. In the body of the fuse two cylindrical chambers are placed, one above the other, with their axes perpendicular to each other. These chambers are both alike, with similar percussion apparatus. In each chamber is placed a solid cylinder of bronze, terminated at each end by a small projection, or piston One head of the chamber is movable, and when screwed into its place, its exterior is flush with the convex surface of the fuse. Holes are left on the exterior for the use of a key, and the head is screwed in, after the hammer is placed in the chamber and suspended. In each end of the chamber is a small recess, a vent being bored through to it from the exterior of the fuse. These are both filled with fulminating powder. A hole is drilled through the hammer at its middle point, and perpendicular to its axis, and is used to suspend the hammer, by means of a copper wire, in the center of the chamber. The wire passes through corresponding holes in the body of the fuse, and is soldered at the ends in the curved positions of the holes near the surface of the fuse. In the lower end of the fuse a third chamber is placed with a percussion apparatus similar to the preceding, acting, however, in the direction of the axis of the fuse, and having but one end of the chamber provided with percussion-powder, the vent leading from which communicates with a cross-chamber, having at each end a small chamber filled with powder. The hammer, a cylinder of bronze, with a piston like the others, on its upper end, is suspended in the same way, and has below it a copper-wire passing through holes in the fuse, and soldered like the rest. At the bottom of this last chamber stands a cylinder of lead, fixed in its position by its base, which is pressed in a little offset, between the bottom end of the fuse and the cap which closes the chamber. When the shell strikes, the suspension wire of that hammer whose axis coincides with diameter of the shell passing through the point of impact, or, is parallel to it, is torn loose, releasing the hammer, and allowing it to plunge forward and explode the fulminate, by striking it with the piston on its end. From the construction of this fuse it will be seen that there are six points on the surface of the shell, the striking of which will produce the working of the apparatus with certainty. See *Fuse.*

MOOTIANA.—In the East Indies, a term applied to the soldiers who are employed to collect the revenue.

MOPPAT.—A very early name for a cannon sponge.

MORGENSTERN.—A mace with a long handle and spiked head. See *Morning Star.*

MORGENSTERN GUN.—A breech-loading rifle having a fixed chamber closed by a movable breechblock, which rotates about a horizontal at 90° to the axis of the barrel, lying above the axis of the barrel, and in front. It is opened by drawing back the handle of the firing-bolt until the ribs on its sides are clear of the grooves in the receiver in which they slide. This cocks the piece by compressing the spiral mainspring which surrounds the firing-bolt, until it is caught and held by a sear lying well in the bottom of the breech-block. The breech-block may then be thrown upward and forward until it is stopped by striking the front part of the receiver. It is held open there by the head of the ejector-spindle, which changes its bearing on the extractor so as, through it, to support the block. The piece is closed by reversing the movement of the breech-block, and is locked by the side ribs of the firing-bolt engaging with the undercut grooves in the rear portion of the receiver. The piece is fired by a concealed spiral-spring lock the firing-bolt being released by the action of the trigger within the receiver upon the sear within the block. Extraction is accomplished by the breech-block striking the lug on the extractor above its centre of motion, and ejection is caused by the acceleration impressed on the extractor by the action of the ejector spring on the ejector-spindle, when, by the motion of opening, the direction of this latter passes below the axis of the extractor. The ejector-spring is then released from the tension caused by its compression in opening, and causes the extractor to rapidly rotate about its axis, carrying the empty cartridge against the beveled shoulders of the receiver, by which it is deflected upward and thrown clear of the gun.

MORGLAY.—An ancient and very deadly weapon, in the form of a great sword.

MORION.—Originally a Spanish helmet. It had neither vizor, nose-piece, gorget, nor neck-guard; but was surmounted by a high crest sometimes half the height of the helmet. Its edge turned up in a point in front and behind, so as to form a crescent when seen in profile. The *Morion* was worn by Arquebusiers and Men-at-Arms.

MORNE.—The head of the lance used in tilting or other peaceful encounters. It was curved so that an adversary might be unhorsed, but not wounded, by a stroke. Also written *Mortne.*

MORNING GUN.—The gun fired at the first note of reveille, at all military posts, forts, etc.

MORNING PARADE.—The daily parade at *troop*, sometimes called Troop Parade. In every garrisoned town, fortified place and camp, as well as in every town through which soldiers pass, or occasionally halt, a certain hour in the morning is fixed for the assembling of the different corps, troops, or companies, in regular order. See *Dress Parade.*

MORNING REPORT.—A report of troops, their service, condition, etc., rendered every morning to superior authority. The Morning Reports of Companies and Detachments are combined and form the *Consolidated Morning Report.* The form of Morning Report, given on page 380, used at West Point, will illustrate its purpose.

MORNING STAR.—A mace having a long handle and a head with projecting spikes. It received its name from the ominous jest of wishing the enemy good morning with the *Morning-star*, when they had been surprised in camp or city. This weapon became very popular on account of the facility and quickness with which it could be manufactured. The peasant made it easily with the trunk of a small shrub and a handful of large nails. *Morning-stars*, short in the handle, like hammers, were made especially for the Cavalry, Some were supplemented with small hand-cannon in the 15th century.

MORRIS-PIKE.—An ancient pike much used by the Moors. See *Pike.*

MORTAR.—A short and comparatively light cannon, employed to throw hollow projectiles at great angles of elevation. It is intended to produce effect by the force with which these explode. The great curvature of their fire gives them power of reaching objects behind works which would be secure from direct fire. As the projectile has a large diameter, and, except in rare instances, a very great range is necessary, a comparatively small charge of powder is requisite. To give this its utmost power and concentration, it is confined in a hemispherical chamber at the lower end of the bore, but of less diameter. The shell completely closes this chamber; and when the explosion ensues receives its full force on its center. Ordinary mortars range in diameter of bore from 5 to 13 inches. Large mortars have, however, been tried at times, as at the siege of Antwerp citadel

NOTE. On the monthly return of absentees and men on special duty to be accounted for by name, after "Explanations of Alterations."

Morning Report of Cadet (Captain) ———— (—) of the U. S. Corps of Cadets.
(———— Regiment of Infantry, Commandant) for ————

PRESENT.																							ABSENT.																				Present & absent			Alterations since last Return.							
For Duty.					Sick.				Spl. Duty.				In Arrest.				Confined.						On det.Ser				By Order.				On Leave.				Without Leave.				Sick.							Joined.			Discharg'd				Explanat'n of Alteration.
Captains.	Lieutenants.	Sergeants.	Corporals.	Privates.	Captains.	Lieutenants.	N. C. Officers.	Privates.	Captains.	Lieutenants.	N. C. Officers	Privates.	Captains.	Lieutenants.	N. C. Officers.	Privates.	Captains.	Lieutenants.	N. C. Officers.	Privates.	Com'd Officers.	N.C.Officers & Priv.	Captains.	Lieutenants.	N. C. Officers.	Privates.	Captains.	Lieutenants.	N. C. Officers.	Privates.	Captains.	Lieutenants.	N. C. Officers.	Privates.	Captains.	Lieutenants.	N. C. Officers.	Privates.	Captains.	Lieutenants.	N. C. Officers.	Privates.	Total.	Aggregate.	Aggregate last Return.	By appointm't	By re-inst'm'nt	By transfer.	By graduation.	By C't-Martial.	By Order.	For Disab'ty.	

Report of Delinquencies.

Reporting Officer.	Names.	OFFENSES.	Date.	REMARKS.

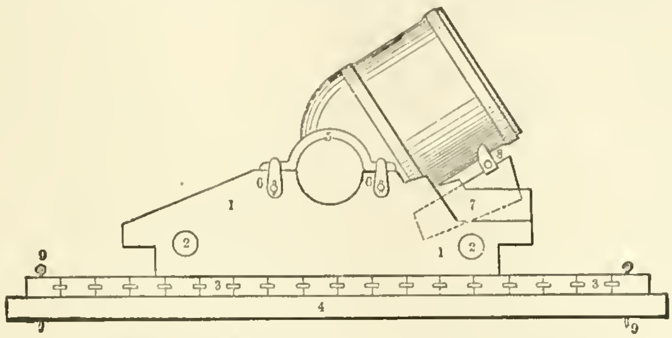
Cadet (First Sergeant) Company ——
Corps of Cadets

Station, ————
Date, ————

Cadet (Captain) Corps of Cadets,
Commanding Company.

in 1832, when the French brought one of 24 inches bore to the attack. This monster, owing to its unwieldiness and other causes, was a failure. Larger still than this, though perhaps more manageable, is Mr. Mallet's great 36-inch mortar, constructed in 1855, of iron parts welded together, and now at Woolwich, rather as a curiosity than for use. As loaded shells are of immense weight, so heavy, indeed, as in larger calibers to involve the apparatus to deposit them in their places, and the mortar is fired at high elevations, the recoil is so great and so nearly vertical that no carriage could withstand the shock; it is necessary, therefore, that the mortar should be mounted on a solid iron or timber bed, by the trunnions, which are placed behind the breech, and supported in front by massive blocks of wood. This arrangement renders the apparatus so heavy provided with complete pointing apparatus, are capable of following the course of a moving vessel with the same facility as a gun.

Mortars, like other cannon, are aimed by first giving the direction and then the elevation. The elevation, which is usually that of the greatest range of projectiles in *vacuo*, viz., 45°, is determined by applying the quadrant to the face of the piece, and raising and lowering the breech until that number of degrees is indicated. The charge of powder is varied to suit the required range. To give the shell, for the same range, a greater velocity in the descending branch of its trajectory, the mortar is sometimes fired at an angle of 60°, in which case the charge of powder must be increased accordingly. As mortars are usually masked from the object to be bombarded by an epaulment or parapet, different means from those



1. Cheeks. 2. Maneuvering bolt. 3. Deck plank. 4. Sleeper. 5. Cap square. 6. Cap straps. 7. Bolster. 8. Quoin. 9. Eye bolts.

that mortars of large size are rarely used in field operations, their ordinary positions being in defensive or siege works, and in mortar-vessels. More wieldy, however, are the Coehorn mortars, invented by the Dutch engineer of that name, for clearing the covert-way or ditch of a fortress. This mortar is sufficiently small to be managed by one man, and is accounted useful in siege or defense operations. The French use a similar Lilliputian ordnance under the denomination of pierriers, or stone-throwers. Small mortars are likewise constructed for mountain warfare; a mule carries the mortar, another the bed, and a third is laden with the projectiles. The use of mortars is diminishing at the present time, elongated shells of great weight being now thrown from rifled cannon.

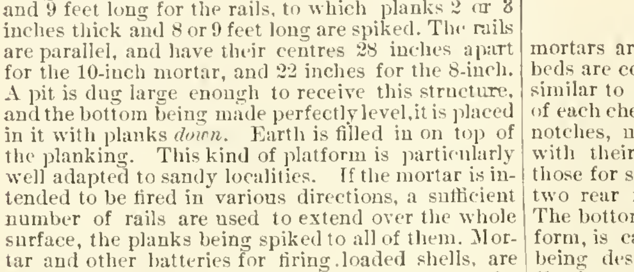
Vertical fire is effective when it is desirable to prevent an enemy from occupying certain anchorage. The deck of a ship is as completely vulnerable to falling shells as the bottom is to submarine mines and torpedoes. Judiciously-placed batteries, if armed with a sufficient number of mortars throwing shells, would make it perilous for an enemy to remain within their reach. But mortar-firing from smooth-bore mortars is at best somewhat wild, and depends on quantity for its effectiveness. It is, however, safe to say that no fleet nor vessel can remain under well-directed fire from heavy mortars. A battery of one hundred heavy mortars will keep at bay all the iron-clads that can maneuver or anchor within their range. The moral effect of mortar-firing is appalling, and increases vastly with the numbers of mortars used. The armor that a vessel is capable of carrying on her deck, in addition to that upon other parts, is not sufficient to resist the crushing power of a 13-inch shell with maximum velocity —419 feet per second. The 10-inch mortar is serviceable only against unarmored decks, or those very slightly protected. In firing at iron-clads the shells should not burst before striking; in fact, it is best to fill the shells with sand instead of powder. Solid shot would be preferable to either. Mortars mounted on the center-pintle traversing chassis, and used with guns become necessary for giving them their direction. There are several processes employed, all of which, however, are reduced to determining practically two fixed points which shall be in line with the piece and the object, and sufficiently near to be readily distinguished by the person pointing the mortar. These points determine a vertical plane which when including the line of metal becomes the plane of fire. See *Bob*, *Coehorn Mortar*, *Dyer Pointing Apparatus*, *Ordnance*, *Paddock Interpolater*, *Plummet*, *Sea-coast Mortar*, and *Siege Mortar*.

MORTAR BATTERIES.—Mortar batteries have principal features of batteries for guns. It is desirable that they should be located where good views of the enemy's position may be had: this, in order that the gunner may himself see the effect of his shot, and not, as is too frequently the case, have to depend upon the imperfect report of a distant observer. For siege mortars, the platforms are placed the same distance apart as for siege guns, viz., 16 feet; for sea-coast mortars, the distance is the same as for sea-coast guns, viz., 18 to 22 feet. They are usually placed in pairs, with traverses between each set of pairs. Embrasures are not required, and as the platform must be at such distance from the parapet that the blast will not injure the interior crest, it is not necessary to revet the interior slope, the earth being allowed to assume its natural slope.

There are two kinds of mortar batteries used in the attack: those for mortars throwing shells; and those for mortars throwing baskets of stones, or other like projectiles. Besides these, there is the Coehorn mortar, which, from its small size, may be placed in any unoccupied corner of the trenches within their range from the besieged works. The first kind of batteries may be in front of the first and second parallels, or any other points farther back. The positions chosen for them should be such as to bring as great a portion of the defences under the direction of their fire as practicable, to increase the chances of destructibility of each shell thrown. The second kind are usually placed in front of the third parallel, mainly with a view to annoy the covered-ways and parts adjacent. These batteries are usually sunk below the natural surface, since even several feet difference of level in the position of a mortar will have but little effect on the range, or the trajectory. The profile suitable for such positions, under the ordinary circumstances, is the following. Width of trench at bottom, 13 feet 6 inches. Depth in front, 3 feet 6 inches. Depth in rear, 4 feet. Reverse slope, $\frac{1}{3}$. Front slope, 2 feet base. Height of parapet, 4 feet. Thickness of parapet, 18 feet. Berm, 1 foot. The earth for the epaulement is taken from an exterior ditch; and, when splinter-proof traverses are required, portions of ditches are made opposite to their position to furnish the requisite earth.

The siege-mortar platform furnished for field-purposes is too light to sustain much firing. For fixed batteries, they should be constructed of heavy timbers, and to insure anything like accuracy in firing, must be both level and stable. The sea-coast platforms when properly laid, are in every respect efficient. A good kind of rail platform may be made by using two pieces of timber, 12 to 15 inches square and 9 feet long for the rails, to which planks 2 or 3 inches thick and 8 or 9 feet long are spiked. The rails are parallel, and have their centres 28 inches apart for the 10-inch mortar, and 22 inches for the 8-inch. A pit is dug large enough to receive this structure, and the bottom being made perfectly level, it is placed in it with planks *down*. Earth is filled in on top of the planking. This kind of platform is particularly well adapted to sandy localities. If the mortar is intended to be fired in various directions, a sufficient number of rails are used to extend over the whole surface, the planks being spiked to all of them. Mortar and other batteries for firing loaded shells, are provided with bomb-proof shelters for the men who load the shells, and others also for the loaded shells These shelters may be placed in the epaulements of the batteries, under thick traverses, or in any position most convenient for the service of the battery.

When the site of the battery is marshy, the construction of the parapet and the laying of the platforms require great care to give them the requisite strength and firmness. Each of these parts should receive a firm bottoming of two layers of long fascines, 12 inches in diameter, the border for a breadth of 2 or 3 feet receiving a thickness of 3 or 4 layers, the first well covered with sand or rammed clay, if they can be obtained, before placing the second

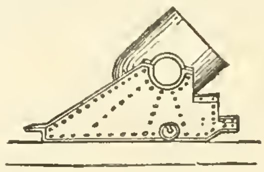


layer, which should cross the first at right angles, and be well picketed to it. On this bed the parapet is raised, and, if the adjacent soil of which it is formed is very wet, layers of smaller fascines may be advantageously used at different heights to prevent the wet soil from running. The site of the guns should be covered, to a depth of at least 6 inches, with moist sand, or good loam well rammed, to receive the platforms; which, like those at the sieges of Forts Pulaski and Wagner, should rest on a bed of plank, over which the weight of the guns should be well distributed by the under timbers of the platform.

On a site of solid rock the only means that can be well employed for constructing the parapet is sandbags. If the surface of the rock on which the platforms are to rest, is too uneven or too much inclined to be easily leveled by hammers, it will be necessary to fill in the space required for the service of the guns with earth or sand, and to use a cribwork if necessary around the border of the interior to confine the soil, which, as in the case of a marshy soil, should be well rammed and levelled before laying the platforms.

The drawing shows a plan of an indented sunken battery on a causeway from 50 to 60 feet wide. A.B. is the line of direction of fire; C, contraction of rear of battery; D D, enlargement of rear of battery; E, ramp.

MORTAR BEDS.—Mortar beds serve the same purpose as gun-carriages. The beds for the smaller

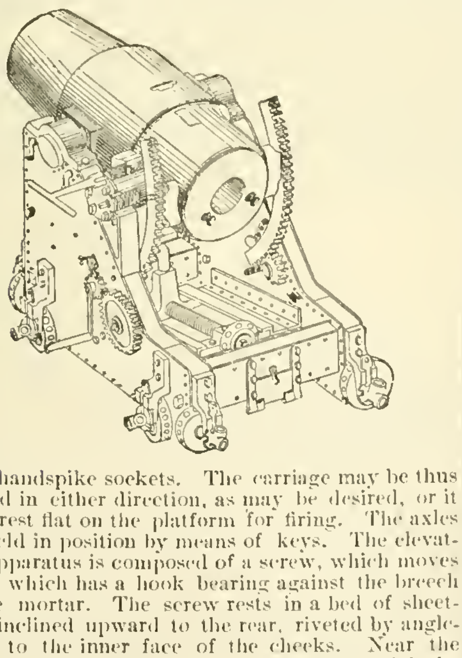


mortars are made of one solid block. The larger beds are constructed and put together in a manner similar to the top-carriages for guns. At the ends of each cheek are projections, called front and rear notches, underneath which the cannoneers embar with their handspikes to move the carriage. On those for siege mortars there are also two front and two rear maneuvering bolts for the same purpose. The bottom part of each cheek, resting on the platform, is called the shoe; the front and rear ends being designated the toe and heel, respectively. Carriages for siege mortars are without truck-wheels, and rest directly on the platform. Sea-coast mortars have two truck-wheels on an eccentric axle, for maneuvering the carriage on the platform, and maneuvering bolts are omitted. See *Mortar Carriages* and *Thirteen-inch Mortar*.

MORTAR CARRIAGES.—The application of the principle of rifling to mortars, in common with guns of all kinds, has had the effect to obliterate to a great degree the sharply-defined lines of distinction which formerly divided the different classes of cannon, and to reduce them more closely to a common model, adapted more nearly to a common use. The rifled mortar, to give it the desired efficiency, has been increased in length until it differs in no respect from a howitzer or short gun, and is no longer confined as formerly to a vertical fire exclusively, but may be used with effect for direct or curved fire, with solid or hollow shot, as well as shell. The carriages for the different guns have had to undergo necessarily corresponding changes to adapt them to the new conditions of service; and as the guns have been modified till they bear a resemblance to each other, so the carriages on which mounted are less distinctive in appearance and more nearly approach the same pattern. The mortar, in place of being mounted as formerly on its bed, must in its changed condition be provided with a carriage constructed so as to enable it to deliver its fire at any angle from 0° to 60°, and be turned with promptness on any object within a wide field of fire.

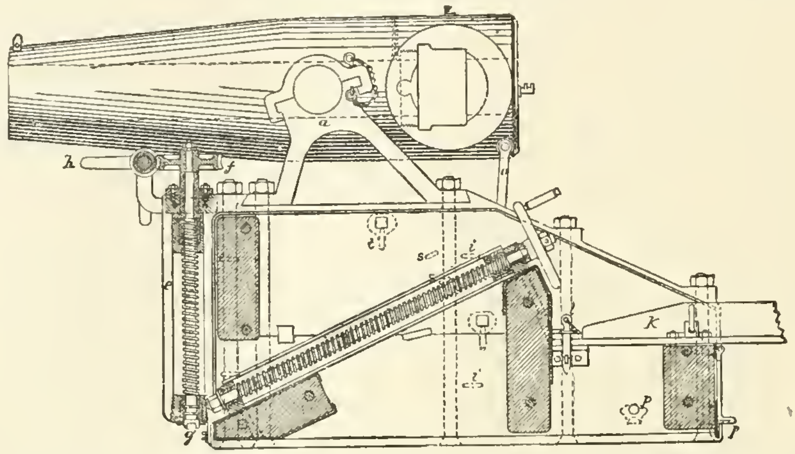
United States.—The Coehorn mortar carriage is simply a block of wood, weighing 132 pounds; the total weight of piece, equipments, and carriage being 311 pounds. The carriage or block upon which the mortar is mounted, is provided with two handles on each side, by means of which the mortar is readily carried by four men from one part of the work to another. They accompany troops in the field for use against an enemy covered by intrenchments. The ground, when firm, is sufficient for the carriage to rest upon; if it is not firm, a platform can readily be extemporized from such material as may be at hand. The carriage should be level when the mortar is fired. The siege mortars are fired from wooden platforms. The carriages are of wrought-iron, and, being without chasses, rest directly upon the platforms. The 13-inch mortar is fired from a wooden platform. The carriage is of wrought-iron, and, being without chassis, rests directly upon the platform. An axle, carrying at each extremity a truck-wheel, passes through the carriage near the front end; this axle is eccentric, and when thrown in gear the truck-wheels rest upon the platform; only the rear part of the shoe then rests on the platform and moves with sliding friction. Two steps are placed on the front part of the carriage for convenience in loading. The carriage of the 10-inch sea-coast mortar is of wrought-iron, and is provided with an eccentric axle and truck-wheels similar to the carriage for the 13-inch mortar.

Austria.—The Austrian carriage is composed of two cheeks, each formed of two plates of boiler-iron riveted together around their outer edges, with a wrought iron frame between them. The cheeks are 47 inches high in front and 18½ inches in rear. Trunnion-beds formed in the upper face are provided with trunnion-plates and cap squares: the latter are held each by two keys. The two cheeks are joined together front and rear by two transoms, each formed of two plates of iron and angle-irons. These transoms pass through cuts made in the inner plate and are riveted to the outer plate of the cheek; they are also secured to the inner plate by angle-irons riveted to each. Two bolts pass through these transoms and join the cheeks, besides a bolt, about a third of the height from the top in front. The part of the bolts embraced between the cheeks has a wrought-iron pipe over it. A square hole is cut in the cheek near the front edge, intended for the wrought-iron axle used in transportation. The axle is composed of a body, square in cross-section, and two cylindrical arms for the wooden wheels. The cheeks are provided with four pairs of truck-wheels, two for moving the carriage to the front or rear, and two others for moving it laterally. They are all mounted on eccentric axles, which have cast-



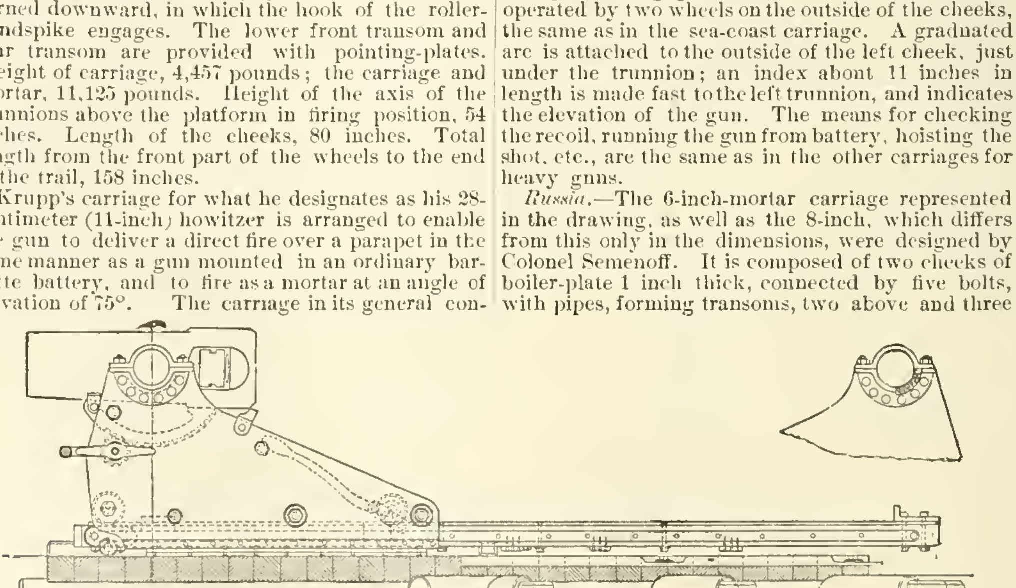
iron handspike sockets. The carriage may be thus moved in either direction, as may be desired, or it may rest flat on the platform for firing. The axles are held in position by means of keys. The elevating apparatus is composed of a screw, which moves a nut which has a hook bearing against the breech of the mortar. The screw rests in a bed of sheet-iron inclined upward to the rear, riveted by angle-irons to the inner face of the cheeks. Near the rear end of the bed there is a collar, in which the screw turns. The head of the screw has in it holes in which is inserted a crank-handle to give rotation to the screw. The nut is guided in its motion by two projections which move in corresponding grooves in the bed. For firing at low angles of elevation a block is placed on the hook, fitting over it and increasing its height. In order to bring the mortar quickly from the firing position to that for loading, there are fastened to either side of the breech of the mortar two circular steel arcs with teeth which engage each with a pinion on the inner face of the cheeks. A wheel and pinion on the outside of the cheeks are used to give motion to the inner pinion. To transport the mortar an axle is inserted in the cheeks of the carriage and ordinary wheels are put on, raising the carriage with jacks. A trail is provided which has a lunette for hooking on to an ordinary siege-limber; it is secured to the carriage by passing one end under the front transom and engaging it in two hooks under the pointing-bed, and held by a cross-piece. Weight of the carriage, 5,140 pounds; of the axle, 231 pounds; the trail, 192 pounds; with the lock-chain and shoe, 286 pounds; the two wheels, 476 pounds; the limber with wheels, 838 pounds; the total weight of the carriage ready for traveling, 6,973 pounds; with the mortar, 17,826 pounds. Width of track of rear wheels, 72 inches; front wheels, 48.5. Angle for turning, 42°. The elevating screw with the ordinary hook will give elevation of 20° to 60°; by putting on the block, angles from 10° to 20°.

Germany—This carriage is composed of two wooden cheeks, the greater portion of the border re-enforced by iron straps and joined together by four wooden transoms and eight transom-bolts. A trunnion-piece, *a*, of wrought-iron is bolted to the upper side of each cheek, and is provided with a cap-square, key, and chain. The elevating apparatus is composed of a long iron screw with a square double thread, turning from right to left, inclined at about 25°. It is terminated at the upper end by a wheel and handle, and turns in two collars fastened one to the front side of the lower transom and the other to the middle transom. The nut *c* travels along the screw throughout its length. The ends of the female screw are provided with rollers, which play in the grooves of channel-beams secured on the inner face of the cheeks. Two iron rods, *o*, connect the female screw to the breech of the mortar, which has a horizontal hole drilled into it to receive a bolt, forming an axle around which the rods, *o o*, move. By this arrangement angles of elevation from 0° to 75° may be given. The carriage is provided with two siege-wheels and a wrought-iron axle, which may be raised vertically by means of a hoisting apparatus and made to move in two slots formed by an iron bar fastened to the front face of the cheeks. This axle has near each arm a square re-enforce, with a vertical hole in it, in which is placed a bronze female screw with a double thread; one nut is right-handed, the other left. The hoisting apparatus is composed of two vertical screws in the slots, *e*, passing through the nuts in the axle. The screws have on their upper end the spur-wheel, *f*, engaging in the threads of the endless screws, one of which is right-handed, the other left, and mounted on the same horizontal shaft, which is turned in journal-boxes in the upper part of the grooves by means of a capstan-handle, *h*, on each end. The axle is guided in its motion in the grooves by a plate of iron, screwed to the inner face of the axle, between the two shoulders, and terminating in square hooks, which form guides, and slide in the grooves. The hoisting apparatus is used either to lower the carriage on the platform by raising the wheels so that they do not touch, or to raise the carriage by bringing the wheels on the ground. Four men at the handles of the screw are sufficient to do this work. To lower the mortar on the platform, it is necessary to raise the wheels only from ½ to ¾ of an inch, whereas for the transportation of the mortar the carriage must be raised sufficiently to attach it to the limber. This is done by means of a trail, *k*, of T-iron. This has a lunette at one end, and is made fast to the middle transom by means of a strong bolt, *l*, and to the rear transom by two iron ears, between which it is firmly held. A 15-centimeter gun-limber is used. The wear on the female screws in the axle is diminished by means of stirrups with screw ends; the axle is lowered to its lowest point in the groove, the ends of the stirrups are passed through holes drilled in the axle to the right and left of the shoulders, and the threaded ends are screwed into double nuts, which are jammed hard. The middle part of the stirrup fits in a notch, *q*, cut in the lower end of the screw, and prevents it from turning. There are several other irons on the cheeks; two priming-wire eye-bolts, four equipment-



rings, *i i*, two hooks, *t*, four plates, *p p*, at the rear, two of which are on the outer face of the cheeks and two on the rear face: they present a kind of cup turned downward, in which the hook of the roller-handspike engages. The lower front transom and rear transom are provided with pointing-plates. Weight of carriage, 4,457 pounds; the carriage and mortar, 11,125 pounds. Height of the axis of the trunnions above the platform in firing position, 54 inches. Length of the cheeks, 80 inches. Total length from the front part of the wheels to the end of the trail, 158 inches.

Krupp's carriage for what he designates as his 28-centimeter (11-inch) howitzer is arranged to enable the gun to deliver a direct fire over a parapet in the same manner as a gun mounted in an ordinary barbette battery, and to fire as a mortar at an angle of elevation of 75°. The carriage in its general con-

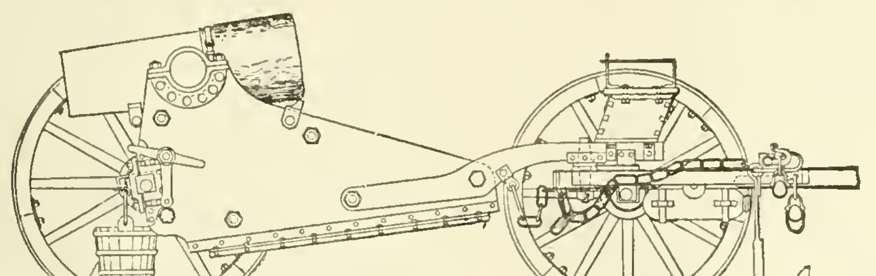


struction is quite similar to that made for the sea-coast guns, with such modifications only as became necessary to fit it for the special service required of it. To enable the chassis to resist the strain brought upon it in firing at elevations of 75°, the rails are made to bear evenly on four traverse-circles laid in the platform, placed at equal distances from each other. The rear traverse-wheels are mounted on eccentric axles, and when the gun is to be traversed these wheels are thrown in gear, and when the proper horizontal direction has been given to the gun they are thrown out of gear, and receive none of the shock of the recoil. The means for traversing the chassis are the same as in the sea-coast carriages, namely, a windlass and chain made fast to the platform near either end of the outer traverse-circle. The pintle is in the front transom. In order to preserve the axis of the gun at the proper height above the platform to enable the gun to fire over parapets of the usual construction, it is necessary to make the top carriage as much higher as the top of the chassis has been lowered. To give the different elevations ranging from 0 to 75°, a circular rack is fixed to the under side of the gun, the center of the rack being at the intersection of the axis of the trunnions with that of the gun. A cog-wheel engages in the teeth of the rack, and is operated by two wheels on the outside of the cheeks, the same as in the sea-coast carriage. A graduated arc is attached to the outside of the left cheek, just under the trunnion; an index about 11 inches in length is made fast to the left trunnion, and indicates the elevation of the gun. The means for checking the recoil, running the gun from battery, hoisting the shot, etc., are the same as in the other carriages for heavy guns.

Russia.—The 6-inch-mortar carriage represented in the drawing, as well as the 8-inch, which differs from this only in the dimensions, were designed by Colonel Semenoff. It is composed of two cheeks of boiler-plate 1 inch thick, connected by five bolts, with pipes, forming transoms, two above and three below. The trunnion-bed is formed by re-enforcing the hole cut in the plate with a flat piece of iron on the outside and an angle-iron on the inside. The trunnion-bed is secured to this by means of rivets with countersunk heads, and inside of the angle-irons are battens, with screws on the end for holding the cap-squares. The lower edge of the cheek is re-enforced both on the inside and outside by angle-irons, and shod with a flat bar fastened by rivets with countersunk heads. Two guides are fastened to the angle-irons in front and rear, and serve to guide the carriage in its motion by pressing against the directrix, which will be mentioned hereafter. The elevating apparatus is composed of an arc fastened at each end to the mortar, having teeth which engage in a pinion mounted on an axle turned by two handles outside of the cheeks. Two cannoneers, one on the right and the other on the left, give the elevation by turning the two handles at the same time. The angles of fire are embraced between 5° depression and 73° of elevation. A clamp-screw on the left end of the shaft prevents the gun from moving after it has been pointed. To load the mortar, it must be brought after firing to nearly a horizontal position. The use of a gunner's level each time is avoided by having a graduated bronze arc fastened on the outside of the cheeks, just under the right trunnion, and an index marked on the face of the trunnion.

In firing, the carriage slides on the platform; or, for the facility of running it into battery and moving it laterally, it may be mounted by means of four truck-wheels on a kind of low chassis or directrix. The two front wheels, mounted on the same axle, are just over the top of the chassis, but do not touch it; the rear wheels are mounted each on a crank-axle; a forked lever, which can be brought down between the cheeks, serves to bring the wheels in contact with the tops of the directrix. To cause the carriage to run on its four wheels, it is sufficient for a cannoneer to force the forked lever down to the rear; the rear end of the carriage is thus raised, and the front wheels are made to bear. The directrix is composed of two wooden beams, covered on top and sides by plates of iron, and joined by two wooden transoms and three bolts. Near the front end is an iron axle, with a vertical hole in its middle for the pintle, and provided with two traverse-wheels which rest on the front traverse-circle of the platform. Two hurters, attached to the front end of the directrix, stop the carriage in its motion into battery, and two counter-hurters, placed in rear, limit the recoil when firing at low angles. Near the middle, between the two beams, is placed a traverse-wheel, which travels on the rear traverse-circle. The directrix is provided underneath with four cross-sleepers, which prevent its bending under the weight of the carriage. The length of the directrix will allow a recoil of 9 feet, which is sufficient for the maximum charges with a dry platform at angles greater than 20°, and with a damp platform at angles greater than 45°. For less angles it is necessary to throw some sand or similar material under the carriage. To give lateral motion to the mortar, if only a slight motion is required, insert the end of the lever in the holes in the rear traverse-circle and press against the carriage. If, on the contrary, it is desired to move the carriage through a great angle, the directrix is traversed on its wheels by three or four men pulling on a rope fastened to its rear end. The platform, as originally adopted, is fan-shaped; nine sleepers, semi-circular in cross-section, are placed crosswise, four toward the front, three in the middle, and two in rear; eleven round sleepers are laid on and slightly let into them; nine of the round sleepers are laid down in the shape of a fan, and the other two halved into the others form the rear oblique sides of the platform. On top of the eleven sleepers, and slightly let into them, are laid thirty-two 6-inch square scantling of variable length, according to their position, the ends cut off obliquely. The last sixteen scantling are secured at their ends by two hurter-planks let into the scantling and held by bolts. The front scantlings are secured in the same way, only the hurter-plank is not let into the scantling. In rear of each sleeper a large picket is driven. Near the front end of the platform the pintle-plate and friction-circle are placed and screwed fast, and near the middle of the platform a second traverse-circle with oblong holes in it. The length of the platform is 16 feet, its slope to the rear 1½°, and the lateral field of fire 90°. This platform, which is still provisionally used in sea-coast batteries, has been recently replaced in siege and garrison batteries by a simpler one, which has been tested with much satisfaction since 1873. This last is formed of two rectangular parts of unequal width. It is composed of nine sleepers, 6 inches square, and covered with twenty planks 3 inches thick and 9 inches wide; seven sleepers, five in the middle and two at the edge of the platform, are 15 feet long, and extend from one end to the other; the remaining two are 7 feet 9 inches long, and support only the rear plank. The sleepers rest on the heads of fifty-eight pickets 2 inches in diameter and 3 feet long, driven into the earth. Two cross-pieces are placed under the front ends and middle of the seven long sleepers; that under the middle supports the front ends of the short sleepers, also the traverse-circle and the rear end of the carriage.

For transporting the mortar and its carriage an axle has been fitted to the latter for two wheels, and a movable trail intended to hitch on to the siege-limber is used. The axle is held in the boxes cut in the front edge of the cheeks by means of cap-squares and bolts. The movable trail is represented in the drawing, with its lunette, its friction-plate, and lashing-ring. It is put in place by unscrewing the two rear bolts of the carriage, bringing the trail in position, replacing the bolts, and securing them by the nuts. The mortar being in battery, to put it in traveling position it is run back to the rear of the platform; the axle and trail are put in place. The front of the carriage is raised by means of a jack put under the middle of the axle, blocking up with blocks till it is high enough. The rear end of the carriage is raised with two jacks, or by means of a lever-bar passed under the carriage crosswise. The wheels are put on and the limber hooked. A seat for the driver is placed on the forward end of the trail, in front of the pintle; in the box under this seat the handles of the elevating-screw are carried; they have to be removed to admit the wheels being put on. The axle is provided with a bucket-hook. The siege-limber is arranged so as to be drawn by ten horses.



In rear of the fixed splinter-bar, with its two swingle-trees, a longer splinter-bar is made fast, and provided with two swingle-trees. The pole has a movable double-tree at its end with three swingle-trees: the front horses are hitched to the traces of the three middle ones. Two lock-shoes for the rear wheels are carried on the body of the limber. The directrices of the mortar carriages are carried by themselves in siege-wagons; four can be carried in one wagon, with great ease.

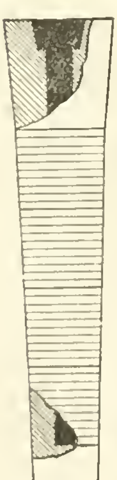
The following are the principal weights and dimensions:

	Pounds.
Weight of the carriage with mortar and limber	8,893
Weight of the mortar	3,461
Weight of the carriage without trail, axle or wheels	2,692
Weight of the trail and seat	3,373
Weight of the axle with two wheels	1,030
Weight of the siege-limber	1,373
Number of horses to draw the carriage	10
Whole length of the carriage to the end of the pole	23 feet.
Width of the carriage	76 inches.
Diameter of the front wheels	56 inches.
Diameter of the rear wheels	62½ inches.

See *Gun-carriages* and *Siege-mortar*.

MORTAR CASEMATES.—These are usually placed in rear of the parapet, by which it is covered from direct fire. The arch is covered by earth, to break the shock of shells. It rises towards the front to give ample room for the shell in its flight. The casemates are covered on their flanks from enfilading fire by an embankment, and are partly closed by a wall in the rear. A small ditch is made in front of the chamber, and a slight wall built within it, to give cover from the splinters of shells falling between the parapet and the casemate. Arched chambers are in some cases made beneath the mortar chambers which serve as store-rooms and temporary magazines. When these casemates are placed in rear of a portion of the parapet but little exposed to direct fire, the thickness of the parapet in front of them may be reduced, and the interior slope be replaced by a breast-height wall along the front of the casemates, in order to give better cover in flank and from slant fire, by throwing forward the casemates more under cover of the parapet. See *Casemates*.

MORTAR FUSE.—The mortar-fuse now used is a paper-case time-fuse, similar in general appearance to the ordinary paper-case fuse, of long time of burning. They are made up in packages and marked with the kind and length of fuse. For any shorter time the fuse is cut with a sharp knife or fine saw. With this fuse is used a wooden fuse-plug, having a conical opening, which is reamed out to fit the paper case. When the shell is loaded, and the fuse cut to the required length, it is pressed in the plug and the plug firmly set in the fuse-hole. The head of the fuse having been covered with tow or something to prevent breaking the composition, the fuse-setter is placed on the plug, and it is driven with the mallet until the head is about ¼ of an inch above the surface of the shell.



The old form of mortar-fuse consists of a case made of beech-wood, turned in a lathe to a conical shape, and bored out nearly to the bottom to receive the composition. The composition is driven with fifteen blows of the mallet. The bore is enlarged at the top to receive a priming of mealed powder moistened with alcohol. To protect priming from moisture, the top of the fuse is covered with a cap of water-proof paper, on which is marked the rate of burning of the composition. The exterior is divided into inches and tenths, to guide the gunner in regulating the time of burning. This operation is generally performed before the fuse is driven into the fuse-hole of the shell, by cutting it off with a saw, or boring into the composition with a gimlet. If the fuse be driven, the column of composition may be shortened by taking a portion from the top with the fuse-auger.

The great disadvantage of this fuse is its irregularity, it being very difficult to press such a large column of composition so that equal lengths will burn in equal times. See *Fuse* and *Time-fuse*.

MORTAR PLATFORM.—A platform similar to that used with siege guns, but of smaller dimensions and without a slope. See *Platform*.

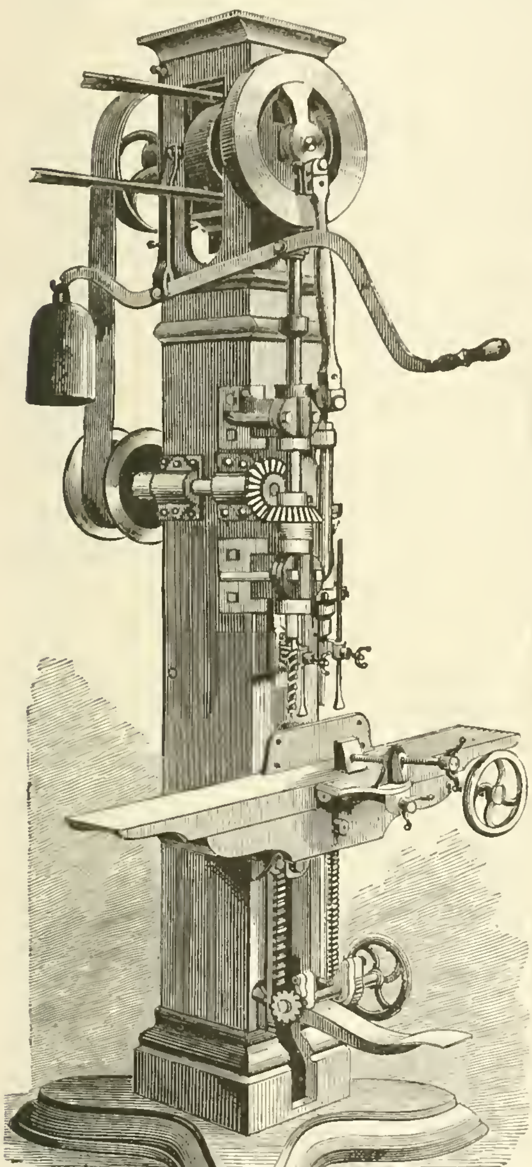
MORTAR SCRAPER.—A slender piece of iron with a spoon at one end and a scraper at the other, used for cleaning the chambers of mortars.

MORTAR SHELL.—A hollow projectile of dimensions to fit the pieces shown under the head of Mortar. Mortar shells are issued loose, but are filled with a charge of bursting-powder at the time they are required. They are fired from mortars at high angles; the larger natures, with the object of setting fire to buildings, ships, or other combustible constructions (and in the attack of a place they would be especially directed on the gunpowder magazines); the smaller natures, to annoy or drive out troops behind parapets or any particular cover.

MORTAR VESSEL.—A class of gun-boat for mounting sea-service mortars, and in some cases provided with steam-power. The mortars are usually of the largest caliber—13 inch. To enable the mortar to be properly maneuvered, and to resist the recoil from the nearly perpendicular explosion of so great a piece of ordnance, the vessel has considerable breadth in proportion to her length. The mortar is slung amidships in a massive bed. The ancient form of mortar-vessel was the "bomb-ketch," convenient because of the length of deck without a mast. The present vessels originated during the Russian war, and were found serviceable at the bombardment of Sveaborg.

MORTAR WAGON.—A wagon used for the transportation of siege mortars, siege guns, and heavy projectiles. The limber and wheels are the same as those for the siege-gun carriage. The body consists of a platform of rails and transoms, resting on the rear axle-tree, the two middle rails being prolonged to the front to form the stock. The side rails are prolonged to the rear, and furnish supports for the roller of a windlass; which is used for loading the wagon, the guns, mortars, etc., being drawn up the stock, which rests on the ground, forming an inclined plane. Each end of the roller is provided with pawl and ratchet, operated by a handspike, fitting into a socket after the manner of the windlass of a gin. Over good and firm roads, the mortar-wagon is capable of carrying the 100-pounder Parrott, or any other piece not exceeding in weight 10,000 pounds.

MORTISING-MACHINE. A machine much used in arsenals in the construction of gun-carriages, etc. The self-acting mortising-machine was invented by General Bentham, and described in his specification of 1793. He made them for the British Admiralty previous to 1800. His description includes the operation by means of a hole previously bored and then elongated by a vertically reciprocating chisel; and also the making of a mortise by a rotary cutter during the traveling of the work. One form included a pivoted table. Brunel's mortising-machine, made by Maudslay for the British Admiralty, about 1804, with improvements, is employed at this time for mortising the shells of blocks. The drawing shows the C. B. Rogers medium-power mortising-machine, as employed in most of the arsenals of construction. This machine is provided with boring apparatus and is especially adapted for ordinary work in hard wood and the heavier classes of building. The chisel has a rapid perpendicular motion, and is brought down to the work by the treadle, and carried up by the balance-weight on back end of treadle. It is self-reversing, turning the chisel when the treadle is let up, at each end of the mortise. The bed can be set at any angle required. The machine has the boring apparatus, which is set on the same line with the chisel, so that the work can be bored and then run under the chisel and mortised without unclamping it from the bed. The bit-shaft is run by a belt from the chisel-shaft, and so arranged, that



when the chisel is working the bit stops, and, as the chisel is let up by the treadle, the bit starts, ready for boring. The driving pulley is 10 inch diameter. 3 inch face, and should make 300 revolutions per minute. The machine may be driven from a main line, if it is level with the pulley in top of machine. If not, a counter will be needed, to set on a level with the pulley, and 8 or 10 feet distant. The weight of the machine is 1,450 pounds. See *Double Boring and Mortising-machine*, and *Hub Mortising-machine*.

MOSS TROOPERS. Marauders; free-booters; plunderers. They were confined to the districts which divided the Scotch and English territories before the Union. They were banded together in clans, and lived by rapine, and received this denomination from the character of the country over which they traveled in their adventurous mode of life. In Fuller's *Worthies of England* it is stated that, at one time, they numbered several thousands, and that their great enemies were "The laws of the land and the Lord William Naworth," who finally reduced them to legal obedience. Scott mentions them in *The Lay of the Last Minstrel*.

MOTHIR AL MOOLK.—In the East Indies, a term applied to fortifications, barricades, intrenchments, or breast works.

MOTION. 1. A division of a movement in the manual of arms to facilitate the instruction of recruits. 2. The laws of motion are the fundamental principles connecting force and motion in the physical universe; and are obviously to be derived from *experiment* alone, since intuitive reasoning cannot possibly give us any information as to what may or may not be a law of nature. Though these laws are derived from experiment, it cannot be said that we have any very *direct* experimental proofs of their truth—our most satisfactory verifications of them are derived from the exact accordance of the results of calculation with those of observation in the case of such gigantic combinations of mutually influencing bodies as that of the solar system; and it is by such proofs that they must be considered to have been finally established. They seem first to have been given systematically and completely by Newton, at the opening of the *Principia;* but the first two were known to Galileo, and some of the many forms of a *part* of the third were known to Hooke, Huyghens, Wren, and others. We shall give them here in order, with a few brief comments, showing their *necessity* and their *use* First, then, we naturally inquire, what matter would do if left to itself; and, by considering cases in which less and less external force is applied to a body, we are led to the statement called the *first law of motion*.

1. *Every body continues in its state of rest or of uniform motion in a straight line, except in so far as it may be compelled by impressed forces to change that state.* This expresses simply the *inertia* of matter—i. e., a body cannot alter its *state* of rest or motion; for any such alteration external *force* is required. Hence the definition of force as that which changes or tends to change a body's state of rest or motion. Now, how does the change of state depend on the force which produces it? This is obviously a new question, to be resolved by experiment; and the answer is the *second law of motion:*

2. *Change of motion is proportional to the impressed force, and takes place in the direction of the straight line in which the force acts.* Newton's silence is as expressive as his speech. Nothing is here said about the previous motion of the body, or about the number of forces which may be at work simultaneously. Hence, a force produces its full effect in the form of change of motion, whether it act singularly, or be associated with others; and whatever, moreover, be the original motion of the body to which it is applied. Hence, there is no such thing as equilibrium of *forces;* every force produces motion—and what we call equilibrium is *not* the balancing of forces, but the balancing of their *effects*. Hence, the absurdity of attempting to found the science of Statics on any other basis than is to be derived from the second law of motion; which, in fact, leads us at once (by the *parallelogram of velocities*, which is a purely geometrical conception) to the *parallelogram of forces*, and thence, with the help of the third law, to the whole subject of Statics. The second law also supplies the means of measuring *force* and *mass;* and of solving any prob-

lem whatever concerning the motion of *one* particle. But more is required before we can study the motion of a *system* of particles—as a rigid body, or a liquid, for instance; or a system of connected bodies. Here there are mutual actions and reactions of the nature of pressure or of transference of *energy* between the parts—and these are regulated by the *third law of motion.*

3. *To every motion there is always an equal and contrary reaction; or, the mutual actions of any two bodies are always equal and oppositely directed in the same straight line.* Thus, the mutual pressure between two bodies has equal, but *opposite,* values for the two. The tension of a rope is the same throughout, and tends as much to pull *back* the horse at one end as to pull *forward* the canal-boat at the other. The earth exerts as much attractive force on the sun as the sun exerts on the earth—and the same law applies to the other attractive and repulsive forces, as those of electricity and magnetism. But Newton goes much further than this: he shows, in fact, that action and reaction (subject to the third law) may consist in *work done by a force,* instead of the mere force or pressure itself. From this form of the third law we derive at once the principle of virtual velocities, which in its application to machines is familiar as "*What is gained in power is lost in speed.*" But we also derive the grand principle of the indestructibility of work or energy; at all events in the case of the ordinary mechanical forces—and this must be regarded as one of the grandest discoveries which Science owes to Newton. It is trne that he merely *mentions* it, and then abruptly passes to another subject; yet we can hardly exaggerate the value of this single remark. Experimenters, mainly Davy and Joule, have since shown that all the physical energies, as heat, light, electricity, etc., are subject in their transformations to the third law of motion, and thus the system constructed by Newton for ordinary dynamical purposes, is now found to rnle the most mysterious of the affections of matter. See *Force*, and *Mutipliers.*

MOTON.—In ancient armor, a small plate covering the armpits of a knight, used when plate armor was worn.

MOTTLED CAST-IRON.—A mixture of the white and the gray varieties in varying proportions, the gray iron sometimes appearing in specks, like minute flowers upon a white ground; whilst in other specimens the mass is composed of gray iron, and the white iron appears in spots. Fine gray mottled iron from its great tenacity is known to be the best fitted for large castings where great strength is required, and is employed for gun-founding. It may be made by mixing white and gray iron, or by continuing gray iron in fusion for some time, until it gets the proper color. The kind of mottle will depend much upon the size of the castings. See *Cast-iron.*

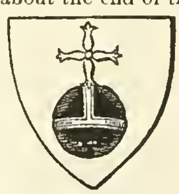
MOTTO.—In Heraldry, a word or short sentence which forms an accompaniment to a coat-of-arms, crest, or household badge. Mottoes were originally attached to the badge when the family had one, or to the crest where there was no badge. In later Heraldry, the practice is to place the motto in an escrol either over the crest or below the shield. A motto is sometimes a religious or moral sentiment, as "Gardez la foi," "Humanitate;" it is not unfrequently a heroic exclamation or war-cry, "Courage sans peur," "Forward." In a great many cases it bears reference to the crest, badge, or some bearing of the escutcheon; thus, Stuart, Earl of Moray, has for crest a pelican wounding herself, and for motto, "Salus per Christum Redemptorem;" and not a few mottoes are punning allusions to the family name—as Scudamore. "Scuto amoris Divini;" Vernon, "Ver non semper viret;" "Fare, fac," for Fairfax; and "Time Deum, cole regem," for Coleridge. Two mottoes are sometimes used by the same family—one above the crest, the other below the shield. The motto, "Dieu et mon Droit," which accompanies the royal arms of Great Britain, is supposed to have been a war-cry, and was used in England at least as early as the time of Henry VI. Its origin has been assigned to a saying of Richard I., "Not we, but God and our right have vanquished France."

MOULINETS.—1. Circular swings of the sword or saber, performed as follows: *Left Moulinet.* Being at guard, extend the arm obliquely to the left and front to its full length, the hand in tierce and as high as the eyes, the point of the saber to the front, and a little higher than the hilt. (Two). Lower the blade, edge to the front, and make rapidly a circle around the hand, to the left of and near the horse's neck, the blade passing close to the left elbow; return to the first position. (Three). Resume the guard.

Right Moulinet. Being at guard, extend the arm to the front to its full length, the hand in quarte, and as high as the eyes, the point to the front, and a little higher than the hilt. (Two). Lower the blade, edge to the front, make rapidly a circle around the hand, to the right of and near the horse's neck, the blade passing close to the right elbow; return to the first position. (Three). Resume the guard.

Rear Moulinet. Being at guard, raise the arm to the right and rear to its full extent, the point of the saber upward, the edge to the right, the body slightly turned to the right. (Two.) Begin by moving the point of the saber toward the left, and describe a circle in rear. (Three.) Resume the guard. In executing the moulinets, the right arm is kept as steady as possible in position, the saber being controlled by motions of the wrist and hand. See *Saber Exercise.*

2. Mechanical appliances employed to draw up the cords of the cross-bows, while the bows were held down by the feet. They were in common use about the end of the 13th century.


Mound.

MOUND.—A bulwark for offense or defense. 2. In Heraldry, a representation of a globe, surmounted with a cross (generally) pattée. As a device, it is said to have been used by the Emperor Justinian, and to have been intended to represent the ascendancy of Christianity over the world. The royal crown of England is surmounted by a mound, which first appears on the seal of William the Conqueror, though the globe without the cross was used earlier.

MOUNT.—The means or opportunity for mounting, especially a horse: and the equipments essential to a mounted horseman. 2. To place one's self on, as a horse, or anything that one bestrides or sits upon. Hence, to put on horseback; to furnish with animals for riding. 3. To put anything that sustains and fits, for use; as, to mount a gun on its carriage, to prepare for being worn or otherwise used; as, a sword-blade by adding the hilt and scabbard. A ship or a fort is said to *mount* cannon when they are arranged for use in and about it. 4. A term in Heraldry. When the lower part of the shield is occupied with a representation of ground slightly raised, and covered with grass, this is called a mount in base; e. g., argent, on a mount in base, a grove of trees ppr.—Walkinshaw, of that ilk, Scotland. 5. A word of command in cavalry exercise for the men to mount their horses. It is executed as follows: The men standing to horse, the Instructor commands: Prepare to mount, whereupon the odd numbers lead out. All the men then face to the right, dropping the right rein from the hand, take two side steps to the right, sliding the hand along the left rein, make


Mount.

a half face to the left so as to bring the right side toward the horse's flank; carry the right foot three inches to the rear; take the reins with the right hand aided by the left, and place the right hand on the pommel, the reins coming into the hand between the thumb and fore-finger, and held so as to feel lightly the horse's mouth. (Two.) Each recruit places a third of the left foot in the stirrup, with the assistance of the left hand if necessary, and supports it against the forearm of the horse; rests upon the ball of the right foot; places the left hand on top of the neck, well forward, and grasps a lock of the mane, the lock coming out between the thumb and fore-finger. The Instructor then commands: 2. MOUNT. At this command, spring from the right foot, holding firmly to the mane, and keeping the right hand on the pommel; bring the heels together, the knees straightened and resting against the saddle, the body erect. (Two.) Pass the right leg extended over the croup of the horse without touching him; let the body come gently down into the saddle; let go the mane, insert the right foot in the stirrup, pass the reins into the left hand and adjust them. At the commands, 3. *Form*, 4. RANK, the even numbers move up upon reaching the saddle, a position should be assumed with the buttocks bearing equally upon the saddle, and as far forward as possible; the reins coming into the left hand on the side of the little finger, and leaving it between the thumb and fore-finger; the little finger between the reins, the other fingers closed, the thumb pressing the reins firmly on the second joint of the fore-finger; the left fore-arm horizontal, the fingers six inches from the body and turned toward it; the little finger a little nearer the body than the upper part of the hand; the right hand behind the thigh, the arm falling naturally, the feet inserted one-third of their length in the stirrups, the heels slightly lower than the toes.

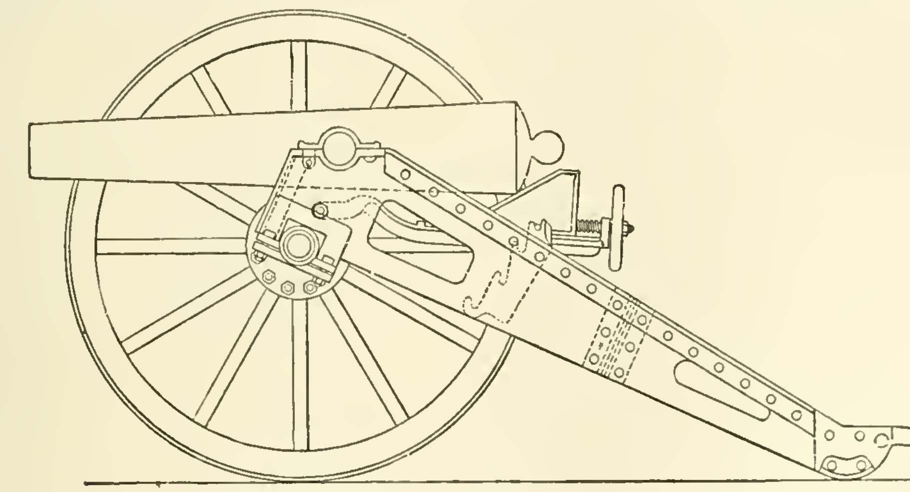
MOUNTAIN ARTILLERY.—Mountain artillery is designed to operate in a country destitute of carriage-roads, and inaccessible to field artillery. It must, therefore, be light enough to be carried on pack-animals. The piece used for mountain service in the United States is a short, light 12-pdr. howitzer, weighing 220 lbs. The form of the chamber is cylindrical, and suited to a charge of ½ lb. of powder. The projectiles are shells and case-shot. It is discharged from a low, two-wheel carriage, which serves for transportation whenever the ground will permit. When the piece is packed, the carriage is packed on a separate animal The mountain howitzer is also employed for prairie service, and in defending camps and frontier forts against Indians, in which case it is mounted on a light, four-wheel carriage, called "the prairie carriage." In the Mexican war, the mountain howitzer was found useful, from the facility with which it could be carried up steep ascents, and to the tops of flat-roofed houses, in street-fighting. See *Field Artillery*.

MOUNTAIN ARTILLERY CARRIAGE.—The carriage for the mountain-rifle is similar in material and general construction to that of the field-gun, and combines strength, simplicity, and lightness. The axle is without an axle-body, and the wheels have metal naves.

The mountain-howitzer carriage should be light enough to be carried on the back of a pack animal, and the axle-tree should be short enough to permit it to pass through very narrow defiles. It differs in construction from the field-carriage, inasmuch as the stock and cheeks are formed of the same piece, by hollowing out the head of the stock. The wheels are thirty-eight inches in diameter, and the axle-tree is made of wood, the arms being protected from wear by *skeans*, or strips of iron. The distance between the wheels is about equal to their diameter. It is arranged for draught by attaching a pair of shafts to the trail. The pack-saddle and its harness are constructed to carry severally, the howitzer and shaft, the carriage, or two ammunition chests, or it enables an animal to draw the carriage, with the howitzer mounted upon it. A portable forge accompanies each mountain battery, and is so constructed that it can be enclosed in two chests, and carried, with a bag of coal, upon the pack-saddle.

The Russian carriage has very short cheeks, the front ends of which are cut off obliquely instead of vertically; the trunnion-beds are let into this oblique face, and the trunnions are held by cap-squares and keys. Krupp makes two sizes of carriages for the 8-centimeter and 6-centimeter guns, respectively. The elevating-screw admits of 18° of elevation and 10° depression. The ammunition-chests are made of wood, with iron angle-pieces.

The English have two carriages, as shown in the drawing, for the two 7-pounder guns, one of which weighs 150 pounds when made of steel, and 200 pounds if made of brass; the other weighs 200 pounds when made of steel, and 224 if made of bronze. The wheels are 30 inches and 36 inches in diameter, respectively, and have a track of 27 inches. The elevating apparatus consists of a movable bed, which hooks on a cross-bar between the cheeks over the axle, and has two studs, one on each side, to rest in racks riveted to the inside of the trail-pieces. A sliding-quoin rests on the bed, and is worked by a screw which passes through a collar in the end of the bed and enters a nut in the quoin. A light iron limber is made for the heavier carriage, and carries two ammunition-chests, which contain ten rounds of ammunition each.



In transportation the gun is carried in Russia and

Germany over the horse's spine, the breech in front, this being deemed the more favorable position for passing narrow passes and the roads through which mountain artillery has frequently to make its way. The objection to having any part of the load cross-ways has induced the Russians to detach the axles for transportation, believing that the delays which may occur on the march from the axle-arms interfering with a free passage through woods, etc., would be greater than would result from having to adjust the axle to the carriage when it was required to commence firing. The carriage pack-saddle is provided with a rear pad to protect the animal's rump from blows from the end of the trail.

The following are the principal weights and dimensions of Krupps carriages :—

	8-centimeter,	6-centimeter.
Weight of carriage with wheels.	322 pounds.	178½ pounds.
Weight of gun with wedge.....	227 pounds.	198 pounds.
Weight of ammunition-chest, packed.................... ..	103.6 pounds.	105½ pounds.
Number of rounds in each chest.	8	16
Weight of pack-saddle.........	46¼ pounds.	46¼ pounds.
Weight of powder-charge......	14 ounces.	7 ounces.
Weight of shell, loaded..	8 lbs. 13 oz.	4 lbs. 6½ oz.
Initial velocity of shell........	952 feet	919 feet.

The following are the principal weights of the English carriages :—

	Pounds.
Weight of light carriage without wheels....................	161
Weight of light carriage with wheels........................	287
Weight of heavier carriage without wheels.........	192
Weight of heavier carriage with wheels.....................	328
Weight of limber.........	333

MOUNTAINOUS SITES.—The crests and gorges are the most important military features of a prominently marked mountainous position. It is through the latter that the roads are made, and the former, from their elevation, command the latter. The crests should therefore never be abandoned to the enemy, although from their position, or distance, they may not directly overlook the gorges; for, independently of the real advantage of position, which the enemy would thus acquire, he would possess a relative advantage in the moral effect produced on troops when they find themselves in a commanded position. If the base of the mountain does not stretch out too far from the summit to admit of a sure retreat on the latter, works may be thrown up for the defense of the base, with intermediate works between the base and the summit placed on the secondary ridges, or other commanding points. But if the distance between the summit and the base is great, and particularly if it is decided beforehand to retreat upon the summits, in case of disaster, then the base should be disregarded.

The works thrown up for the defense of the summit should be laid out on the brow of the height, for the purpose of overlooking and guarding its sides. As has already been stated, the plan and relief of the defenses will be subordinated to the features of the ground. Where the surface along the crests is undulating, presenting salient and re-entering parts, consisting of spurs and ravines more or less prominent, the salient points should be occupied by works with a good relief, and otherwise strengthened by passive obstructions to the assailant's advance, as from their position a broad flanking sweep of the surface for artillery can be obtained for the defense of the approaches upon the collateral salients. The re-entering portions may be occupied with defenses of a weaker profile, as their position is stronger and it is from them that a strong fire of musketry and of the lighter field guns can be brought to bear upon the ground directly in front of the salients adjacent to them. The cremaillère line and the redan line with long curtains broken forward, so as to form a tenailled combination with alternate long and short branches, both lend themselves better than most other combinations to a configuration of ground of this description.

Very steep slopes will not admit of a defense with artillery, because the gun cannot be fired under a much greater depression than one-sixth, and unless the shot take effect the enemy will be inspirited to advance, confiding in the safety of his position. In slopes of this character the works may consist simply of a parapet, in the form of a glacis, without any ditch, the earth for the parapet being taken from an interior trench; in some cases a dry stone wall may be substituted for an earthen parapet. An abattis may be formed in front of the parapet within close musket range; and heavy round logs, or large masses of rock, be arranged along the parapet, ready to be rolled over on the enemy should he break through the abattis. Steep escarpments of rock are generally considered as inaccessible; but those points should never be left to their own strength. It is always prudent to post a small detachment to frustrate an attempt of the enemy to surprise them. A steep natural slope maybe made inaccessible by cutting away the face of the eminence.

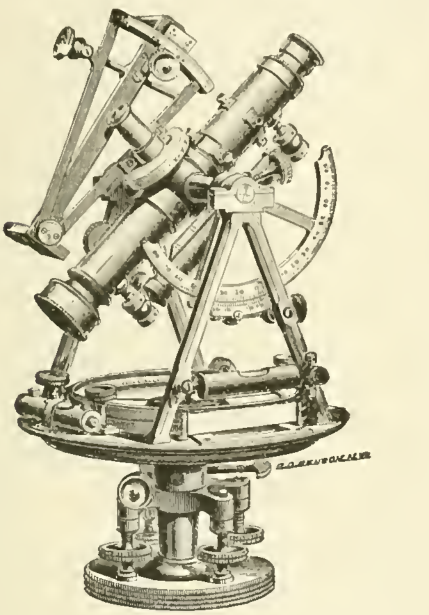
It may, in some cases, be indispensably necessary to guard certain points at the base of a mountain, as, for example, where the base is washed by a river, over which there is an important ferry. Under such circumstances the point to be guarded should be most thoroughly protected by some strong work; moreover, a number of posts, placed at intervals on the most commanding points between the summit and the base, should connect the two. These posts should, when practicable, be placed in defensive relations, and in all cases their fire should sweep all the ground between the two principal points. The interior of the posts most advanced should be exposed to the fire of those in their rear, in order that the enemy may be driven out, should he succeed in forcing his way into any one. As these posts will require a considerable detachment for their defense, care should be taken not to multiply their number unnecessarily, and never at the expense of the main defense. All communications, leading through the mountains, should be carefully guarded, both at their outlets and at the most suitable intermediate points for defense; otherwise the most respectable positions will be liable to be turned by the enemy. If the communications are not of use to the assailed, they must be barred by a line of abattis, or by an artificial inundation, etc.; and they should be watched by a detachment of light troops, whose retreat on the main works should be secured in case of an attack by superior forces. If the communications are of use to the assailed they should be defended by intrenchments, which should command and enfilade them in the most effectual manner.

MOUNTAIN TRANSIT.—This instrument is a modification of the Engineer's Transit, made for mountain and mine surveys, but applicable as well to all the other work of the Engineer. It is made exceedingly light and portable, its needle being 4 inches long; and its telescope 8 inches long, having a power of 20 diameters. Its sockets with the leveling head, remain attached to the instrument; and its compass circle is movable about its center, so as to lay off the variation of the needle. In this instrument the limb is divided on solid silver to half degrees, with verniers reading to single minutes: sometimes the limb is divided to twenty minutes with verniers reading to half minutes. There are also cylindrical caps above the leveling screws to exclude the dust, etc. The drawing shows one of the celluloid reflectors, which are placed over the two opposite verniers of the limb, and are of service especially in the surveys of mines, to throw light upon the divisions below.

Like the Engineer's Transit, this instrument is sometimes used with a plain telescope; but oftener with one or more of the extras, as level, clamp and tangent, and vertical circle. More frequently, however, the Mountain Transit is furnished as shown, with vertical arc, level, clamp and tangent, and the solar attachment,' which is essentially the solar apparatus of Burt placed upon the cross-bar of the ordinary transit, the polar axis being directed above instead of below, as is the case in the solar compass. A little circular disk of about an inch and a half diameter, and having a very short, round pivot, projecting above its upper surface, is first securely screwed to the telescope axis. Upon this pivot rests the enlarged base of the polar axis, which is also firmly connected with the disk by four capstan-head screws passing from the under side of the disk into the base already named. These screws serve to adjust the polar axis.

The hour circle surrounding the base of the polar axis is easily movable about it, and can be fastened at any point desired by two flat-head screws above. It is divided to five minutes of time; is figured from I. to XII., and is read by a small index fixed to the declination arc, and moving with it. A hollow cone, or socket, fitting closely to the polar axis and made to move snugly upon it, or clamped at any point desired by a milled-head screw on top, furnishes by its two expanded arms below, a firm support for the declination arc, which is securely fastened to it by two large screws, as shown.

The declination arc is of about five inches radius, is divided to quarter degrees, and reads by its vernier to single minutes of arc, the divisions of both vernier and limb being in the same plane. The declination arm has the usual lenses and silver plates



on the two opposite blocks, made precisely like those of the ordinary solar compass, but its vernier is outside the block, and more easily read. The declination arm has also a clamp and tangent movement, as shown in the drawing. The arc of the declination limb is turned on its axis and one or the other solar lens used, as the sun is north or south of the equator; the drawing shows its position when it is north. The latitude is set off by means of a large vertical limb having a radius of two and a half inches; the arc is divided to thirty minutes, is figured from the center, each way, in two rows, viz., from 0 to 80°, and from 90° to 10°, the first series being intended for reading vertical angles; the last series for setting off the latitude, and is read by its vernier to single minutes. When desired, an arc of three inches radius is prepared reading by its vernier to half minutes of a degree. It has also a clamp-screw inserted near its center, by which it can be set fast to the telescope axis in any desired position. The vernier of the vertical limb is made movable by the tangent-screw attached, so that its zero and that of the limb are readily made to coincide when, in adjusting the limb to the level of the telescope, the arc is clamped to the axis. The usual tangent movement to the telescope axis serves, of course, to bring the vertical limb to the proper elevation. A level on the under side of the telescope, with ground vial and scale, is indispensable in the use of the solar attachment. The divided arcs, verniers, and hour circle are all on silver plate, and are thus easily read and preserved from tarnishing.

To determine latitude, first level the instrument very carefully, using, as before, the level of the telescope until the bubble will remain in the center during a complete revolution of the instrument, the tangent movement of the telescope being used in connection with the leveling screws of the parallel plates, and the axis of the telescope firmly clamped. Next clamp the vertical arc, so that its zero and that of its vernier coincide as near as may be, and then bring them into exact line by the tangent-screw of the vernier. Then, having the declination of the sun for 12 o'clock of the given day as affected by the meridional refraction carefully set off upon the declination arc, note also the equation of time and fifteen or twenty minutes before noon, the telescope being directed to the north, and the object-end lowered until, by moving the instrument upon its spindle and the declination arc from side to side, the sun's image is brought nearly into position between the equatorial lines. Now bring the declination arc directly in line with the telescope, clamp the axis firmly, and with the tangent-screw bring the image precisely between the lines and keep it there with the tangent-screw, raising it just as long as it will run below the lower equatorial line, or in other words, as long as the sun continues to rise in the heavens. When the sun reaches the meridian the image will remain stationary for an instant, and then begin to rise on the plate. The moment the image ceases to run below is of course apparent noon, when the index of the hour arc should indicate XII, and the latitude be determined by the reading of the vertical arc. It must be remembered, however, that the angle through which the polar axis has moved in the operation just described is measured from the zenith instead of the horizon as in the ordinary solar, so that the angle read on the vertical limb is the complement of the latitude.

The Mountain Transit is usually placed upon an extension tripod, in which all the legs can be shortened or lengthened at will. It is thus adapted for use in mountain surveys, where one or more legs must be shortened; or for mines, where in many places a short tripod is indispensable. If desired, the sliding pieces can be easily turned end for end, the points being thus put out of the way, and the tripod more safely transported. The tripod when closed is only three feet long, and is carried by an ordinary shawl-strap. The weight of this instrument, as made by the Messrs. Gurley, United States, with plain telescope is 8½ pounds; with the solar attachment, arc, level, and clamp, 9½ pounds. The extension tripod weighs about 8 pounds. See *Engineer's Transit*.

MOUNTAIN WARFARE.—In warfare, mountains offer a considerable obstacle to an invading army, and, if properly defended, may either stay the advance of an enemy or prevent ingress into the country. The difficulty to be overcome will be still greater if there be other obstacles, such as rivers and a succession of mountain ranges. In such warfare the invading General should use every precaution in examining each step of the way, and gleaning all information in his power from maps, guides, and reconnoissances. Further, he should be careful that he does not fall into a trap, which the enemy may lay for him in feigning retreat, when he is endeavoring to outflank him and get in his rear, thus rendering the position of the invader very precarious. It should therefore be laid down as a maxim that, in mountain operations, especially, the flanks and rear of the invading army must be secured, to prevent being surrounded. One of the great difficulties in this nature of warfare is keeping the communication open with the rear, and bringing up food for the army, as mountain ranges, passes, etc., do not afford facility for using wheeled carriages; and the transport, therefore, resolves itself into men and pack animals. Such transport forms but a slow and precarious means of carrying forward supplies, if not well guarded. History affords examples of the difficulty of mountain warfare in transporting the *matériel* of war; thus, for instance, that of Napoleon, the First Consul, whilst effecting the passage of the Alps, with the French army, in that part called the Great and the Little St. Bernard. The carriage of his artillery and stores was a source of great anxiety and difficulty. The exertion of a whole battalion was requisite for the conveyance of one field-piece, with its proportion of ammunition; one-half of the regiment could only draw the load, while the other half was obliged to carry the knapsacks, firelocks, camp kettles, and five days' rations.

MOUNTED PAY.—A grade of pay allowed mounted officers, or to other officers serving under conditions which entitle them to the same pay. The following officers, in addition to those whose pay is fixed by law, are entitled to pay as mounted officers: officers of the Staff Corps below the rank of Major, officers of troops of cavalry, officers of one light battery for each regiment of artillery, officers announced in orders from the Adjutant General's Office as Acting Signal Officers, and authorized Aides-de-Camp duly appointed as such. Other light batteries of artillery which may be designated by the President, and equipped as such, will each have the organization of a light battery, except the additional 2d Lieutenant and the officers thereof actually serving with the light batteries will be mounted. Officers actually serving with companies of infantry mounted by authority of the War Department, and not in excess of the legal organization of infantry, are mounted while so serving. A company of infantry mounted retains the same organization as on foot. Other officers on duty which, in the opinion of the Department Commander, requires them to be mounted, are entitled to be so considered, on the certificate of their Department Commanders that they have been on duty in the service of the United States which required them to be mounted during the time. See *Pay*.

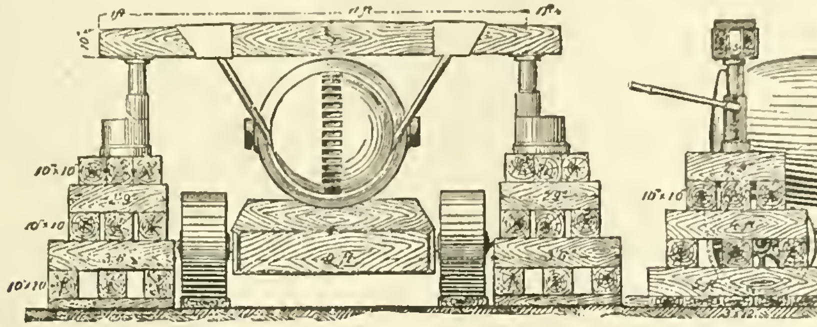
MOUNTED RIFLEMEN.—Mounted infantry, the designation of riflemen being given to them from the arm they were equipped with. Mounted riflemen are soldiers trained to act as foot and cavalry soldiers. This arm is but little known at the present time in the British service, but since the war of 1870–71, which has confirmed the opinion held by many soldiers, that mounted riflemen are now essential to every enterprising army, the subject of reintroducing it in the army has been often discussed. The first mention in military history of mounted riflemen is that of the dragoons created by Maréchal de Brissac in 1600. They were foot soldiers mounted on horses, who on emergencies carried a comrade *en croupe*. The first official record of such troops in the British service dates from a royal warrant of 1672, which regulates the matchlock as one of the arms. The Scots Greys, who were raised in 1683, carried also fire-arms, as well as the British dragoons of the seventeenth century; both were instructed to act as infantry on horses, to enable them to make more rapid movements. Dragoons, acting as such, were eventually changed into cavalry; and the last corps bearing the name of mounted riflemen was that at the Cape, which was disbanded a few years ago. This nature of mounted infantry has been reintroduced in the volunteer forces of the country, there being four small bodies of mounted riflemen. Mounted riflemen were considerably used and appreciated by Napoleon I. and his Generals. Jomini writes on the subject as follows: "It is certainly an advantage to have several battalions of mounted infantry, who can anticipate an enemy at a defile, defend it in retreat, or scour a wood." Sir G. Wolseley, in writing on the subject of outposts, gives it as his opinion that, whenever mounted infantry is introduced into the service, and its employment properly understood, these outpost duties will devolve to a very considerable extent on it. Such men are invaluable in covering retreats; to seize, destroy, and hold bridges; for works of destruction, such as removing rails and telegraphs, etc. For these duties they were frequently employed in the American and the last Continental wars, most foreign armies having adhered to that system. Colonel Hamley says, in his "Operations of War," second edition: "As cavalry alone could effect nothing in an intersected country, or against a body of mixed troops, or a force sheltered by obstacles, it is indispensable that the troops thus employed, while mounted for the sake of celerity, should be able to meet infantry on good terms. Their chief action must therefore be as infantry, the horses of the dismounted men being held by their comrades. . . . Mounted infantry is altogether a different thing from dismounted cavalry, and the two kinds of force should be kept carefully distinct. All experience has shown that cavalry who are habituated to rely on their fire-arms are apt to lose their distinctive characteristics of promptitude, impulsion, and resolution in attack; and it would be impossible, by any amount of training, to combine such opposite functions in the same troops. By establishing mounted riflemen as a separate arm of the service, men and horses of a size which, though admirably suited for rapid and sustained movements, is deficient in the power and weight that tell so formidably in the charge, might be turned to excellent account." Colonel Hamley further states that on this kind of troops might properly devolve the business of reconnoitring or heading the advanced guards, of seizing defiles, etc. On the other hand, the regular cavalry, spared in great measure the harassing duties which fritter away its strength, would be preserved intact for the day of battle. In a country like India, infantry can be mounted on camels, and has been so utilized when it was desirable to send troops on a forced march to take a place by surprise, or to scatter a collecting force. Each camel carries two men. It would be necessary on such service to dismount; and rest the men during the journey. But except for the expense there is no reason why there should not be a permanent Corps.

MOUNTING CANNON.—If the platform is much above the general level of the ground, as in casemated batteries and on ramparts, the cannon have to be raised by strong *derricks* to the level of the platform, or they may be drawn up ramps of earth or of scaffolding.

1st. The chassis being on the platform, the top carriage not in position.

There will be required to mount the gun one or two *hydraulic* or two or three *screw jacks*, depending on their power, and *blocks* of different lengths and widths, varying in thickness from one to twelve in., also a few skids and chocks. The gun is brought parallel and near the chassis, a jack is placed under the breech and one under the muzzle; the extremities of the gun are raised alternately and supported by blocks till they are at such a height that skids placed on the rails of the chassis will pass under it. The gun is rolled till it occupies a proper position under that for the top carriage. It is then raised as before, being supported by cribs of blocks built one under the swell of the breech, another under the chase, three feet from the muzzle, till it is brought to a height above that for the trunnion beds, the trunnions being level. The top carriage is taken to pieces and assembled in position under the gun, which is then let down into place.

2d. The chassis and top carriage being in position.—The gun is brought parallel to the chassis, and is raised and rolled as before on to skids placed on the rails in rear of the top carriage, the breech projecting to the rear. It is then lifted by jacks and supported on a crib of blocks built in rear of the chassis under the breech, and by a skid bearing under the muzzle laid across and resting on two cribs, one on each side of the muzzle without the chassis. The gun being sufficiently high, the top carriage is moved to the rear and the gun lowered into the trunnion beds. In raising heavy cannon an ordinary gin can sometimes be used for the muzzle, the jack being required for elevating the breech only. In building the cribs the thickest blocks, as a rule, should be



placed at the bottom, and thin blocks should be replaced by thicker ones as the gun rises.

3d. The cannon being on or by the platform, the chassis and the top carriage in position or not.

In many instances the position of the platform is such that the mounting may be facilitated by the jacks being placed above the gun. In this case a special device is used. The jacks, two in number, are supported each upon a heavy timber or *bolster* resting on blocks, or on high, strong trestles. On top of the jack rests one end of a *lever*, the other end bearing on a *fulcrum*. A strong iron *hoisting-bar* also through one made in the lever. This bar is passes through a mortise prepared in the bolster and pierced with a number of holes, into which iron pins may be placed. The extremities of the gun are slung to the lower ends of the hoisting-bars; pins being placed in the bars immediately above the levers, the jacks acting on the levers raise the gun; pins are then passed through the bars above the bolsters and the weight sustained by them till a new lift is taken with the jacks; by transferring the pins the gun is brought to any desired height, the jacks being worked together. The bolsters should be of sufficient length to embrace the chassis, and the gun placed by the side of it. If the chassis and top carriage are in position the gun is raised to the necessary height, the carriage traversed till it is brought beneath it, and the gun then lowered into place. If the gun alone is on the platform it can be raised, and the chassis and top carriage be brought in succession on a truck and placed in position beneath it. The appliances to be employed in mounting heavy cannon, and the order in which the different parts should be placed on the platform, must vary with the position and nature of the work and the construction and the arrangement of each particular platform. Any device or arrangement that may expedite or facilitate the work should be resorted to. The circumstances may be such as to render advisable slight variations in the steps taken in mounting each gun in a battery. See *Mechanical Maneuvers*.

MOURNE.—That part of a lance or halbert to which the steel or blade is fixed.

MOUSER.—In the British Army, a sobriquet which was sometimes used in sport to distinguish the battalion men from the flank companies. It was indeed generally applied to them by the Grenadiers and Light Bobs, meaning that while the latter are detached, the former remain in quarters, like cats to watch the mice, etc.

MOUSING A HOOK.—A mode of passing a piece of spun yarn round the point and back of the hook of a block, in order to prevent it disengaging itself from anything to which it may be hooked.

MOUSQUETAIRES.—A body of horse-soldiers under the old French *Régime*, raised by Louis XIII, in 1622. This Corps was considered a Military School for the French nobility. It was disbanded in 1646, but was restored in 1657. A second company was created in 1660, and formed Cardinal Mazarin's Guard. Also written *Musketeers*.

MOUSQUET FUSIL.—A *flint-lock* gun which was invented by Marshal Vauban, about 1640, and which was so contrived that in case the flint did not strike fire, the powder might be inflamed by means of a small match which was fixed to the breech. Most authors of Encyclopedias, from the habit of copying one another, have repeated that the bayonet was invented and manufactured at Bayonne by Puységur, who died in 1682. Nevertheless this sort of dagger or sword had been adapted to the arquebusc, and even perhaps to the earliest portable fire-arms. The bayonet was already known in France in 1570, but was not universally adopted until 1640, when it replaced the pike in certain regiments. Subsequently the bayonet was fixed at the end of the gun by means of the socket. This was the side-arm joined to the fire-arm, called *musket-gun*, and attributed to Vauban.

MOUTH.—1. The opening of a piece of ordnance at which the charge is introduced, and from which, when fired, it issues. 2. The interior opening of an embrasure, from eighteen inches to two feet wide, according to the caliber of the gun, and of a rectangular or trapezoidal form. See *Embrasure*.

MOVABLE BATTERY.—A battery usually consisting of field guns and small mortars which can take up, temporarily, any favorable position for damaging the enemy's defences. The movable gun batteries will consist of 10, in some cases, 20-pounder rifled guns; and the Napoleon gun for throwing hollow projectiles. These guns will take advantage of any temporary covers, as undulations of the ground, woods, fences, etc., from which they can bring a damaging fire on the defences, and which they will maintain until the fire of the besieged becomes too heavy for them. In this way, a very important auxiliary to the fixed batteries will be called into play; sometimes forcing the besieged to establish new positions to drive off these light guns. In like manner the smaller mortars that can be readily moved by hand, or on sleds, may be placed in good temporary positions to increase the amount of fire delivered on any given point. See *Batteries* and *Fixed Batteries*.

MOVABLE PIVOT.—The arc described by the soldier or guide on that flank of a line of troops toward which a wheel is made. See *Pivot*.

MOVEMENT.—The regular and orderly motion of an army for some particular purpose. It is also described as the changes made by an army from place to place, either to take up new camping ground, to engage the enemy, or to avoid him. Under this term are comprehended all the different evolutions, marches, countermarches, and maneuvers, which are made in Tactics, for the purpose of retreating from or of approaching towards an enemy. The science of military movements forms one of the principal features in the character of a great Commander. If he be full of resource in this important branch, he may oftentimes defeat an enemy without even coming to blows, for to conceal one's movements requires great art and much ingenuity.

MOYENNE.—An ancient 4-pounder, 10 feet long, weighing 1,300 pounds. In the time of Charles IX. (1572) it was a $2\frac{3}{4}$ pounder.

MOYENNE VILLE.—A term formerly given by the French to any town in which the garrison was equal to one-third of the inhabitants, and which was not deemed sufficiently important to bear the expense of a citadel; more especially so because it was not in the power of the inhabitants to form seditious meetings without the knowledge of the soldiers who were quartered on them.

MOYENS COTES.—In a fortification, all those sides which contain from 80 to 120 toises in extent. They are always fortified with bastions on their angles. The *moyens cotés* are generally found along the extent of irregular places, and each one of these is individually subdivided into small, mean, and great sides.

MUFTI.—A term in the army for plain clothes, the opposite of regimental clothing. In the British army, an officer in England is permitted to appear in *mufti* when off duty.

MUHLAGIS.—Turkish Cavalry composed of expert horsemen, who generally attend the beglierbeys. They are not very numerous.

MUIRKIRK IRON.—A variety of iron well suited for the purposes of gun construction. It is made with charcoal at Muirkirk, Prince George's County, Maryland The ore used is a nodular carbonate of iron from the tertiary sands of the western shore of Chesapeake Bay. It is more or less altered into sesquioxide of iron by the action of surface water, and is cleaned and roasted before charging the furnace. The yield of iron from the raw ore is from 40 to 45 per cent., and from the roasted about 50 per cent. This iron has been used at the South Boston foundry for a number of years and with excellent results, but has not until recently been employed for ordnance purposes. See *Dover Iron* and *Iron*.

MUIR-MONTSTORM RIFLE.—A breech-loading small-arm having a fixed chamber closed by a movable breech-block, which rotates about a horizontal axis at 90° to the axis of the barrel, lying below the axis of the barrel and in front, being moved from above by a thumb-piece. The breech-block of this arm is moved by an outside lever, the interior shaft connected with which is cam-shaped, so that the first motion of opening draws down the breech-block, until a lip on its upper surface is clear of a hook or jaw formed on the under side of a projection of the frame overhanging the mouth of the chamber. By continuing the motion of the lever, the breech is fully exposed by the rotation of the block, the hammer at the same time being brought to the full-cock. By reversing the movement of the lever the breech is closed. The breech-block is locked by the abutment of the frame upon its back. Extraction and ejection are accomplished by a sliding extractor in the lower side of the barrel. Its under side is notched for the upper end of a lever, which is pivoted on the same pin as the hammer. This lever has two horizontal arms, which are struck by corresponding prongs on the lower side of the block, in opening the piece.

MULCT.—A soldier is said to be *mulcted* of his pay when put under fine or stoppages for necessaries, or to make good some dilapidations committed by him on the property of the people or the government.

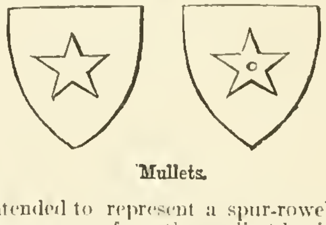
MULE.—A hybrid animal, the offspring of the male ass and the mare, much used and valued in many parts of the world as a beast of burden. The ears are long; the head, croup, and tail resemble those of the ass rather than those of the horse; but in bulk and stature the mule approaches more nearly to the horse. The mule seems to excel both the ass and the horse in intelligence; it is remarkable for its powers of muscular endurance; and its sure-footedness particularly adapts it to mountainous countries. It has been common from very ancient times in many parts of the East; and is much used also in most of the countries around the Mediterranean Sea, and in the mountainous parts of South America. Great care is bestowed on the breeding of mules in Spain and Italy, and those of particular districts are highly esteemed. In ancient times the sons of Kings rode on mules, and they were yoked in chariots. They are still used to draw the carriages of Italian Cardinals and other ecclesiastical dignitaries. Both in Spain and in South America mules employed to carry burdens are driven in troops, each preceded by an animal—in South America usually an old mare—called the *madrina*, or godmother, to the neck of which a little bell is attached, and the mules follow with the greatest docility. When troops mingle in their halting-places or elsewhere, they are readily separated, as they recognize at once the sound of their own bell. Mules are comparatively little used in Britain.

Pack mules should not be too large or high on their legs. The Spanish-Mexican mules, for endurance, are superior to all others. These mules are small, but can stand a great amount of abuse and starvation, and will suffer but little from the effects of a hard drive. Being smaller than the American mules, they can fill up in a much less time, and it will be found that in three hours on thin grass they will fill up and recuperate better than American mules on the same pasture in six hours. This is the secret of small mules outlasting the large ones in the mountains and on the prairies. The time spent in camp is not sufficiently long, when the grass is scarce, to allow a large one to find enough to eat. The small mule finds sufficient in a short while and has some time left for rest and recuperation.

As in other hybrid animals generally, males are more numerous among mules than females, in the proportion, it is said, of two or three to one. There is no instance on record of offspring produced by two mules: but instances occur, although rarely, of their producing offspring with the horse and with the ass. The mule is very superior in size, strength, and beauty to the hinny, the offspring of the male horse and the female ass. See *Pack Animals*.

MULLER.—A hand instrument made of wood and covered with leather; it is used in the laboratory for reducing powder to great fineness. The term is also applied to the painter's stone for mixing paint.

MULLET.—Mullet, or Mollét, in Heraldry, is a charge in the form of a star having generally five



Mullets.

points, intended to represent a spur-rowel, and of frequent occurrence from the earliest beginnings of coat-armor. Gwillim, Sir George Mackenzie, and Nisbet lay it down that mullets should always be pierced to represent the round hole in which the spur-rowel turns, but this has been by no means uniformly attended to in practice. Much confusion exists in blazonry between mullets and stars; in England the rule most generally adopted is that the mullet has five points, whereas the star has six, unless any other number be specified. Nisbet lays down a rule nearly the converse of this, which has never been adhered to; and in Scottish Heraldry the same figure seems to be often blazoned as a mullet or a star, according as it accompanies military or celestial figures. The mullet is the mark of cadency assigned to the third son, "To incite him to chivalry." The mullet is occasionally used in Heraldry for the fish so called. See *Heraldry*.

MULTIBALL CARTRIDGE.—A cartridge in which two or more bullets or pieces of lead are substituted for the ordinary bullet, with the idea of doing more execution at short ranges. The following advantages are claimed for the encased multiball cartridge as manufactured by Merwin, Hulbert & Co:—1. No leading of barrel by any number of discharges. 2. At each discharge the casing acts as the cleaner and lubricates the barrel. 3. The lubricated case taking the rifling gives an easy transit of balls and accuracy of flight. 4. The lubricant is preserved under the different ordinary degrees of temperature. 5. By the centrifugal force given to the casing and balls by the rifling, the casing is thrown off after leaving the barrel, the balls diverge or separate nearly equal to the front of three men at about one hundred yards distance. 6. The multi (or 3-ball) cartridge in its effective (or destructive) results at each discharge at short range is nearly equal to three separate discharges by a breech-loader throwing one ball. 7. The cartridge is firmly constructed and will withstand rough usage of actual service and preserve its uniformity of shape. 8. Continuous (and rapid) firing without requiring the barrel to be cleaned. 9. Preservation of powder. The casing as an insulator prevents galvanic action between the metallic shell and balls which chemical action in time would deteriorate the powder. 10. The casings are made, the balls placed and secured firmly therein, separate from the metallic shells and can be transported in bulk or otherwise without injury and attached to the loaded metallic powder case when desirable (or at reloading of shells)

The multiball cartridge for the service rifle is shown in Fig. 1, and has the following particulars:

Weight of powder charge. . . .	grains.	52
Number of balls.		3
Diameter of balls (each)		0″.424
Weight of balls	grains.	108.66
Total weight of lead.	grains.	326

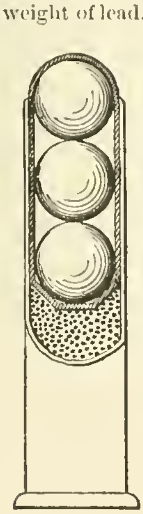


Fig. 1.

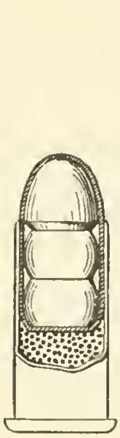


Fig. 2.

The charge is inclosed in a copper cartridge case of service dimensions. The three balls are inclosed in a strong casing of paper lubricated with a mixture of paraffine and beeswax, making of them a single piece. The paper is saturated with the lubricant. The case is crimped at the base to hold the balls in place; longitudinal cuts are made through the case to facilitate rupture after it has left the piece. (A light coating of shellac covers the portion of the case that projects from the shell in some of the cartridges with a view to protection of the cartridges from atmospheric influences). The lubricant is placed in the recesses (corresponding to cannelures), where the balls come in contact.

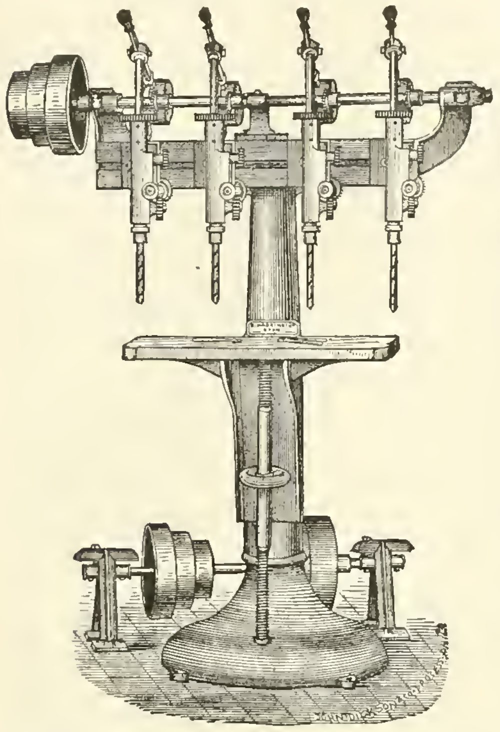
The multiball cartridge for the service revolver is shown in Fig. 2, and has the following particulars:

Weight of powder charge . . .	grains	22
Number of balls (1 ogival and 2 spherical segments)		3
Diameter of balls		0″.424
Length of ogival bullet		0″.39
Altitude of segments -		0″.236
Weight of ogival bullet	grains	111
Weight of segments (each) . . .	grains.	82
Total weight of lead	grains.	275

The charge is inclosed in a copper cartridge case, of service dimensions. The paper casing for the bullets is like that for the rifle. The ogival has a flat base, and the bases of the segments fit to this and to each other. The lubricant is placed in the recesses and about their junctions. Assuming that $1\frac{1}{4}$ inches penetration in soft pine boards with these balls would inflict a dangerous wound, it has been found by experiment that the effective range of the rifle-bullet multiball is limited to about 160 yards; and with the pistol even at 25 yards, but one of the bullets in the cartridge has a penetration of $1\frac{1}{2}$ inches. The question naturally arises whether it would be advisable to encumber men in action with cartridges which, as revolver cartridges, are not at any range superior to the uniball to inflict a dangerous wound, and in any case could not be used with effect beyond 75 yards; and as rifle cartridges could not be used with effect beyond 175 yards, while their superiority to the uniball is limited between 30 and 160 yards. See *Buckshot Cartridge* and *Wright Multiball Cartridge*.

MULTI-CHARGE GUN.—Many attempts have been made by inventors to utilize the accelerating effect on the projectile of several charges successively fired in a gun. Bessemer proposed to use a very long gun, placing the charges separately in holes at the breech, to be fired in succession by electricity. In the Lyman-Haskell multi-charge cannon, the inertia of the shot is first overcome by a moderate charge of very coarse-grained, slow-burning powder, and then repeated charges of quick-burning powder are applied in succession until a great increased velocity is attained. In recent experiments with an acce e-ating or multi-charge gun the average penetration in laminated armor composed of one-half inch boiler-plates was $4\frac{7}{16}$ inches. No doubts are entertained by experts that early experiments will show that these guns, at comparatvely moderate cost, will be at least as efficient as the best in Europe. See *Lyman Haskell Multi-charge Cannon*.

MULTIPLE DRILL.—A tool designed more especially for drilling side frames and steel armor plates, but well adapted to a wide range of other general work in the armory. The large size machine is fitte l with two or any required number of sliding heads; these heads, carrying drill spindles, with a lateral range of 17 feet from center to center of spindles, and a forward and back movement, at right angles, on a sliding horizontal arm, of 10 inches (or more if desired), thus enabling holes to be drilled in *line or otherwise*. Capacity on top of table under drill spindle, 32 inches; from floor to top of table, 32 inches; fsom column to center of drill spindle, 22 inches, or more, according to length of the sliding arm; from column to front of table 18 inches; top surface of table, 14 inches wide by 18 feet 4 inches in length; table has a front or vertical surface, 25 inches deep by 18 feet 4 inches in length; T-slots on both top and vertical surfaces for clamping work; vertical traverse of spindles, 12 inches; spindles balanced by weight attached direct to top of spindle; has quick return by wheel and rack; has automatic gear feed suitable for drilling or boring; driving cone $22 \times 4\frac{1}{4}$ inches in diameter, to run 225 turns per minute, four or more sections; each head has perfectly independent universal movement and an independent feed, also an independent friction for stopping and starting; spindles are steel; pinions and rack gearing are of steel; steel shafts and screws; all cut gearing; floor space occupied, 48 inches wide by 18 feet 8 inches long; total height to top of spindles, 9 feet; weight, 18,000 pounds. The drawing shows a smaller tool which is used for general work. The spindles have hand and power feed; balanced, quick return by lever; lateral adjustment, can be run one or more at same time, and at any desired speed, by arrangement of gearing; table has vertical adjustment by right and left screw; distance from spindle to column, $7\frac{1}{2}$ inches; and with counter-shaft and pulleys, 12 by $3\frac{1}{2}$ inches, to run 350 turns per minute. Weight, 850 pounds. See *Drill Press* and *Gang Drills*.



MULTIPLE LINES.—It has been proposed, by some writers, to throw up several lines of detached works for the defence of a position; so that the troops in the first line may retreat under cover of the second, and so on. This arrangement, in the first place, can seldom be made, without *weakening the order of battle*, and therefore weakening the defence, by too great a dissemination of the troops. Moreover, in works of great extent there never can be that concert which is so essential to a vigorous defence, from the impracticability to direct it properly. The troops destined to act offensively against the enemy if repulsed, are too far in the rear to be brought up in time; and the ground being greatly cut up, by such a multiplication of works, will render the maneuvers slow and difficult. Besides, *a very capital objection in war*, the time and labor required to throw up so many works are altogether beyond what can be disposed of in the ordinary circumstances of an army. See *Lines*.

MULTIPLIERS.—It would exceed the limits of this work to enter into a discusion of the formulas from which the values of the multipliers used in the equations of motion in air are calculated; it will be sufficient to explain how these tables are used in practice.

The reader will find this subject, as well as all others relating to Ballistics, ably and fully treated in Dinion's *Traité de Balistique*.

Multiplier B. The decimals are carried out to three places, which is sufficient for ordinary purposes. The valnes of $\frac{x}{c}$ are given in the first horizontal line, the value of $\frac{V_,}{r}$ in the first vertical column, and the values of the corresponding multipliers are set opposite to them.

To find the multiplier B for two intermediate values of $\frac{x}{c}$ and $\frac{V_,}{r}$, not given in the tables, we seek, in the absence of the proper numbers, the corresponding values of the nearest tabular numbers. We add to these, parts proportional to the differences, as though each part were to be considered separately.

Multiplier I. The values of I are given in the same table as those of B; except that it is necessary to commence in the lower horizontal line, and subtract from them the product of $\frac{V_,}{r}\left(1+\frac{V_,}{r}\right)$, by the corresponding number of the line called "Correction."

Values of U and D. This table is calculated for differences of 0.10 in case of $\frac{x}{c}$, in the upper line, and for differences of .05 in case of $\frac{V_,}{r}$. For U, the values of $\frac{x}{c}$ are found in the upper horizontal line, and for D, in the lower line.

Values of $\frac{x}{c}B$ for calculation of Ranges. This table gives the value of $\frac{x}{c}$ and $\frac{V_,}{r}$, for differences of 0.05 and 0.05; the unknown quantity to be determined is $\frac{x}{c}$ when $\frac{V_,}{r}$ and $\frac{x}{c}B=p$, are given.

Arrange the calculations as in the preceding cases. Only one of the proportional parts is unknown, and this is determined by the condition, that if it be added to the other proportional part, and to the number in the table, the sum is equal to the required number.

Values of $\frac{V_,/r}{\sqrt{B}}$ for initial velocities. This table gives the result arising by dividing $\frac{V_,}{r}$ by $\sqrt{B}$ for values of $\frac{x}{c}$ and $\frac{V_,}{r}$; the quantity to be determined is $\frac{V_,}{r}$. The method is the same as in the preceding table; the sign of the difference should invariably be changed if the value of the quotient q is found to diminish as

x
-increases. See *Didion's Formulas.*
c

MUNCHEEL.—A kind of litter which is used on the Madras and Bombay side of India. It is simply a hammock suspended from a horizontal pole, and is carried by two men. It weighs about 20 lbs. To keep the canvas of the cot or hammock at full length, there is a cross piece of wood at the top and bottom. On service it would be used for the same purpose as the doolie of Bengal. Under another name, the muncheel is largely used to carry people about in the Himalaya Mountains. A large umbrella is used to keep off the sun, and a waterproof piece of cloth, or a blanket, is thrown over the supporting pole to keep off the rain. See *Litter.*

MUNIFICE.—A Roman soldier who was subjected to every kind of drudgery-work in camp.

MUNIMELL.—A stronghold, fortification, breastwork, etc.

MUNITIONS OF WAR.—Ammunition and military stores of every description.

MURAGE.—An ancient term for money appropriated to the repair of military works.

MURAL CIRCLE.—An astronomical instrument for taking declinations; consisting of a large circle built against the wall (whence its name), movable on its axis in the plane of the meridian, and with a telescope attached, also in the plane of the meridian, which turns about an axis. The circle is graduated, the whole instrument counterweighted and furnished with an illuminating apparatus for night readings. Readings are made accurate by set-screws and microscopic micrometers. The plane of the limb and the optical axis of the telescope are made parallel to the meridian by leveling and sweeping-screws, and the cross lines of the eye-piece should follow a star near the equator their whole length. The instrument being rectified, the height of a star above the horizon is measured by a cup of mercury; the star is observed directly and then by reflexion, the half sum of the readings being the correct angle. The co-latitude of the place is obtained as with the theodolite. As the tube is movable about the circle, reading should always be checked by reiteration: with more than one limb of the circle.

MURAL CROWN.—In Heraldry, a crown in the form of the top of a circular tower, masoned and embattled. It is meant to represent the crown which was given by the Romans as a mark of distinction to the soldier who first mounted the walls of a besieged town, and fixed there the standard of the army. A mural crown supporting the crest, in place of a wreath, occurs in the achievements of several of the English Nobility, and in various grants of arms made in the early part of the present century to officers who had distinguished themselves in war. Viscount Beresford, in consequence of his gallantry at the battle of Albuera, obtained as crest, issuing out of a mural crown, a dragon's head with its neck pierced through by a broken spear, the head of the spear, point downwards, being held in the mouth of the dragon.

MURDER.—The crime of killing a human being of malice aforethought, and is punishable with death. It is immaterial what means are employed to effect the object. Blackstone says that the name of murder, as a crime, was anciently applied only to the secret killing of another, which the word *moërda* signifies in the Teutonic language. And among the ancient Goths in Sweden and Denmark the whole vill or neighborhood was punished for the crime, if the murderer was not discovered. Murder is defined by Coke thus: "When a person of sound memory and discretion unlawfully killeth any reasonable creature in being, and under the King's peace, with malice aforethought, either express or implied." Almost every word in this definition has been the subject of discussion in the numerous cases that have occurred in the law courts. The murderer must be of sound memory or discretion; i. e., he must be at least 14 years of age, and not a lunatic or idiot. The act must be done unlawfully, i. e., it must not be in self-defense, or from other justifiable cause. The person killed must be a reasonable creature, and hence killing a child in the womb is not murder, but is punishable in another way. The essential thing in murder is that it be done maliciously and deliberately, and hence in cases of hot blood and sculling, the offense is generally manslaughter only. Killing by duelling is thus murder, for it is deliberate. It is not necessary, in order to constitute murder, that the murderer kill the man he intended, provided he had a deliberate design to murder some one. Thus if one shoots at A, and misses him, but kills B, this is murder, because of the previous felonious intent which the law transfers from one to the other. So if one lays poison for A, and B, against whom the poisoner had no felonious intent, takes it, and is killed, this is murder. The only sentence on murderers is now death, which is carried out by hanging. Formerly the murderer was directed after death to be hung on a gibbet in chains near the place of the crime. Formerly, also, dissection was added as part of the sentence, and the execution was to take place on the day next but one after sentence. But now an interval of a fortnight usually takes place and the body is buried in the precincts of the prison. Attempts to murder were until recently punishable in England like capital felony; but now all attempts to murder are punishable only with penal servitude for life, or for a term not less than three years.

MURDERER.—A great piece of artillery. Among the ordnance given up to Monk with Edinburgh Castle in 1650 is mentioned "The great iron murderer, Muckle Meg."

MURDRESSES.—In ancient fortification, a sort of battlement with interstices raised on the tops of towers in order to fire through.

MURSAIL.—That portion of the helmet made so as to lower or turn down in order to protect the face. So called from the resemblance it bore to the muzzle of an animal. It is the same as *Mesail* and *Ventail.*

MUSCHITE.—A local designation applied to the early hand-culverins, and which gave its form to the word *mousquet* or musket.

MUSCULE.—In ancient times, a machine of war; a low, long, and sharp-roofed shed, which enabled the besiegers to advance to and sap the wall of the besieged. See *Testudo.*

MUSICIANS.—The men enlisted and detailed to furnish music for troops. Regiments are supplied with field music on the requsitions of the Commanders, made, from time to time, direct on the Adjutant General; and, when requested by Regimental Commanders, the Adjutant General will endeavor to have suitable men selected from the recruits, or enlisted, for the regimental bands. See *Band, Drummer, Fifer,* and *Trumpeter.*

MUSKET—MUSQUET.—The fire-arm for infantry soldiers, which succeeded the clumsy arquebuse, and in 1851 gave way before the Enfield rifle, which, in its turn, was converted into Snider's patent breech-loading rifle, now known as the Snider-Enfield; the latter arm, so far as the regular infantry is concerned, has been replaced by the Martini-Henry breech-loader, but the English navy, cavalry, and the auxilliary forces still retain the Snider. The first muskets were match-locks; after which came wheel-locks asnaphans or snap-hance and flint muskets; and lastly, percussion muskets, which were a vast improvement, both for accuracy and lightness, on all which had gone before. Compared, however, to either the Enfield or Martini Henry rifle, the musket familiarly known as Brown Bess, was a heavy, ugly, and ineffective weapon. The following is a table of the ranges attained, on an average, by the musket, the Enfield, and the Martini-Henry :

	Musket	Enfield Rifle.	Martini-Henry Rifle.
Accurate fire	100	600	1200
Effective against detached parties	150	800	1500
Effective against troops in column	200	1000	1800

MUSKET BASKETS.—Small baskets about a foot or a foot and a half high, 8 or 10 inches diameter at bottom, and a foot at the top, so that being filled with earth there is room to lay a musket between them at the bottom. They are set on low breastworks, or parapets, or on such as are beaten down.

MUSKETEER.—A soldier armed with a musket. See *Mousquetaires.*

MUSKETOON.—An obsolete weapon, a short musket with a very wide bore, carrying a ball of 5 oz., and sometimes bell-mouthed like a blunderbuss. The arm was mostly used toward the close of the seventeenth century. Also written *Musquetoon.*

MUSKETRY INSTRUCTION.—The knowledge imparted to the officers and soldiers of a regiment, to perfect them in the theory and practice of small-arms. The following is the course pursued in all Line Regiments. Every year, in the infantry and cavalry, each company and troop in a regiment is struck off duty in turn, to go through the annual course of musketry, under the Regimental Instructor. This is divided into preliminary drill and practice. The former lasts four days, and consists of position (standing and kneeling), aiming, the judging distance drill, and the teaching of theory; the latter is divided into three periods, and consists in firing a number of rounds at different distances, from 150 to 800 yards—standing, kneeling, or in any position. Volley and independent firing, skirmishing, etc. form part of the course, during which each man fires 90 rounds. The result of each man's firing is consigned to carefully drawn up tables, and classified by regiments according to the figure of merit. These tables are published yearly in a blue-book. See *Schools of Musketry.*

MUSKETRY INSTRUCTOR.—In England, an officer attached to each regiment of the regular and auxiliary forces, to carry out the instruction and practice of the musket. He is one of the Permanent Staff of a regiment.

MUSTER.—A review of troops under arms and fullly equipped, in order to take an account of their numbers, inspect their arms and accoutrements, and examine their condition.

In the British army, muster is a calling over of the names of all the men composing a regiment. Each man present answers to his name, those not answering being returned as absent. The muster-roll from which the names are called is the Paymaster's voucher for the pay he issues, and must be signed by the Commanding Officer, the Adjutant, and himself. The crime of signing a false muster-roll, or of personating another individual at a muster, is held most severely punishable—by imprisonment and flogging for a common soldier, by immediate cashiering in the case of an officer. In regiments of the Line a muster is taken on the 24th of each month. The muster after a battle is a melancholy proceeding, intended to show the casualties death has wrought. In early times, before the army was a standing force, and when each Captain was a sort of contractor to the Crown for so many men, the muster was most important as the only security the Sovereign had that he really obtained the services of the number of men for whom he paid. Accordingly, any fraud, as making a false return, or as mustering with his troop men not actually serving in it was by the Articles of War of Henry V. made punishable with death for the second offense, and by Charles I. with death "without mercy" for even the first such crime; while any person abetting in any way in the fraud shared the penalty.

In the United States, troops are mustered for pay on the last day of February, April, June, August, October, and December. The musters are made by an Inspector General, if present, otherwise by an officer specially designated by the Commander of the Army, Division, or Department; and in absence of either an Inspector General or officer specially designated, the muster is made by the Commander of the Post. All stated musters of the troops, when practicable, are preceded by a minute and careful *Inspection* in the prescribed mode; and if the command be of more than a company, by a *Review*, before inspection. The Mustering Officer having inspected the companies in succession, beginning at the head of the column, returns to the first company to muster it; each Captain, as the Mustering Officer approaches, brings his company to rear open order, supports arms, and commands: *Attention to muster.* The Mustering Officer then calls over the names on the roll; each man, as his name is called, distinctly answers *Here!* and brings his piece to a *carry* and then to an *order arms.* The Adjutant, at muster, provides himself with the muster-roll of the Field and Staff; and each Captain with a roll of his company, and a list of absentees alphabetically arranged. After muster, the presence of the men reported in the hospital and on guard is verified by the Mustering Officer, who is accompanied by the Company Commanders.

MUSTER-BOOK.—A book in which military forces are registered.

MUSTER-MASTER.—The *Mustering* or *Inspecting* officer who takes an account of troops, and of their arms and other military apparatus. This title is not known in the United States Army. See *Muster.*

MUSTER-ROLL.—A return or list of all troops and establishments, actually present on parade or otherwise accounted for, which is taken on the day of muster. The presence at muster of all concerned is peremptorily necessary, otherwise an officer or soldier subjects himself to forfeiture of pay, unless leave by competent authority has been obtained Sometimes written *Muster-file*. See *Pay-roll.*

MUTILATED.—Wounded in such a manner as to lose the use of a limb. A battalion is said to be *mutilated* when its divisions, etc., stand unequal.

MUTINY.—Behavior either by word or deed subversive of discipline, or tending to undermine superior authority. Till recently mutiny comprised speaking disrespectfully of the Sovereign, Royal Family, or General Commanding, quarrelling, and resisting arrest while quarrelling; but these offenses have now been reduced to the lesser crime of "Mutinous Conduct." The acts now constituting mutiny proper are exciting, causing, or joining in any mutiny or sedition; or when present thereat, failing to use the utmost effort to suppress it; when, knowing of a mutiny or intended mutiny, failing to give notice of it to the Commanding Officer; striking a Superior Officer; or in using or offering any violence against him while in the execution of his duty; disobeying the lawful command of a Superior Officer. The punishment awarded by the Mutiny Act to these crimes is, if the culprit be an officer, death or such other punishment as a General Court-Martial shall award; if a soldier, death, penal servitude for not less than four years, or such other punishment as a General Court-Martial shall award. As the crime of mutiny has a tendency to immediately destroy all authority and all cohesion in the naval or military body, Commanding Officers have strong powers to stop it summarily. A Drum-head Court-Martial may sentence an offender, and if the case be urgent, and the spread of the mutiny apprehended, the immediate execution of the mutineer may follow within a few minutes of the detection of his crime. It, however, behooves Commanding Officers to exercise this extraordinary power with great caution, as the use of so absolute an authority is narrowly and jealously watched. To prevent mutiny among men the officers should be strict without harshness, kind without familiarity, attentive to all the just rights of their subordinates, and above all things most particular in the carrying out to the very letter of any promise they may have made.

MUTINY ACT.—An Act of the British Parliament passed from year to year, investing the Crown with powers to regulate the government of the Army and to frame Articles of War. The Navy stands under Navy Discipline Acts, 1861 and 1866, the successors of Articles of War first enacted under Charles II., which, unlike the Mutiny Act, remained in force for an indefinite time. By the Bill of Rights, the maintenance of a Standing Army in time of peace, unless by consent of Parliament, was declared illegal, and from that time the number of troops to be maintained, and the cost of the different branches of the service, have been regulated by an annual vote of the House of Commons. But Parliament possesses a further control over the Army. Soldiers, in time of war or rebellion, being subject to martial law, may be punished for mutiny or desertion; but the occurrence of a mutiny in certain Scotch regiments soon after the Revolution, raised the question whether military discipline could be maintained in time of peace; and the courts of law decided that, in the absence of any statute to enforce discipline, a soldier was only amenable to the common law; if he deserted, he was only liable for breach of contract; or if he struck his officer, to an indictment for assault. The authority of the Legislature became indispensable to the maintenance of discipline; and Parliament, from 1689 till 1879, at the beginning of every Session, conferred this and other powers in the Mutiny Act, limited in its duration at one time to six months, but latterly to a year. Although it was greatly changed from the form in which it first passed, 190 years ago, the annual alterations were slight, and substantially it had a fixed form. The preamble quoting the above declaration from the Bill of Rights, added that it was judged necessary that a force of such a number should be continued, while it gave authority to the Sovereign to enact Articles of War for the government of the force. The Act had 107 clauses, the first five specified the persons liable to its provisions—namely, all enlisted soldiers or commissioned officers on full pay, those of the Militia or Yeomanry employed on active service, and to recruits for the Militia under training. Clauses 6-14 treated of Courts-Martial; clauses 15-28 related to crimes and their punishment; for mutiny, desertion, cowardice, treason, insubordination, death might be the penalty; for frauds, embezzlement, etc., penal servitude was awarded. Clauses 29-33 provided for military prisons, the reception of soldiers in civil jails under the sentences of Courts-Martial. Clauses 34-37 enacted rules for deserters. Clause 38 referred to furlough; 39-41 enacted that no person acquitted or convicted by a Civil Magistrate or Jury be tried by Court-Martial for the same offense, and similar matters. Clauses 42-59 referred to Enlistment; 60-74 to stoppages, billets, carriages, and ferries, and the conveyance and entertainment of troops. The remaining 24 clauses adverted to miscellaneous matters. By clauses 105 and 106, the Militia, Yeomanry and Volunteers might on emergency be attached to the regular forces. For years prior to 1878, attention had been drawn in Parliament and elsewhere to the shortcomings of the Act, as well as to its cumbrousness, and the Articles of War by which it was accompanied, explained and amplified. These representations culminated in the appointment of a Parliamentary Committee, which, in 1879, presented a Bill to supersede the Mutiny Act, and, like it, to be passed annually as the "Army Discipline and Regulation Act." The Marine Mutiny Act, applying to the Marine Forces when serving on shore, was almost identical in its provisions with the Mutiny Act. Passed annually up to 1878, it was in 1879 merged with the Mutiny Act in the "Army Discipline and Regulation Act."

MUZZLE-LOADER.—The name given to all guns, smooth-bore or rifled, which are loaded at the mouth or muzzle, to distinguish them from those loaded at the breech. All the newly-made ordnance used in the service are rifled, and loaded at the muzzle, but the first rifled guns (Armstrong's) were breech-loaders. The change from breech-loading to muzzle-loading was brought about, chiefly, from the instability of the system in heavy guns, a want of a reliable breech-closer, and the want also of a suitable percussion-fuse. Moreover, the nature of the powder used when heavy breech-loaders were in the service was such as to render the breech apparatus unsafe. A muzzle-loading gun has a simpler, less costly, and stronger construction: the ammunition is less costly, and a simple fuse, without percussion arrangement, can be used.

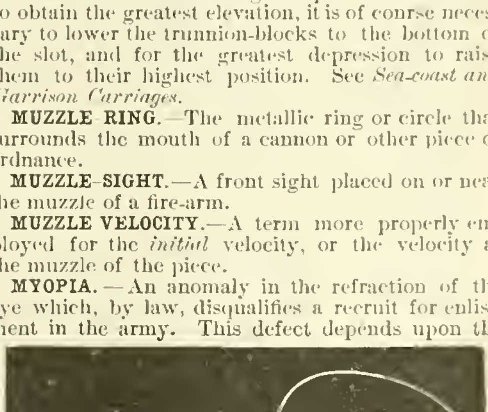
MUZZLE-PIVOTING CARRIAGE.—The vertical field of fire of guns mounted in casemates is so much restricted by the embrasure that the want has long been felt of a carriage which will allow the gun to be used at high angles of elevation, and also at a depression, without a great enlargement of the embrasure. With the view of solving this problem, a new carriage for casemates has been constructed recently, by which the gun can be fired through an embrasure of the usual dimensions at 15° elevation and 7° depression. The principle adopted in its construction is to vary the height of the trunnion-beds instead of always preserving them in the same fixed positions as in the ordinary carriages. To effect this, each cheek of the carriage is cut with a wide vertical slot, in which plays up and down a rectangular block of iron bored with a hole to receive the trunnion of the gun. Under this block is placed a strong screw to support the weight of the gun. By means of a hydraulic jack placed under each trunnion-block the gun is raised or lowered to any desired height, and the motion is immediately followed up by the two screws, to which the weight of the gun is at once transferred. Two minutes are required to raise the gun from the lowest to the highest position. In order to obtain the greatest elevation, it is of course necessary to lower the trunnion-blocks to the bottom of the slot, and for the greatest depression to raise them to their highest position. See *Sea-coast and Garrison Carriages*.

MUZZLE RING.—The metallic ring or circle that surrounds the mouth of a cannon or other piece of ordnance.

MUZZLE-SIGHT.—A front sight placed on or near the muzzle of a fire-arm.

MUZZLE VELOCITY.—A term more properly employed for the *initial* velocity, or the velocity at the muzzle of the piece.

MYOPIA.—An anomaly in the refraction of the eye which, by law, disqualifies a recruit for enlistment in the army. This defect depends upon the



refractive condition of the eye; it is that condition in which the rays from distant objects come to a focus *in front* of the retina, and consequently the latter receives but the blurred and indistinct image of external objects. A glance at the drawing will explain this. Myopia is usually due to an abnormal lengthening of the eyeball, thus causing the retina to recede from the point where the rays come to an accurate focus. It is a disease which often exists from birth, and is frequently hereditary; but, although frequently this condition is present from birth, and manifests itself in later life, no doubt, many cases are developed by excessive use of the eyes at fine "near work," such as reading or sewing, before the coats of the eye have become fully developed and hardened. Statistics show that the percentage of Myopia increases in proportion to intellectual development, and, that while it may be quite small in the lowest grades of Schools, it steadily gains in numbers as the course of study becomes higher, until, in the Colleges and Universities it reaches a very large percentage.

Among the prolific causes of the development of this disease, is the habit of reading with the head bent forward and over the book, thus preventing the free circulation of the blood, and causing a congestion of the eyes, which tends still further to stretch the coats of the perhaps already weakened organ. The habit of reading with insufficient illumination, or in a reclining posture, is also most injurious. The popular belief that near-sighted eyes are strong ones is not only absolutely incorrect, but also most mischievous, since there is no state of the eye which more urgently demands the use of a proper glass, than does Myopia. Such eyes instead of being strong, are not only absolutely weak, but they are sick eyes, and, if the defect be of a high degree, liable to the most serious accidents, which may result in loss of sight. The danger lies not in the imperfect vision, but in the interocular changes which accompany the defect in its higher grades, and which often are progressive.

The treatment of near-sightedness is the use of the proper *concave* glasses. By this, there is an endeavor to attain two objects. The rays are brought to a focus on the retina, and thus distinct vision is insured; and, by wearing the proper glasses, the disease may usually be arrested. In cases where the defect is slight, the correcting-glasses can be given by a good optician, care being taken to select the *weakest* concave lens with which vision is normal; where, however, the defect is high, the advice of an oculist should be sought. Messrs. Walmsley & Co. make a specialty of glasses for myopic eyes, and supply most hospitals with same. See *Recruits*.

MYRIARCH.—A Captain or Commander of 10,000 men.

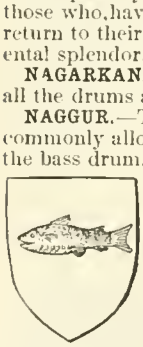
MYRMIDONS.—Those soldiers who accompanied Achilles in the expedition against Troy. Rough, desperate characters banded under a leader, are frequently called Myrmidons.

N

NABOB.—A corruption of the word *nawâb* (deputy), was the title belonging to the administrators, under the Mogul Empire, of the separate Provinces into which the district of a *Subahdar* was divided. The title was continued under the British rule, but it gradually came to be applied generally to natives who were men of wealth and consideration. In Europe, and especially in Britain, it is applied derisively to those who, having made great fortunes in the Indies, return to their native country, where they live in oriental splendor. Also written *Na'ab*.

NAGARKANA.—In the East Indies, the place where all the drums and war-music are kept.

NAGGUR.—The principal drum in Asiatic armies, commonly allowed only to persons of high dignity; the bass drum.



Naiant.

NAIANT—NATANT.—A heraldic term applied to a fish when borne horizontally across the shield in a swimming position.

NAIGUE.—A native subaltern officer among Indian and Anglo-Asiatic troops, whose functions are rather somewhat analogous to those performed among European troops by the Drill-sergeant. Also written *Naick* and *Naik*.

NAIL BALL.—A round projectile with an iron pin protruding from it, to prevent its turning in the bore of the piece.

NAILS. Pointed pieces of metal, generally having flattened or rounded heads, used for driving into wood-work, for the purpose of holding the pieces together. A variety, in which the head is very large, and the spike portion small, used by shoemakers for protecting the soles of boots and shoes from wear, is called the *hob-nail*; another, which is made by cutting thin plate-iron into thin pointed pieces of various lengths, is called *brads;* these sometimes are without heads, but are usually made with a slight projection by way of a head. When made small, with flat heads, for attaching cloth or hangings in upholstery work, they are called *tacks;* and when very large for heavy carpentry, *spikes*. Formerly, all nails were hand-made, by forging on an anvil; and in Britain and the north of Europe vast quantities are still made in this manner, being preferable, for many kinds of carpenters' work, to those made by machinery. In France, the greater part of the nails used for light carpentry-work are made of soft iron wire, pointed with the hammer; and in order to head them they are pinched in a toothed-vise; which leaves the portion for the head projecting, and makes below it three or four grooves in the nail, which increase its hold on the wood when driven home. The head is beaten into a counter-sinking on the vise, which regulates the size. The iron used for hand nail-making in Britain is sold in bundles, and is called *nail-rods;* it is either prepared by rolling the malleable iron into rods or small bars of the required thickness—which process is only employed for very fine qualities—or by cutting plate-iron into strips by means of rolling-shears; these shears consist of two powerful revolving shafts, upon which are fixed discs of hard steel with squared edges. The discs of one shaft alternate with those of the other; they are of the thickness of the plate to be cut, and the shafts are so placed that a small portion of one set of the discs are inserted between those of the other set. When the shafts are revolving a plate of iron is pressed between the discs, and it is forcibly drawn through, the steel discs cutting the plates into strips with great rapidity. The quantity produced in this way is enormous, some mills turning out at the rate of ten miles per hour of nail-rods. Several inventions in which America took the lead, have been introduced, and are successfully worked, for making nails direct from plate-iron, either by cutting them out cold or hot; and a very large proportion of the nails in use are made in this way. Nail-making by machinery was originated in Massachusetts in 1810.

NAIRS.—A native military tribe of the Malabar Coast. They affirm that they are the oldest nobility in the world. Their pride on this supposition is greater than that of the Rajpoots. In 1755, the King of Travancore, with the assistance of a French officer called Lannoy, disciplined 10,000 Nairs in the method of European Infantry.

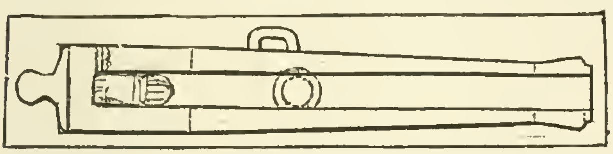

Naissant.

NAISSANT.—A term applied in heraldric blazon to an animal depicted as coming forth out of the middle—not like *issuant* or *jessant* out of the boundary line—of an ordinary.

NAKED BULLET.—A grooved or cannelured bullet as distinguished from the patched bullet. See *Bullet.*

NANA.—In the East Indies, the title which is given to a Chief of the Mahrattas. It more properly signifies the acting head of the Government, and General of the forces.

NAPOLEON GUN. In 1856 it was proposed to increase the power of the light and diminish the weight of the heavy field artillery, by the introduction of a single piece of medium weight and caliber. The form of the new piece is shown in the drawing. It has no chamber and should therefore be classed as a gun. Its exterior is characterized by the entire absence of molding and ornament; and in this respect it may be at once distinguished from the old field cannon. The first reinforce is cylindrical; and it has no second reinforce, as the exterior tapers uniformly with the chase from the extremity of the first reinforce. The size of the trunnions and the distance between the rimbases are the same as in the 24-pdr. howitzer, in order that both pieces may be transported on the same kind of carriage. The *diameter of the bore* is that of a 12-pdr. The *length of bore* is just $13\frac{3}{4}$ calibers. The *weight* is one hundred times the projectile, or 1,200 lbs. The *charge of powder* is exactly the same as that for the heavy 12-pdrs. (pattern of 1840), or $2\frac{1}{2}$ lbs. for solid and case shot, and 2lbs. for canister shot. It has, therefore, as great range and accuracy as the heaviest gun of the old system; and, at the same time, the recoil and strain on the carriage are not so severe. The new gun and carriage weigh about 500 lbs. more than the 6pdr. and carriage; still it has been found to possess sufficient mobility for the general purposes of light artillery. The effect of this change is to simplify the *matériel* of field artillery, and to increase its ability to cope with the rifle-musket, principally by the use of larger and more spherical case-shot. The principal objection to an increased caliber for light field-guns is the increased weight of the ammunition, and the reduction of the number of rounds that can be carried in the ammunition chests. See *Field Artillery.*



NASAL.—A kind of peak or visor, on ancient helms for the protection of the nose.

NASIR-JUNG.—An Indian term expressing victorious or triumphant in war.

NATION.—A word used in two distinct senses. 1. A State or Independent Society united by common Political Institutions. 2. An aggregate mass of persons connected by ties of blood and lineage, and sometimes of language. The modern dogma of nationalism, as maintained by a class of Continental Politicians, starts from an assumption that a nation in the latter sense ought necessarily to be also a Nation in the former, and endeavors to assign limits to the several races of Europe, with the view of erecting each into a distinct State, separated from other States or Nationalities. The extreme Politicians of the National School seem to consider the supposed rights of Nationalities as paramount even to the obligations of treaties, and the political conjunction of one Nationality with another is looked on by them as an adequate ground for a revolt or separation, apart altogether from the question whether the Nationality is well or ill governed. In point of fact, the different races in Europe are so commingled, that any reconstruction of the political map of Europe, on ethnological principles, would be impossible, even if desirable. The blood of nine-tenths of Europe has been mixed within the historical period. The test of language, on which Nationality has sometimes been based, is a deceptive one, in so far as it is indefinite and perpetually fluctuating. The people on the frontier between two races, as in the South Tyrol, generally speak two languages. Then we have dialects, like the Walloon, the Grödnerisch of the Tyrol, and the Romansch of the Grisons—as also the Breton, Welsh, Gaelic, and Irish languages, which could hardly be made the basis of independent communities. The well-being of the people governed is properly the end of all government, and it has practically not been always found that a State is better governed when it consists of one race only, than when it includes an aggregate of races. Highly diversified Nationalities may be united in one political system, provided only that the Government respects and consults the peculiarities of the several races and does not attempt to force the usages, habits, or language of one on the rest.

NATIONAL ANTHEM.—A selection of music set to words, and common to all nations. In England the national anthem is "God save the Queen," which is played when troops pay the prescribed honors to the Sovereign and members of the Royal Family; in the latter case only six bars of the anthem are played. The first part of the national anthem may also be played at the salute of a Viceroy, at state ceremonials, and at the trooping of colors. The playing of the national anthem is only due to those personages who are entitled, under the regulations, to a royal salute.

NATIONAL ARMORY.—A national establishment for the manufacture of small-arms, etc. The manufacture of United States small-arms and small-arm ammunition for the present armies and militia, and for the reserve supply, is one of the greatest importance, and the Springfield Armory is a model one of the world in the perfection of its fabrications, the extent and completeness of its arrangements and the facilties for the production of this class of war-ike stores.

NATIONAL ARMORY CIRCULAR CUTTER.—A modification of the Adams cutter, from which it differs only in the details of its form and dimensions. The diameter of the circle which forms the cutting-edge is 3″; the angle formed by the elements of the two right cones whose intersection forms that edge is 60° instead of 61° 20′. The altitudes of these cones are the same, and are equal to 0″.866. The thickness of the disk is 0″.25 The angle of 60° was adopted for the edge as being an angle which could be accurately formed in a turning-lathe without difficulty, as almost every machinist possesses an equilateral triangular gauge by which he can verify at any instant the angle included between the legs of the striding-gauge that he uses to guide him in turning the bevels. The diameter and thickness of the disk-plate were chosen with reference to retaining the angle of 60°, and with reference to ease of exact measurement by practical mechanics. By assuming these dimensions the strength of the cutter is not impaired; it is rendered a little more sensitive to small differences of pressure than the Adams cutter; and its dimensions, both linear and angular, are easily preserved in fabrication by any one of ordinary mechanical skill. The limits of these linear dimensions, whether expressed in hundredths or thousandths of an inch, can always be made to fall upon the larger and more common divisions of almost any English scale of inches. The special advantage of the circular cutting or indenting edge is that it can be readily pressed into the indentation, previously made in the copper block or disk while in the piece, upon its removal to the dynamometer or testing-machine. In the case of the pyramidal cutter, it is, and always will be, a matter of considerable difficulty to make the apex of the pyramid coincide with its former position, in adjusting it in a dynamometer for the purpose of getting the reading of the estimator or the setting of the limit-gauge, in order to govern the operator in making the similar secondary cut or cuts from or by means of which the pressures are determined. The more accurately the cutter is inserted into the indentation made by the force of discharge, and the greater the precision of the adjustment of the limit-gauge, the more nearly will be the approximation to the true pressure as determined by the dynamometer. With the circular cutter, no difficulty is experienced in adjusting its edge to the bottom of the indentation in the copper. The steel disks for the National Armory circular cutters were made in September, 1876. See *Adams Cutter*, *Benton Dynamometer*, *Circular Cutter*, and *Pressure Gauge*.

NATIONAL CEMETERIES.—In the United States, these are the burial-places for soldiers, provided by the general government. The Quartermaster General of the army has charge of all the National Cemeteries, and the records pertaining thereto. There are, at present, (1884) 26 National Cemeteries of the *First Class;* 20 of the *Second Class;* 11 of the *Third Class*, and some 23 of the *Fourth Class*. The Superintendents of these classes are paid $75, $70, $65, and $60 per month respectively. Military Commanders exercise the same supervision over National Military Cemeteries within the Geographical limits of their commands as over other military posts or establishments under them, only excepting the Military Cemeteries in the District of Columbia and at Arlington and Alexandria, Virginia, which are attached to the Quartermaster's Principal Depot of Washington, D. C.—

A copy of the following law is kept posted at the entrance, and in several other conspicuous places, in each Cemetery :

Every person who willfully destroys, mutilates, defaces, injures, or removes any monument, gravestone, or other structure, or who willfully destroys, cuts, breaks, injures, or removes any tree, shrub, or plant within the limits of any National Cemetery, shall be deemed guilty of a misdemeanor, punishable by a fine of not less than twenty-five dollars and not more than one hundred, or by imprisonment for not less than fifteen days and not more than sixty. The Superintendent in charge of any National Cemetery is authorized to arrest forthwith any person engaged in committing any misdemeanor herein prohibited, and to bring such person before any United States commissioner or judge of any district or circuit court of the United States within any State or district where any of the cemeteries are situated, for the purpose of holding such person to answer for such misdemeanor, and then and there shall make the complaint in due form. See *Battle-ground Cemeteries*, *Post Cemeteries*, and *Superintendent of National Cemeteries*.

NATIONAL DEFENSE.—The defense of a State or a Nation against invasion. The national defenses of a country consist, besides her armies and reserves, of the navy ; of the fortifications, forts, and fortresses built along the coasts, and on some important strategical points, either inland or on the frontier line; of torpedoes laid down for the protection of harbors, arsenals, etc. When these have been found insufficient, an appeal is made to all men able to carry arms to stand up for the defense of the country, and to repulse the invasion. This is called a *levée en masse*. In England, in the event of a threatened invasion, the volunteers would be called out and mobilised with the different army corps to which they belong.

NATIONAL GUARD.—A body of militia composed ncipally of the Bourgeoisie, first formed by the Committee of safety in 1789, and mustering at one time 300,000 men under the command of Lafayette. Napoleon dissolved them in 1795, and reorganized them in 1814. They were again dissolved in 1827, by Charles X., were reorganized in 1830, deserted Louis Philippe in 1848, were reorganized in 1852, and took part in the Franco-Prussian war and the Insurrection of the Commune.—The same term is applied to the State Militia of New York and New Jersey.

In England the National Guard is an organization for local defense, differing from the British militia and volunteers, in being at the disposal of the Municipalities, not of the Crown. Italy, Greece, and other nations have maintained this civic force; but the country whence it derives historic fame is France. The French National Guard was instituted in Paris in 1789, when the Government had an army of 30,000 at the gates. The Municipality armed 48,000 men, and their example was followed by the chief towns of France. These corps obtained the name of National Guard and assumed the famous tricolor as their ensign. In 1795, 30,000 of the Paris National Guards attacked the Tuileries and were repulsed by Napoleon Bonaparte with 6,000 regular troops. In 1830 they were reorganized under the command of Lafayette, their original chief; and between 1848 and 1851 a law was passed by which all males above 20 not otherwise employed under Government were included in the National Guard. After the *Coup d'Etat* in December, 1851, they were reduced to the condition of an armed police. In the war of 1870-1871 they showed some signs of vitality in sympathy with the Commune, but effected nothing for France. After the fall of the Commune they were disbanded. See *Militia*.

NATIONAL HYMNS.—Popular airs which are peculiar to and characteristic of a particular nation. It is a singular fact that the composers of national hymns are seldom known. The Germans call their national music *volk's musik*, a designation which is very appropriate, as a people collectively may not improperly be considered as the actual composer of its national tunes. A short melody extemporized by some one in a moment of patriotic emotion, is often taken up by others and traditionally preserved. In the course of time it generally undergoes modifications, until it has attained those conditions which insure it a general acceptance. This fully explains what W. Grimm means in his laconic saying, "A national song composes itself" (*Ein Volkslied dichtet sich selbst*), for the attempts of celebrated musicians to invest a tune with universal and permanent popularity have been successful in a few instances only. Among the most popular European national hymns, is *God save the King*, but the authorship of the tune has not hitherto been satisfactorily ascertained. In Prussia it is called *Heil Dir im Sieger Kranz*, and in the United States the melody is sung with the words "*My country 'tis of thee*," etc. Although there is no satisfactory evidence of its having been in existence before the reign of George II., there are several tunes known of an earlier date in some degree resembling it. The Austrian national hymn, *Gotte erhalte* [*Franz*] *den Kaiser*, is a composition by Joseph Haydn. Having during his visit to England witnessed the effect of *God save the King*, on public occasions, Haydn resolved after his return to Vienna, to present his country with a similar composition. Baron Swieten and Count Saurau procured the poetry for him, and the hymn was sung for the first time on the birthday of the Emperor Franz, Feb. 12, 1797. The poetry was written by L. Leopold Haschka. The Russian hymn dates from the year 1830, when the Emperor Nicholas ordered it to be performed in concerts and representations on the stage. Its composer was Alexis Lwoff, and the air appears to have been suggested by the *Sicilian Mariner's Hymn*, which is also a favorite melody of the Gondoliers in Venice. The poetry of the patriotic song of the Danes, *Kong Christian stod ved hoien Mast*, was written by Ewald, and the music is by a German composer, Johann Hartmann. The French national hymn, the *Marseillaise*, dates from the year 1792. It was composed by Rouget de l'Isle, during the French Revolution. The national hymn of the Germans, *Die Wacht am Rhein*, came into great popularity during the Franco-German war of 1870. *Was ist des Deutschen Vaterland* was written by Ernst Moritz Arndt, a German patriot, during the wars of Napoleon I. There have been many attempts to manufacture national songs in the United States, but the great national hymn of America will probably be a spontaneous production. The *Star-Spangled Banner* was written by F. S. Key, in 1814, and the words were adapted by F. Durang to an old French air, long known in England as *Anacreon in Heaven*, and in America as *Adams and Liberty*. It grew in favor in the Loyal States during the Rebellion, and was played continually by all military and orchestral bands. But as a patriotic song for the people at large it is almost useless, as the range of the air, an octave and a half, places it out of the compass of ordinary voices. *Yankee Doodle* has the claim of long association, and will probably always retain a certain degree of favor. Its words are mere childish burlesque, and it is reported to have been a popular tune in England during the Commonwealth. Some state that its doggerel words originated at that time, Oliver Cromwell being designated as Nankee Doodle. Others state that it was the tune originally set to the old English song, *Lydia Locket lost her Pocket*, and that the present words were written by a British Sergeant in Boston in 1775. *Hail Columbia* was written by Joseph Hopkinson in 1798, and was set to the music of the *President's March*, which was composed by one Phylas or Fayles, a German leader of orchestra in New York. *Columbia the Gem of the Ocean*, and Harrison Millard's *Viva l'America* have also attained considerable popularity.

NATIONAL RIFLE ASSOCIATION.—Although the introduction of the rifle as a military weapon was owing to the lessons of our Revolution, and although our success in the earlier contests of our history depended upon the skill in its use displayed by our ancestors, no recognition, until lately, was given by our citizens of the fact that the change which has taken place in the habits of the American people was rapidly depriving them of that personal skill in arms and marksmanship, which hitherto formed one of the greatest elements of our national strength. Other nations have long since instituted a thorough system in rifle practice. France, Germany, Switzerland, and, above all, England and Canada, unite in giving to rifle practice a leading position in their system of military training. 150,000 trained riflemen are a standing proof of the Wimbleton contests in England. So, on our Northern border, Canada boasts her 40,000 skilled shots, and has her annual Local, Provincial, and Dominion matches, by which their skill is maintained. In this country, on the other hand, the matter was entirely neglected, although our entire system of defense is based upon the levying of volunteers in cases of emergency, who, to be valuable, or even available, must understand the use of arms, and supply by their skill as individuals the confidence which discipline gives to regular troops.

While England had a system of rifle practice which was required to be annually and thoroughly performed by every soldier in the army, whether stationed in India, Australia, or Europe, our war Department for a long time sent raw recruits against the Indian sharp-shooters of the plains. In the National Guards a similar apathy prevailed; and it was the rule, not the exception, for a man to serve out his full term of enlistment in their ranks without firing a shot.

This anomalous condition of affairs having excited on siderable discussion among military men through the press, finally, on November 24, 1871, led to the formation in the city of New York of the *National Rifle Association*, which was designed to be the parent of many similar Associations throughout the country, and of uniform practice in the Army. This Association was incorporated under the laws of the state of New York, and included among its incorporators many prominent officers and ex-officers of the Army and National guard.

The main aim of the Association is the encouragement of rifle practice throughout the United States, and the success thus far attained surpasses the most sanguine anticipations. The present scope and condition of the Association will be best comprehended by carefully reviewing the Regulations:

I.—Management.—*A.—Annual Meetings.* 1. Annual meetings for competition will be conducted by an Executive Officer, wearing a *tri-colored* badge, aided by a Statistical Officer, wearing a *blue* badge, a Financial Officer, wearing a *white* badge, a Range Officer, wearing a *red* badge, and assistants, wearing badges corresponding in color to those worn by the chiefs of their respective Departments. 2. The Executive Officer shall have control of the range for the conduct of matches, and shall appoint an Adjutant to assist him. 3. The Statistical Officer shall have charge of all statistics. 4. The Financial Officer shall have charge of all finances connected with these meetings. 5. The Range Officer shall have charge of all Firing Points, and of the shooting thereat. *B.—Other Competitions.* 1. All other association competitions will be conducted by an Officer or Director of the Association, or other competent person previously designated as the Executive Officer. In the absence of the Officer, Director, or other person previously designated, the Assistant-Secretary or Superintendent of Range shall act as the Executive Officer.

II.—General Regulations.— 1. During the progress of a match, no one, except, the Officers, Directors and Employees of the Association, the competitors and the Scorekeepers, will be permitted within the ropes, without special permission of the Range Officer. 2. The squads of competitors will be stationed not less than four yards in the rear of the firing points, where each competitor must remain until called by the Scorekeeper to take his position at the firing point, and until he has completed his score. The Scorekeepers will be seated close to and in rear of the firing point stakes. 3. Scorekeepers shall, as each shot is signaled, call in a loud voice the name of the competitor and the value of the shot, and at the conclusion of the score of each competitor, announce in like manner his name and total score. Competitors must pay attention to the scores as announced and recorded, so that any error may be promptly investigated. 4. All competitors will be allowed to examine the records of the Scorekeeper during the progress of any match. 5. All protests and objections must be made to the Executive Officer, or, in his absence, to the Range Officer in charge. In case a competitor is dissatisfied with the decison of the latter, he may appeal to the Executive Officer. 6. Any competitor feeling himself aggrieved by the ruling of an Executive Officer, may make to the Secretary a statement of his grievance in writing, giving the names of two or more witnesses in the case, which shall be handed to the Executive Committee at its first meeting thereafter for its consideration. The decision of the Executive Committee shall be final, subject, however, to the discretion of said Committee, or any two members of it, to refer the matter to the Board of Directors for its decision. 7. All practice upon the Range is subordinate and must give way to matches of the Association. 8. These regulations, and such special rules or directions as the Executive Officer may give, must be rigidly complied with by competitors and all other persons upon the Range grounds.

III.—Rifles.—The rifles or carbines allowed to be used in the competitions are—1st. Military rifles;

2d. Any rifles; and must comply with the following conditions, viz.: 1. *Military Rifles*, weight (without bayonet) not to exceed 9 pounds, 4 ounces. Stock sufficiently strong for military purposes, and such as to admit the use of a sling; minimum pull of trigger six pounds. Sights to be of *bona fide* military pattern, to be attached to the barrel; the front sight to be immovable. The rear sight may be used as a wind gauge, by the sliding bar or the leaf being moved laterally, either by sliding, or by a screw, or by any similar device suitable for military purposes. Filing or altering the sights of such rifles, or of the rifles used by the National Guard, or Regular forces (except as authorized by the military authorities thereof) is prohibited. The sliding bar of the rear sight may be inverted, and lines drawn to mark the center. Any pad or shoe attached to the butt is prohibited. 2. *Any Rifle*, maximum weight 10 pounds, minimum pull of trigger three pounds; sights of any description, except telescope, magnifying and such front aperture sights as solid disks or bushes pierced in the center, which cover the target so as to conceal the danger signal when displayed. No stirrup constructed of metal or other substance, connected to the rifle by straps of any kind, for the purpose of taking up or lessening its recoil, will be allowed. 3. Competitors shall submit their rifles and ammunition for inspection whenever required. 4. No hair or set trigger will be allowed. 5. No fixed or artificial rests will be allowed.

IV.—Ammunition.—1. In competitions restricted to the use of breech-loaders, the gun shall be loaded at the breech with fixed ammunition. 2. In all other competitions any ammunition may be used.

V.—Targets.—The targets are divided into three classes, and shall be of the following sizes:

1. *Third Class*, to be used at all distances up to, and including 300 yards—Target 4×6 feet.
   Bull's-eye circular, 8 inches in diameter.
   Center " 26 " "
   Inner " 46 " "
   Outer, remainder of target.

2. *Second Class*, to be used at all distances over 300, to, and including 600 yards—Target 6×6 feet.
   Bull's-eye, circular, 22 inches in diameter.
   Center " 38 " " "
   Inner " 54 " " "
   Outer, remainder of target.

3. *First Class*, to be used at all distances over 600 yards—Target 6×12 feet.
   Bull's-eye, circular, 36 inches in diameter,
   Center " 54 " " "
   Inner, square, 6×6 feet.
   Outer, remainder of the target.

VI. Marking, scoring and signaling.—

1. Bull's-eye, counts 5; signal, white circular disk.
   Center, " 4; " red "
   Inner, " 3; " white and black "
   Outer, " 2; " black "
   Ricochet, scored R; " red flag waved quickly twice right and left in front of the target. Ricochet hits will be marked out after the flag signal. 2. When a shot strikes the angle iron upon which the target stands, the marker will open the trap and raise and lower his flag three times in front of the target. 3. Any objection to the record of a shot as signaled or to one not signaled, must be made before another shot is fired. Any competitor challenging the marking of a shot shall first deposit with the Executive Officer, or his representative, the sum of $1.00. If his challenge is sustained the money shall be returned. In case the challenge is not sustained the money shall be forfeited to the Association. The challenger shall be permitted to inspect the target in company with the proper officer. 4 Any alteration of a scoring ticket must be witnessed by the officer in charge of the firing point, and endorsed with his initials.

VII. Running Deer. 1. Will be run only by a signal from the firing point. Any rifle may be used, provided the sights are without traverse adjustment. Position, standing; distance, 100 yards, unless otherwise prescribed. A fine of ten cents will be imposed for firing when out of bounds, not firing, or for hitting the haunch.

Scoring and Signalling.

Bull's-eye, white disk, counts 4,
Center, red " " 3.
Outer black " " 2.
Haunch, white disk, with black cross, scoring H.

VIII.—Bull's-Eye Targets.—1. Bull's-eye targets will be open all the time during the Annual Meetings. 2. Tickets (entitling the holder to one shot at any Bull's-eye target) will be sold at the office of the Financial Officer, upon the Range, at 10 cents each, or twelve for $1.00. 3. Each competitor making a Bull's-eye will receive a Bull's-eye ticket. 4. At the close of the firing each evening, the pool receipts (less one-half retained for expenses) will be divided *pro rata* among those making Bull's-eyes, on presentation of their tickets. 5. No person will be allowed to fire more than three shots consecutively at any Bull's-eye target, provided others are waiting to fire.

IX.—Matches.—1. The commencement of the Annual Meetings will be signaled by the firing of two guns, 15 minutes apart. The first will be the signal for competitors and scorekeepers to assemble at the firing points, and the second to commence firing. 2. The matches will take place, if possible, at the hour previously named. Any deviation from the programmes will be posted upon the Bulletin board as long before hand as practicable. *The posting upon such bulletin board will be considered sufficient notice to all competitors of everything so posted.* It should be examined by all competitors daily, both morning and afternoon, before the shooting commences. 3. In team matches, at Annual Meetings, an officer will be assigned to each of the firing posts as Supervisor, and he will, in connection with the Scorekeeper, keep a record of the firing; and any disagreement between such officer and Scorekeeper, will be decided by the Executive Officer, subject to appeal, as provided for in the Regulations. 4 Each Team may appoint a responsible person to act as Supervisor, whose duty it shall be to see that the rules of the N. R. A. are strictly adhered to by the team at whose target he may be assigned. 5. No practice will be allowed upon the range on any of the days of the Annual Meetings, unless specially authorized by the Executive Officer. This does not apply to days upon which special matches of the Association, or of affiliating associations or clubs take place.

X.—Entries.—*A. Annual Meetings.*—1. For all competitions open to military organizations, the teams shall (unless otherwise specified) consist of twelve from each Regiment, Battalion, Company, or Troop. 2. In all cases competitors for prizes offered to military organizations must be either officers or regularly enlisted members in good standing of the Regiment, Battalion, Company, or Troop which they represent, and shall have been such for at least three months prior to the match for which they are entered. All entries must be made for full teams. 3. Entries must be made at the office of the Association, in New York City, at least *one week* preceding the commencement of the meetings, when the entry books will be closed at the office of the Association, and all subsequent entries shall be called Post Entries, and a charge of 50 per cent. additional will be imposed upon all such Post Entries. 4. Competitors who are prevented from being present at any meeting shall have the entrance fees they have paid returned after the meeting, provided that they send their tickets and give written notice to the Secretary before the day on which the prize for which they have entered has been announced for competition. 5. Competitors prevented from competing by illness will receive back their entrance fee in full, on production of a medical certificate and their entry tickets. 6. The holders of post entry tickets may be ordered to fire whenever target accommodation can be provided, but should they be precluded from competing by deficiency of target accommodation, their entrance fees will be returned to them, the Executive Officer not being able to guarantee accommodation for all such entries. 7. All entries are received upon the express condition that the competitor is to appear at the firing point at the exact time named upon his score card, and complete his score within the limitation of time prescribed, regardless of weather or any other unforeseen cause. 8. The same person shall not be a member of more than one team in the same match. 9. Competitors selected to shoot in team matches, or who are detailed to shoot off a tie at a particular hour, and who find that such engagements will interfere with their shooting in other competitions, must at once communicate with the Executive Officer. These cases will be provided for, *when possible*, by altering the hour; and when that cannot be done, the entry will be cancelled and the entrance fee refunded.

B.—General Regulations.—1. A member of the Association entering for or shooting in a match on the range must exhibit his badge. 2. A register ticket may be transferred at any time before the firing for the match has commenced, by exchanging it at the office of the Statistical Officer for one having the name of the new holder. It is available only for the hour and target for which it was originally issued. Any erasure or alteration not initialed by the Executive Officer will render the ticket invalid. 3. No post entries shall be received for any competition after the firing in such competition has commenced, unless expressly permitted by the terms of a match.

XI.—Shooting.—1. Competitors must be present at the firing points punctually at the time stated upon their tickets, or forfeit their right to shoot. 2. After a competitor has joined a squad he shall not quit it until he has completed his firing, or retired. 3. No two competitors shall shoot in any match with the same rifle, nor shall a competitor change his rifle during a competition, unless expressly permitted by the terms of a match, or unless his first rifle has become unserviceable through an accident, which must be verified by the officer in charge of his firing point. 4. In all competitions confined to members of military organizations, competitors shall shoot in the authorized uniform of their corps, including waist belts. 5. In each match of the Annual Meetings, except where otherwise stated, the squad or team assigned to each target will be required to commence firing at the time named on the score card, and to continue firing at the rate of one shot per minute until the completion of the score. 6 The time for each squad to commence and close will be signaled by firing a gun every thirty minutes, from 9 A. M. to 5.30 P. M., and no firing by any of its members will be permitted except between those signals. In case a competitor, without fault on his part, has been prevented from finishing his score within that time, he may apply to the Executive Officer for further assignment, the granting of which will be in the discretion of that officer. 7. Competitors retiring from matches forfeit all claims therein. 8. *No sighting shots will be allowed in any match*, but targets will be assigned as *Bull's-eye Targets* at which competitors may practice at any time, provided such practice does not in any manner interfere with their presence at the designated time at the firing point to which they may have been previously assigned. 9. In all competitions restricted to military rifles the competitors shall place themselves at the firing point by twos, and shall fire alternately until they have fired all their shots. 10. In other competitions the competitors shall fire their shots alternately throughout the squad. 11. Competitors may wipe or clean their rifles during any competition, except those restricted to the use of military rifles. In competitions at more than one distance, restricted to military rifles, cleaning will be permitted between distances. 12. Whenever the danger flag is displayed, competitors about to fire will be required to open the breech block of their rifles (if breech-loaders). If they leave the firing point they must withdraw the cartridge. 13. Any competitor delaying his squad will be passed by. In no case will the firing be delayed to enable a competitor to procure a rifle. 14. Competitors must shoot their scores at different distances in the order named in the conditions of the competition.

XII.—Position.—1. In all matches (except those specially for carbines), the position up to and including 300 yards, shall be standing. The left elbow may be rested against the body, provided the little finger of the left hand is in front of the trigger guard. 2. In carbine matches, the position at 200 yards shall be standing; at 300 yards, kneeling; over that distance, in any position (as prescribed for infantry). 3. In all other matches, at distances above 300 yards, any position may be taken without artificial rest to the rifle or body. 4. One-armed competitors will be allowed to use false arms, without extra support, in the standing and kneeling positions, and to assume any position in the use of military rifles, at distances above 200 yards. 5. Shots at Bull's-eye targets, at all distances, beyond 300 yards may be fired in any position without artificial rest. 6. In all cases the rifle shall be held clear of the ground.

XIII —Ties.—1. Ties shall be decided as follows:

A.—In Individual Shooting. 1. When the firing takes place at more than one distance, by the total score made at the longest distance; and if still a tie, and there be three distances in the competition by the total score at the second distance. 2. By the fewest misses in the entire score. 3. By the fewest outers in the entire score. 4. By the fewest inners in the entire score. 5. In handicap matches (after the preceding), by the fewest centers in the entire score. 6. If still a tie, by inverse order of shots, counting singly from the last to the first. 7. In matches where two or more scores added together count, if still a tie, by adding together the last shots of each single score, and if still a tie, by adding together the next to the last and so on. 8. By firing single shots at the longest range.

B.—In Team Shooting. 1. By the aggregate total score made at the different distances in inverse order. 2. By the fewest misses in the entire score. 3. By the fewest outers in the entire score. 4. By the fewest inners in the entire score. 5. By the total of each round in inverse order. 6. By the competitor on each side who has made the highest score, firing five rounds at the longest distance. II. The names of competitors who have to shoot off ties will be posted on the Bulletin-board as soon after each match as practicable. III. When the ties are shot off, one sighting shot shall be allowed without charge IV. Competitors not present at the firing points at the hour named for shooting off ties, loose their right to shoot. V. If, having forfeited their right to compete, they shall still be within the number of prize winners, they shall take any prize that may be allotted to them by the Executive Committee.

XIV.—Prizes. 1. Prize winners, upon application to Statistical Officer on the range, will receive certificates, which must be given up on receiving the prizes. 2. Prizes will be delivered on the range at the close of the meeting, under the direction of the Prize Committee, unless otherwise specified. 3. All prizes and Bull's-eye money not claimed within thirty days after the day on which same was won, shall be forfeited to the Association.

XV.—Penalties.—Competitors must make themselves acquainted with the regulations, as well as with the conditions of any match for which they may have entered, as the plea of ignorance of either of them will not be entertained. *Disqualification*: Any competitor (*a*) who shall fire in a name other than his own, or who shall fire twice for the same prize, unless permitted by the conditions of the competition to do so, or (*b*) who shall be guilty of any conduct considered by the Board of Directors or the Executive Committee as discreditable; or (*c*) who shall be guilty of falsifying his score or being accessory thereto; or (*d*) who shall offer a bribe of any kind to an employee—shall, upon the occurrence being proved to the satisfaction of the Board of Directors or the Executive Committee, forfeit all his entrance fees, be forever disqualified from competing at any time upon the range of the association, and shall not be entitled to have any prize won by him at the time or meeting awarded to him.

Exclusion from all further Competition. 1. Any competitor who shall be detected in an invasion of the conditions prescribed for the conduct of any match, shall be ruled out of such competition. 2. Any competitor, in any meeting or match, refusing to obey any instructions of the Executive Officer, or his assistants, or violating any of these regulations, or being guilty of unruly or disorderly conduct, or being intoxicated, will be immediately ruled out of all further competition, during such meeting or match, and forfeit his entrance fees; and may also be reported to the Board of Directors or the Executive Committee, and be by them disqualified from the use of the Range. 3. Any competitor firing when the danger flag or trap disc is shown at the target or firing point, or knowingly discharging his rifle except at a target to which he has been assigned or into the blowing-off pits, or as may be directed by an Officer, shall be debarred from all further competitions during the meeting, and shall forfeit his entrance fees. This shall not apply to a competitor accidentally firing at the wrong target, when no danger disc is up. 4. Any person discharging a rifle or snapping a cap within the inclosure, except in accordance with the regulations for shooting may, at the discretion of the Executive Officer, be required to leave the ground. 5. Any competitor or other person found with a loaded rifle except at the firing points and when about to shoot, shall be debarred from further competition during the whole of that meeting or competition. 6. Any person, whether a competitor or not, interfering with any of the firing squads, or annoying them in any way will be at once expelled from the ground. 7. Any competitor discharging his rifle accidentally, either by his own want of care or by reason of any defect in the rifle, shall be disqualified from further competition in the match. 8. Should a competitor lose his register ticket, omit to take it to the firing point, fail to attend at the prescribed hour, or give a wrong ticket, and so by his own neglect miss the opportunity given to him of competing for the prize for which his ticket was issued, his claim in regard to such competition shall be cancelled. 9. Any person firing on a wrong target will be reported by the scorer to the Executive or Range Officers present and will be fined $1.00 or be debarred from further competition; or both, in the discretion of the Executive Officer. 10. Any person ruled out of any meeting or competition shall forfeit all entrance fees.

NATIONAL SALUTE.—A salute of one gun for each State in the Union. This salute is fired at noon on the anniversary of the Independence of the United States at each military post or camp provided with artillery. See *Salutes*.

NATIONAL TROOPS.—Troops raised under the authority of Congress, in contradistinction to the Militia, which may be called State troops, being organized by the several States.

NATURAL ANGLE OF SIGHT.—The angle which the *natural line of sight* makes with the axis of the piece.

NATURAL FORTIFICATION.—A fortification consisting of those obstacles which nature affords to retard the progress of an enemy; such as woods, deep ravines, rocks, marshes, etc. The term is employed in contradistinction to *Artificial Fortification*, or that which is raised by human ingenuity to aid the natural advantages of the ground, or supply its deficiencies. See *Fortification.*

NATURAL LINE OF SIGHT.—The right line passing through the highest point of the line of metal at the muzzle, and the highest point of the same line in rear of the trunnions. See *Line of Metal.*

NATURAL POINT-BLANK.—The point-blank is the point at which the line of sight intersects the trajectory the second time; or, more practically speaking, it is that point which, being aimed at, is struck by the projectile. The *natural point-blank* corresponds to the natural line of sight when this line is horizontal, and the distance of this point from the muzzle is called the *point-blank range*.

NATURAL STEEL.—A variety of steel which is obtained by reducing the rich and pure kinds of iron ore with charcoal, and refining the cast-iron, so as to bring it to a malleable state. It is made principally in Germany, and is used for making files and other tools. The India steel, called *wootz*, is said to be a natural steel, containing a small portion of other metals. See *Shear Steel* and *Steel.*

NAVAL CAMP.—In military antiquities, a fortification, consisting of a ditch and parapet on the land side, or a wall built in the form of a semi-circle, and extended from one point of the sea to the other. This was beautified with gates, and sometimes defended with towers, through which the defenders issued forth to attack their enemies. Towards the sea, or within it, they fixed great piles of wood, like those in their artificial harbors; before these, the vessels of burden were placed in such order, that they might serve instead of a wall, and give protection to those without; in this manner, Nicias is reported by Thucydides to have encamped himself. When their fortifications were thought strong enough to defend them from the assaults of enemies, the ancients frequently dragged their ships on shore. Around these ships the soldiers disposed their tents, as appears everywhere in Homer But this seems only to have been practiced in winter, when their enemy's fleet was laid up, and could not assault them; or in long sieges, and when they lay in no danger from their enemies by sea, as in the Trojan war, where the defenders of Troy never once attempted to encounter the Grecians in a sea-fight.

NAVAL CROWN.—In Heraldry, a rim of gold round which are placed alternately prows of galleys and square sails. The device is said to have originated with the Roman Emperor Claudius, who, after the conquest of Britain instituted it as a reward for maritime services. He who first boarded the enemy's ship, and was the occasion of its being captured, was entitled to a naval crown. A naval crown supporting the crest in place of a wreath occurs in various grants of arms in the early part of the present century, to the naval heroes of the late war. The crest of the Earl of St. Vincent, bestowed on him after his victory over the Spanish fleet in 1797, is issuing out of a naval crown or, enwrapped by a wreath of laurel vert, a demi-pegasus argent maned and hoofed of the first and winged azure, charged in the wing with a fleur-de-lis or.

Naval Crown.

NAVAL HOWITZER.—A bronze shell-gun, adapted to field and boat service. They are made of bronze on account of their comparative lightness for the same strength, and from their being less liable to burst than iron guns of the same caliber. They are both smooth-bore and rifled, and are alike in the principle of construction and general appearance, and differ only in weight and dimensions. Around the charge the metal is distributed in the form of a cylinder, extending sufficiently in front of the seat of the projectile; thence to the muzzle it is continued as a truncated cone.

NAVE.—The central portion of a wheel; it is generally composed of a cylindrical block of wood in which the spokes are firmly fixed, and in which the axle-arm works. This has hitherto been the nave of all artillery carriages in the British service, but in the newly constructed wrought-iron carriages the Madras pattern nave, made of metal, with some slight modification, has been adopted. In the Madras wheel, as originally formed, the nave-box is made of gun-metal, and cast in one piece with one of the plates, but the principle of construction is the same whether it be so united or cast separately. Between the two plates, 12 spokes are placed, so formed that the parts which enter the nave are in close contact with each other, and with their ends forming an arch completely round, but not quite touching, the nave box. The whole construction is then firmly bolted together, with 12 triangular bolts passing through holes in the discs, and fitting into the triangular spaces formed between each spoke by their radiation from each other. These bolts have circular heads, and when driven into their places, their ends are secured outside by nuts. The naves are in two or three parts. The great advantage in the latter is that the top and bottom, as two of its parts are termed, are almost rendered perpetual, whereas in the nave in two parts, if the box wears and therefore becomes unserviceable, the box with bottom, altogether nearly three-fourths of the nave, is rendered useless, and must be renewed; but with the nave in three parts, the box alone is renewable if it wears away. In the late Madras artillery, the *gun-metal nave* had been in use for the last sixty or seventy years, and no failure of its strength or want of durability had ever been reported. For many reasons it was a great improvement on the *block nave*. Its durability was apparent after the occupation of Burmah in 1852, and subsequent years. In that country, for a long period after it was annexed to the British possessions, gun carriages, Bengal and Madras, had for want of cover to stand out exposed to sun and rain. During that period not a Madras wheel was the worse for exposure, whereas the majority of the Bengal wheels had large deep slits in the wooden naves, which necessitated their being replaced and the wheels set up afresh. Side thrusts on the wheel tend to shear the material of the nave (if it be of wood), and to bend the flanges when of metal. The amount of material and its disposition in the nave, must be fixed with special reference to these side thrusts. The strains in the planes of traction are but slight, on account of the small inertia of the nave about its axis. See *Archibald Wheel*.

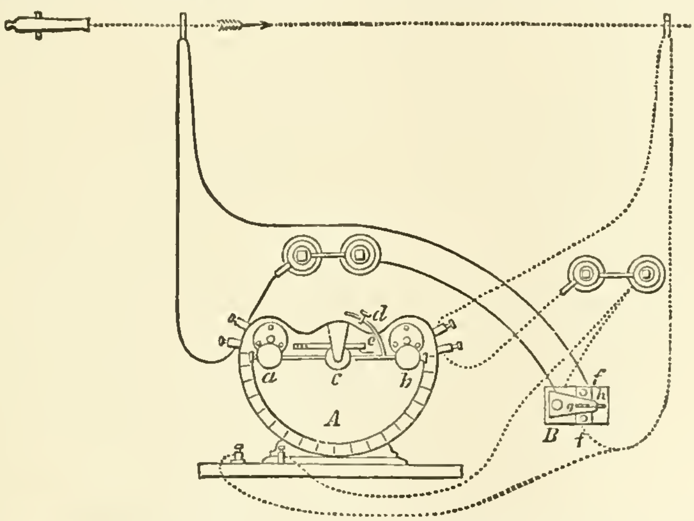
NAVE-BOXES. Boxes which are placed in the naves; they were formerly made of brass, but experience has shown that those of cast-iron cause less friction, and are much cheaper. There are two, one at each end, to diminish the friction of the axletree against the nave.

NAVE-BRAKE. A contrivance for skidding the weeels of gun carriages in order to increase the frictional resistance, at the time of recoil. The two halves of the brake clasp the nave with more or less tightness. The attachment between the brake and the nave is only a frictional one, and a certain amount of slipping round occurs if there is a very violent recoil.

NAVE HOOPS.—Flat iron rings used to bind the nave; there are generally three on each nave.

NAVEL.—A lug with a hole through it on the under side of a carronade, used to connect it with its carriage.

NAVEZ-LEURS CHRONOSCOPE.—This is probably the most successful of all the pendulum instruments, where the value of the time is expressed in arc. It may be said to consist of two separate instruments, the *pendulum* and the *disjunctor*. The pendulum is an upright plate of vulcanite with a graduated arc, *A*, mounted on a stand, and supporting two pendulums, two electro-magnets, a pair of springs, and the pivot upon which the escapement system works. One of the pendulums, *a*, is termed the *chronometer pendulum*, and the other, *b*, the *register pendulum;* and the magnets are so adjusted, one behind each pendulum, that when magnetized by a current of electricity they will just sustain the bobs of their respective pendulums, into both of which a piece of soft iron is inserted. An index-needle, having a vernier at the end to slide along the graduated arc, is riveted to a steel disc, *c*, working in the same axis as the chronometer pendulum, with which it oscillates, simply by friction, until clamped by the action of the escapement. The springs are attached to the vertical plate, and pass one on each side of the steel disc, *c;* near the ends of the springs are two cleats, one on each spring, between which a wedge-lever, *e*, can be adjusted to keep the springs apart: two other cleats close on the disc of the index-needle, which is between the springs, when the wedge-lever, *e*, is displaced by the face of the stirrup, *d*.



____________Circuit from battery which magnetizes the chronometer electro-magnet.
..........................Circuit from the battery which magnetizes the register electro-magnet.
- - - - - - - - - - - - - - -Arrangement of the second circuit to investigate the value of the coefficient x.

The rod of the register pendulum is provided with an arc carrying a stirrup, *d*, which in its descent when the pendulum is released, knocks away the wedge-lever, *e*, from between the springs, and so closes them upon the disc, *c*, of the index-needle, thus clamping it. The disjunctor consists of a small stand, *B*, on which are two pieces of brass, *ff*, each provided with a pressure-screw, a brass spring, *g*, fastened by another pressure-screw, and a cam, *h*, to work the spring: the brass pieces have platinum points, separated from each other by a very short interval, and the spring has also a platinum point below it, which, when pressed down by the action of the cam, connects the two other points; thus connecting, when requisite, the circuits through the apparatus.

The electric currents are obtained by means of Bunsen's voltaic batteries, there being two circuits for an ordinary experiment, one passing through the magnet of the chronometer pendulum on the first screw, the other through the magnet of the register pendulum and the second screw; as both pass through the disjunctor, the simultaneous disjunction of both circuits can be effected by turning the cam, releasing the spring, and so disconnecting the platinum points. The apparatus is placed in a small house at a distance of about 130 yards from the gun, so that it may not be effected by the firing, and the arrangement of the gun and targets is as follows: The first target is placed at a distance of 10 yards in front of the muzzle of the piece, and the second target 40 yards beyond the former; both targets are of the same construction and dimensions; each consisting of a wooden frame having copper wires stretched across in parallel rows by means of pins in the sides of the frame, and these wires are broken by the passage of the projectile through them. In order to protect the wires of the first target from the action of the gas, a wooden screen is placed about 40 inches from this target, between it and the gun; the screen has a circular hole, about 1½ calibers in diameter, through which the projectile passes. When the gun is fired, the projectile passes through the first target, breaks the first circuit, and demagnetizes the magnet of the chronometer pendulum; the bob begins to fall, carrying with it the index-needle. When the projectile cuts the wires of the second target, the circuit is broken, and the magnet of the register pendulum is demagnetized; the bob falls, carrying with it the arc and stirrup, which in its descent knocks away the wedge-lever and clamps the index-needle. The time due to this arc of vibration can, by the theory of the pendulum, be readily ascertained, but it must be greater than the time taken by the projectile to pass from one target to the other; for a certain small interval of time elapses between the rupture of the second circuit and the clamping of the index-needle. This small portion of time is found by means of the disjunctor, before the gun is fired, by breaking both circuits at once, and the small arc so found must be deducted from the arc determined by firing the gun. See *Chronoscope*.

NAVICULAR DISEASE.—A disease in the horse, consisting in strain of the strong flexor tendon of the foot, at the point within the hollow of the fetlock, where it passes over the navicular bone. It is most common amongst the lighter sorts of horses, and especially where they have upright pasterns, outturned toes, and early severe work on hard roads. It soon gives rise to a short, tripping, yet cautious gait, undue wear of the toe of the shoe, wasting of the muscles of the shoulder, and projecting or "pointing" of the affected limb whilst standing. When early noticed, and in horses with well-formed legs, it is often curable; but when of several weeks standing, it leads to so much inflammation and destruction of the tendon and adjoining parts, that soundness and fitness for fast work are again impossible. Rest should at once be given, the shoe removed, the toe shortened, and the foot placed in a large, soft, hot poultice, changed every few hours. Laxative medicine and bran mashes should be ordered, and a soft bed made with old short litter. After a few days, and when the heat and tenderness abate, cold applications should supersede the hot; and, after another week, a blister may be applied round the coronet, and the animal placed for two months in a good yard or in a grass field, if the ground be soft and moist; or, if sufficiently strong, at slow farm-work on soft land. Division of the nerve going to the foot removes sensation, and consequently lameness; and hence is useful in relieving animals intended for breeding purposes or for slow work. The operation, however, is not to be recommended where fast work is required; for the animal, insensible to pain, uses the limb as if nothing were amiss, and the disease rapidly becomes worse.

NEBULY.—One of the partition lines in Heraldry, which runs out and in, in a form supposed to represent the uneven edges of clouds.

NECESSARIES.—The articles issued to the British soldier, such as boots, shirts, stockings; razor, etc., which are requisite for his comfort and cleanliness. These are technically termed *regimental necessaries*. Non-commissioned officers are not allowed to sell regimental necessaries to the soldiers. Every article is directed by the Regulations to be marked with the owner's name, the letter of his company, and the number of his regiment; and the sale or injury of them renders him liable to be tried by Court-Martial and punished.

NECK.—The elbow or part connecting the blade and socket of a bayonet. See *Bayonet*.

NECK COLLAR.—A piece of armor which supported the whole of the rest of the harness. This must not be confounded with the *gorget*, underneath which it was placed, and which, like it, was formed of several plates.

NECK LINE.—An old term in fortification signifying the gorge.

NECK OF A CASCABEL.—The part joining the knob to the base of the breech. See *Cascabel*.

NECK OF A GUN.—The small part of the piece in front of the chase.

NEEDFIRE.—Fire obtained by the friction of wood upon wood, or the friction of a rope on a stake of wood, to which a wide-spread superstition assigns peculiar virtues. With varieties of detail, the practice of raising needfire in cases of calamity, particularly of disease among cattle, has been found to exist among most nations of the Indo-European race. It has been supposed effectual to defeat the sorcery to which the disease is assigned. When the incantation is taking place, all the fires in the neighborhood must be extinguished and they have all to be relighted from the sacred spark. In various parts of the Scottish highlands the raising of needfire was practiced not long ago, and it is perhaps still had recourse to in some very remote localities. The sacrifice of a heifer was thought necessary to insure its efficiency. The ways of obtaining fire from wood have been various; one is by an apparatus which has been called the "fire-churn," a cylinder turning on a pivot, and furnished with spokes, by means of which it is made to revolve very rapidly, and fire is generated by the friction. Fire struck from metal has been supposed not to possess the same virtue, and in some instances the persons who performed the ceremony were required to divest themselves of any metal which might be about them. In its origin the fire-churn was considered a model of the apparatus by which the fires of heaven were daily rekindled. It is still in daily use in the temples of the Hindus. The same superstition was doubtless the origin of the story of Prometheus.

NEEDLE.—An instrument of metal, or other material, for the purpose of carrying the thread in sewing, embroidery, knitting, netting, and other similar operations. Needles are generally made of metal, but bone, ivory, and wood are also used; for ordinary needlework, called sewing, they are made of fine steel, and are too well known to need description; for other kinds of work they are often much larger and differently formed, according to the requirements of the work to be done. The *magnetic needle* is a slender bar, usually pointed and resting on a pivot, in a compass, so as to turn freely towards the magnetic poles of the earth by virtue of the magnetic polarity with which it has been artificially endued.

NEEDLE GUNS. To be loaded at the breech, and to be fired by the penetration of a needle into, or the impinging of a piston on, a detonating cap within the cartridge, are distinct attributes in a weapon; and although it is only within the last fifty years that the system has been carried out with success, breech-loading arms have been tried, accepted, and abandoned without number during the last three centuries. Indeed, a sort of instinct dictates that loading at the breech is the preferable course; and all the earliest muskets were so made, the system being doubtless abandoned from the difficulty of accurately closing the breech, in those days of rough workmanship. The extraordinary efficacy of breech-loading arms for military purposes was brought prominently forward during the wars of the last few years, and notably in the Prussian campaigns of 1864 against Denmark, and of 1866 against Austria. The successes of the Prussian arms were attributed in no small degree to the rapidity with which their troops could fire as compared with the enemy. They had, in greater or less numbers, borne these same rifles since 1835, but these were the first opportunities of using them in warfare. To all the other powers, whose men still carried muzzle-loading rifles and who had debated, without practical result, for years past the question of armament with breech-loaders, soldiers thus armed appeared irresistible. From July, 1866, to the present moment, the hammer and the anvil have been busy night and day throughout the civilized world in making the weapons of death yet more deadly. Scarcely two countries seem to have adopted the same plan; each nation has elaborated a system from among its own inventors. Those possessing no great reserve of rifles have prepared new arms; but the majority of Governments have been content, in the first instance, to convert their existing stock into breech-loaders of as good a construction as circumstances would permit. Thus, Britain, after offering a handsome prize for the best design, selected one said (subject to some controversy) to be the invention of the late Mr. Snider. It is to be borne in mind that the British Government only regarded the Snider arm as a make-shift for the conversion of the enormous stock of Enfield rifles then in hand, reserving to itself the ultimate selection of a suitable pattern on which to manufacture new weapons. It is not to be understood from what is said above that Britain adopted a breech-loading arm in a sort of panic *after* the battle of Sadowa. It was after the Danish Campaign, on the 11th July, 1864, that it was decided as an abstract question to arm the British infantry with breech-loaders; a portion of the cavalry having for a number of years previously been armed with Sharp and Westley Richards carbines, loading at the breech. The selection of an arm took longer; but by the beginning of 1865 it had been decided to convert the great stock of rifles on the "Snider" system. In 1869 it was determined that new arms should be on the Martini-Henry system—i. e , with the Henry barrel, and the Martini breech action. The advantage of breech-loading is obvious; to be able to insert the charge at the breech end instead of the muzzle, is to save time, and to avoid exposure to hostile fire during the operation of loading and ramming home, which involves considerable outstretching of the limbs. The great condition of success is, that the bullet shall be propelled with equal force and accuracy, and with equal safety to the rifleman, as from the muzzle-loader. When a charge is ignited, the constituents of the gunpowder, assuming a gaseous condition under the heat engendered, expand into a volume of light gas many times greater in bulk than the powder before occupied. On the amount of this expansion and its sudden action on the projectile, the force of the shot depends. Any joint in the breech-piece through which a portion of this gas can escape, without having imparted its thrust to the ball, tends, therefore, to lessen the range and penetration; while the shock of the explosion falling more severely on this than on any other part of the barrel, tends yet more to dislocate the breech-piece, and diminish the closeness of the joint's fit. In weapons which do not call for a long range, as revolver pistols, a perceptible interval is left between the chamber and barrel, through which much gas escapes; but in rifles, which have range and penetration as principal objects, there is *prima facie* ground for preferring a muzzle-loader. The gas, however, is far from pure, as generated in the barrel, for much water is produced and held in suspension, while there is also a solid residuum consisting of unburned materials of the powder. In the muzzle-loader, these clog (or, technically, foul) the barrel, filling the grooves, and rendering the ramming home of succeeding charges more and more difficult. The effect is, that a solid mass of unburned matter is gradually forced by ramming into the head of the barrel, destroying the accuracy and usefulness of the weapon. In the breech-loader, this solid deposit must be provided against both ways. The backward throw on firing (for, of course, the charge explodes with equal power in every direction) tends to force it into the mechanism of the joints, preventing their proper fit, and continually augmenting the escape of gas; and, on the other hand, the deposit in front is most detrimental to accuracy of fire. This protection of the breech apparatus, the prevention of fouling, and the retaining, and, if possible, improving the force and accuracy of fire, were the problems which inventors have had to solve.

A moderate escape of gas in front of the first position of the ball, is not under any circumstance, found to be of any material disadvantage. If, then, the barrel could have an opening where the cartridge could be inserted, and then pushed backwards, an escape of gas through the joints by which the opening might be subsequently closed would be comparatively immaterial; but this formation would be impracticable, because the explosion of each cartridge would drive the fouling more and more backwards, till ultimately the chamber at the breech would be unable to contain the cartridge. It is clear, therefore, that the charge must be inserted either at the barrel's head, or, if the barrel be opened, in a space close to the barrel's head. In either of these cases, the breech must be solidly closed to resist the explosion. A third case, as in the Snider, is where the cartridge is inserted and then pushed forward, the aperture being closed by a solid breech-piece which completely fills that portion of the barrel, and forms, with the barrel's head, a massive foot to resist the backward pressure of the fired powder. No breech action can be made to fit so accurately, as to prevent a backward escape of gas unless a properly-constructed cartridge-case is used. A perpendicular moving joint is found in practice to be the one which is best adapted for preventing a serious escape of gas. In the Prussian needle-gun, the end of the barrel is the frustum of a cone, which fits into a corresponding cavity in the fore-end of the breech-piece, but in practice this joint is not sufficiently tight to prevent an escape of gas from the self-consuming cartridge used with this gun, which becomes inconveniently great after long use of the weapon, and it is only available when the breech-piece is pushed up from the rear. In the Snider and several other breech-loading weapons, the cartridge is made itself to close hermetically the aperture between the barrel and the fore-end of the breech-piece. This is effected by the expansion of the cartridge-case which, being composed of metal, or a combination of metal and paper, is driven out by the force of the explosion till it completely fills the chamber and prevents any escape backwards between the sides of the case and the chamber. The cartridge has a portion of its case at the base flattened out into a rim which fits into a corresponding recess in the end of the barrel; and to prevent expansion backwards, which would fracture the cartridge-case, and injure the breech or the firer, the breech-piece is made to fit as closely as possible against this base. This rim is on the Snider cartridge.

The Prussian gun, although it may be said to be now obsolete (having been superseded by the Mauser, a bolt gun on much the same principle, but using a metallic cartridge-case), was first in the field. As regards its breech-apparatus and needle-lock, it consists of three concentric hollow cylinders, with a solid cylindrical bolt inside the last (Figs. 1 and 2).

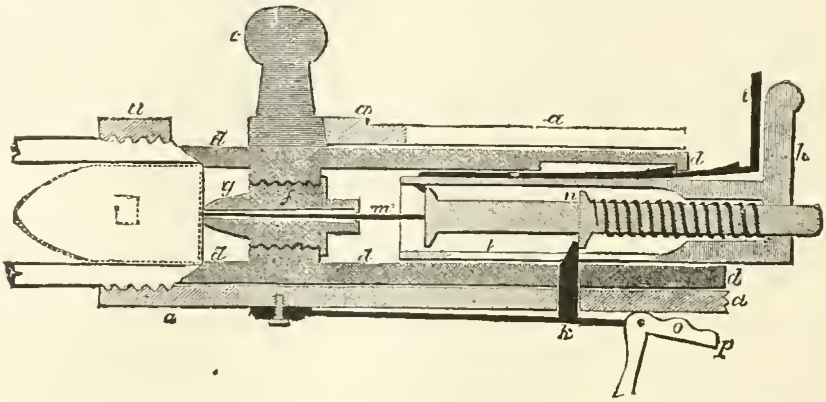


Fig. 1.

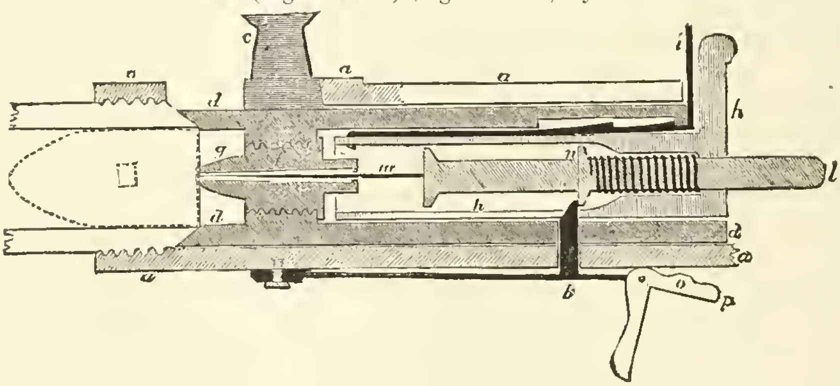


Fig. 2.

The rear-end of the barrel is firmly screwed into the head of the chamber, *a*, which is fixed to the stock of the piece, and is open at the rear-end. The upper half of the cylinder is cut away at the front end for rather more than the length of the cartridge; this constitutes the opening in which the musketeer inserts the cartridge. From the rear of this opening to the back, a groove is cut, sufficiently wide to allow the square pillar of the breech-handle, *c*, to pass along it. In the middle of this groove is a right-angled shunt, offering a stop to the breech-handle when drawn backwards, unless it be likewise turned downwards when it may be passed completely out at the rear end. Next within the chamber is the breech-piece, which, to admit the cartridge, is drawn back for a sufficient distance by the breech-handle along the groove. When the cartridge is deposited in the recess in the chamber, this breech-piece is closed against the heel of the barrel by moving up the handle to the front end of the groove, and then turning it down to prevent it from being driven back on the explosion of the charge; representing, indeed, the resistance offered by the heel of an ordinary muzzle-loading barrel. Firmly screwed within the breech-piece, at a short distance from its front, is a solid block of metal, on which impinges the first force of the explosion. Projecting from this block to the base of the cartridge is a strong *tige*, or pillar, around which a suitable space containing air is left. Through this same pillar is the channel for the needle to work. Fitting within the rear-end of the breech-piece is a smaller cylinder, *h*, constituting the lock of the gun. It slides within the breech-piece, and is retained from falling out backwards by the spring, *i*, which catches in a notch, *d*. Along the bottom of this cylinder is a groove to admit the passage of the trigger, *k*, and at the back is a short, upright handle, by means of which the weapon is cocked. Lastly, within the lock is a bolt, *l*, pressed forward by a spiral spring, and having the needle, *m*, rigidly fastened to its front end. Having now described the several parts of the rifle, it is easy to follow it from the moment of a shot being fired until the next is ready for discharge. The soldier first presses down the spring, *i*, with his finger, releasing the catch below it, and enabling him to draw back the lock to the next catch on the spring (Fig. 1.) Having done so, he raises the breech-handle to the perpendicular, and passes it along the groove to open the breech. This done, he places the cartridge in the opening thus made in the chamber, and again moving up the breech-piece to close the breech, the tige in it pushes the cartridge forward into the barrel, and the rifle is at once at "half-cock;" for in drawing back the lock, the front point of the spring, *i*, forced the bolt, *l* (including the needle *m*), with it, and the projection, *n*, on it, having passed over the head of the trigger, *k*, is caught by the latter in a way which can only be released by the falling of the trigger.

It will be observed that at half-cock the needle is ready to penetrate the cartridge, but that the spiral spring is loose and without power. To "full-cock," no more is necessary than to push *h* back to its original position. It cannot take the bolt, *l*, with it, as the trigger retains it to the rear. The position (Fig.2) is now obtained, in which the bolt, *l*, projects at the back, and the spiral spring is compressed into a state of passive strength. All that is now needed to fire the gun is to press upon the trigger, until the point *o* bears, when the bolt, *l*, being released by the depression of *k*, the spiral spring asserts its power, and drives the needle into the heart of the cartridge, the parts all resuming their original positions. At first sight, one cannot help exclaiming: "What a complicated apparatus with the four cylinders and the springs"; but, in reality, it is as simple as almost any other gun, for the whole mechanism of the lock is dispensed with. If it be desired to take the needle-gun to pieces, press the trigger till the point, *p*, bears. If the breech-handle be then in the hinder part of its groove, the breech-piece with its contents will slip out of the chamber. Pressing down, next, the spring *i*, until the second catch is passed, there is nothing to retain the lock, *h*, in the breech-piece; and the lock being free, the needle, with its attached bolt and spring, falls readily out of its fore-end. The gun is thus taken to pieces in a few seconds, and as many suffice to put it again in fighting order. The most delicate portions are the needle and the spiral spring; but in case of accident to these, there is a spare one in a small cavity opening by a spring in the butt-end of the stock. The worst feature about this celebrated gun is its weight, 12 lbs., or 33 per cent. heavier than the Enfield or Snider rifle. See *Prussian Needle Carbine* and *Prussian Needle-gun*.

NEESHUNGPAT.—An Indian term expressing a violent assault without bloodshed.

NEGATIVE.—1. A term used to express the result of measures or enterprises which, though not entirely successful, are not productive of serious or mischievous consequences. Hence the British expeditions to Spain and Walcheren may be considered as having had negative success. 2. In photography, that kind of photographic picture in which the lights and shadows of the natural object are transposed; the high lights being black, and the deep shadows transparent, or nearly so. Negatives are taken on glass and paper by various processes, and should indicate with extreme delicacy, and in reverse order, the various gradations of light and shade which occur in a landscape or portrait. A negative differs from a positive inasmuch as in the latter case it is required to produce a deposit of pure metallic silver to be viewed by *reflected* light; while in the latter, density to *transmitted* light is the chief desideratum; accordingly inorganic reducing and retarding agents are employed in the development of a positive, while those of organic origin are used in the production of a negative.

NEGATIVE HAUSSE.—In order to strike an object at a distance less than point-blank range, it will be necessary to diminish the angle that the axis of the piece makes with the natural line of sight. This will be accomplished by diminishing the difference between the radii of the muzzle and base-ring. This amount, required to be taken from the radius of the base-ring, is generally called the *negative hausse*.

NEGATIVE PENALTY.—The term applied to such punishments as removal from command, bars to indulgence, reprimands, etc.

NEGLECT OF DUTY.—Total omission or disregard of any prescribed service, or unsoldier-like execution. All crimes not capital, and all disorders and neglects, which officers and soldiers may be guilty of, to the prejudice of good order and military discipline, though not mentioned in the Articles of War, are to be taken cognizance of by a General, or a Regimental, Garrison, or Field Officers' Court-Martial, according to the nature and degree of the offense, and punished at the discretion of such Court.

NESHAUMBURDAR.—The Indian name of an Ensign.

NETLEY HOSPITAL.—The Royal Victoria Hospital, at Netley, is a superb building, on the shore of Southampton water, for the reception of invalids from the army on foreign service, and from among the troops serving in the adjacent military districts. In times of peace, it is only necessary to use a portion of the vast structure; but in the event of a European war, in which the British army should take part, the exigencies of the service would probably tax its accommodation to the utmost. There is provision for 1,000 patients with power to increase the number if necessary. The Medical Staff of course varies in proportion to the work to be done; but at present it consists of a Governor, an Adjutant, a Paymaster, an Assistant-Commandant, and Medical Officers, and Officers of Orderlies of various ranks. The total cost of the construction of this hospital, which was commenced in 1855, has been about £350,000. Attached is the Medical School for candidates for the army Medical Department, the students having the best means of practical instruction in the wards of the hospital. Netley is also the head-quarters of the female nurses of the army, who are under the control of a lady stationed there as Superintendent. Complete arrangements have been made for the landing of wounded men in front of the hospital and for conveying them thither with the least disturbance. There is no doubt as to the convenience of this great hospital for its purposes; but some questions have been raised, under high sanitary authority, as to the salubrity of the site, adjacent as it is to the wide banks of mud which Southampton water uncovers at low tide.

NETTOYER LES MAGAZINS.—In artillery, a term which means to remove the different pieces of ordnance, for the purpose of having them carefully examined, etc., and to have the stores and ammunition so arranged as not to receive damage.

NETTOYER LES TRANCHEES.—A term meaning to scour or clean the trenches. This is effected by means of a vigorous sally which the garrison of a besieged place make upon the besiegers; when they beat in the guard, drive off the workmen, level the parapet, break up and choke the line of circumvallation, and spike or nail the cannon.

NEUTRAL AXIS.—The name given to an imaginary line to any body which is being subjected to a transverse strain, and separating the forces of extension from those of compression. If the ratio of the resistances to extension and compression were the same for all substances, and depended merely on the form of the body, then in all bodies of the same form the neutrals axis would have a definite geometrical position; but it has been satisfactorily proved by Mr. Eaton Hodgkinson, that this ratio has a separate value for each substance. In wood, where the ratio is one of equality, the neutral axis in a beam supported at both ends, whose section is rectangular, passes lengthwise through the center of the beam: while in cast-iron, in which the resistance to compression is greater than that to extension, it is a little above, and in wrought-iron, in which the contrary is the case, it is a little below, the center.

NEUTRALS.—Nations who, when a war is being carried on, take no part in the contest, and evince no particular friendship for or hostility to any of the belligerents. As a general rule Neutrals should conduct themselves with perfect impartiality, and do nothing which can be considered as favoring one belligerent more than another. The duties and obligations of Neutrals at sea have given rise to many complicated questions. It is allowed on all hands that a Neutral State forfeits her character of neutrality by furnishing to either belligerent any of the articles that come under the denomination of contraband of war. If she does so, the other belligerent is warranted in intercepting the succors, and confiscating them as lawful prize. Contraband of war, besides warlike stores, has sometimes been held to include various other articles, a supply of which is necessary for the prosecution of the war; and it has been doubted how far, in some circumstances, corn, hay, and coal may not come under that category.

An important question regarding the rights of Neutrals is, whether enemies' goods not contraband of war may be lawfully conveyed in neutral bottoms. The principle that free ships make free goods was long resisted by England and other maritime countries; and the general understanding has been that belligerents have a right of visiting and searching neutral vessels for the purpose of ascertaining—First, whether the ship is really neutral, as the hoisting of a neutral flag affords no absolute security that it is so; Second, whether it has contraband of war or enemies' property on board. Neutral ships have therefore been held bound to provide themselves with passports from their Government, and such papers as are necessary to prove the property of the ship and cargo; and it is their duty to heave to when summoned by the cruisers of either belligerent. It has been considered that a neutral ship which seeks to avoid search by crowding sail, or by open force, may be captured and confiscated. When a merchant-ship is sailing under convoy of a vessel of war it has been said that the declaration of the officer in command of the convoy that there is no contraband of war or belligerent property on board is sufficient to bar the exercise of the right of search.

A declaration having important bearings on the rights of Neutrals was adopted by the Plenipotentiaries of Great Britain, Austria, France, Prussia, Russia, Sardinia, and Turkey, assembled in Congress at Paris on April 16, 1856. By its provisions, 1. Privateering is abolished. 2. A neutral flag covers enemies' goods, with the exception of contraband of war. 3. Neutral goods, with the exception of contraband of war, are not liable to capture under the enemy's flag. 4. Blockades, in order to be binding, must be effective—that is, maintained by a force sufficient really to prevent access to the coast of the enemy. It has sometimes been proposed to exempt private property at sea from attack during war. Such a project, however, seems inexpedient. There may be a propriety in respecting the property of individuals on land in a time of war, because its destruction, however injurious to the persons immediately concerned, can have little influence on the decision of the contest. But at sea private property is destroyed, because those from whom it is taken, being purveyors or carriers for the community at large, its loss must seriously affect the public, and have no small influence in bringing the contest to an end. See *Blockade*, and *C'ntraband of War*.

NEUBAUER SYSTEM OF FORTIFICATION.—This system is distinguished by a reduit in the re-entering places of armes, imitated by Cormontaingne. It also proposes six fold flanks.

NEW MATTER.—It is not proper that the Prosecutor should be allowed to introduce *new matter*, neither should it be admitted on the defense. There is a great difference between new matter of accusation and facts proved by evidence to mitigate the sentence. The latter are not new matter in its strict sense. Should either party, in the course of their examination of witnesses, or by bringing forward new ones for that purpose, introduce new matter, the opposite one has the right of calling other witnesses to rebut such new matter. The Court-Martial should be very circumspect to see and prevent new matter from being introduced, either in the prosecution or defense. But the Accused may urge in his defense mitigating circumstances, or examine witnesses as to character or service, and produce testimonials of such facts, without its being considered new matter; and if any point of law be raised, or any matter requiring explanation, the Judge-Advocate may explain ; no other reply is admitted.

NEW MODEL.—In the United States, all cannon made since 1861 are on the *New Model*. This is characterized by the absence of all ornament on the exterior,—the outline is made up of gentle curves as far as possible,—and on the inside the bottom of the bore is a semi-ellipsoid.

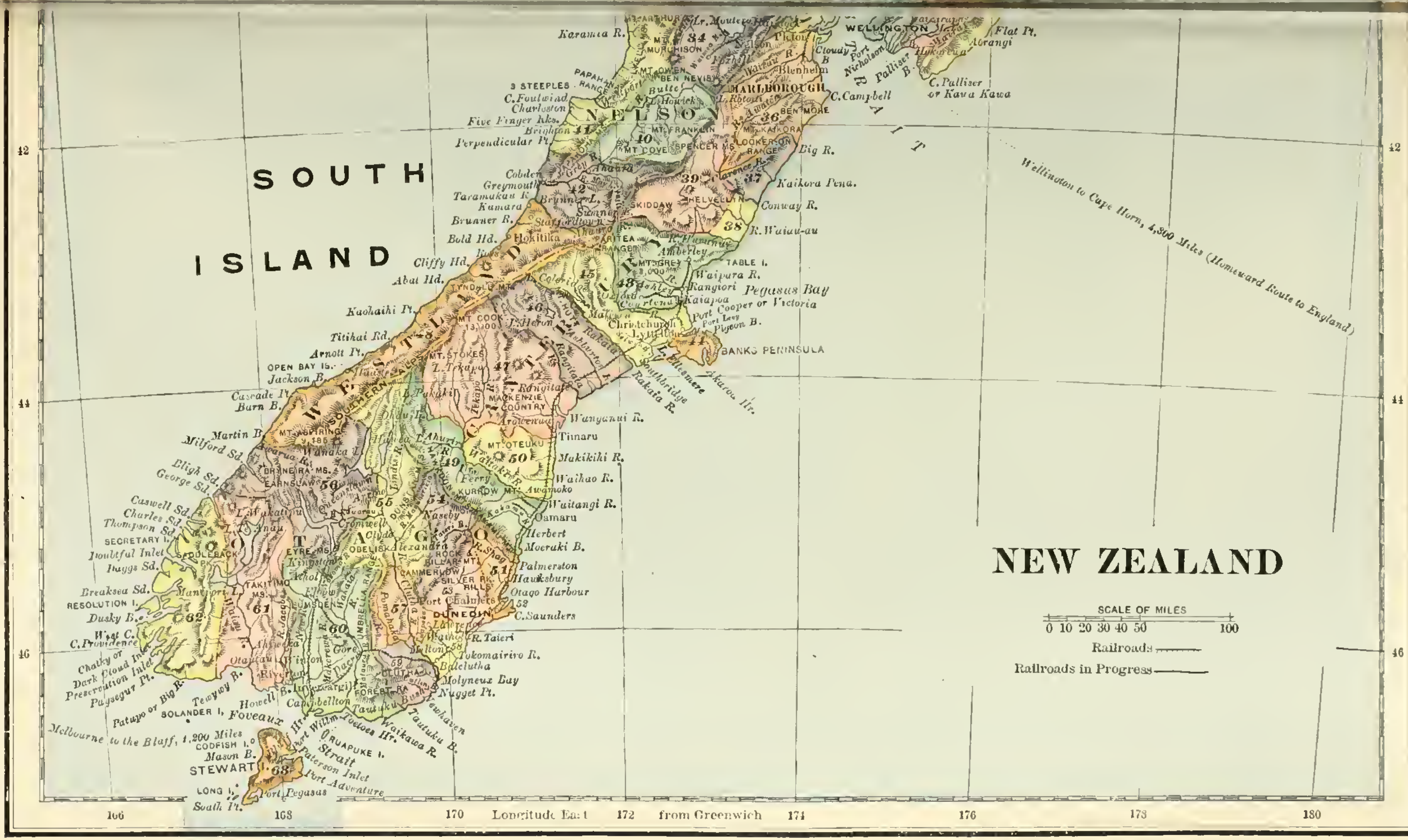
NEW TRIAL.—In Court-Martial, the privilege of a new trial is not denied. The provisions therefore are borrowed from common law, and are not held, in either civil or military tribunals, to preclude the accused from having a second trial on his own motion. Officers who sat on the first trial should not be detailed for the new trial; they have formed and expressed opinions. New, or second trial, can only be authorized where the sentence adjudged upon the first trial has been disapproved. After a sentence has been duly approved and has taken effect, the granting of a new trial is beyond the power of a Military Commander, or the President.

NEW ZEALAND CROSS.—A decoration instituted in the year 1869. The New Zealand Cross was provided in the year 1869, by the Government of the Colony, with the sanction of the Crown, as a reward for acts of distinguished valor similar to those recognized by the Victoria Cross. The fourth clause of the Order in Council, which subsequently received her Majesty's special sanction, as "Fountain of Honor," provides that "The distinction shall only be conferred upon those officers or men who, when serving in the presence of the enemy, shall have performed some signal act of valor or devotion to their duty, or who shall have performed any very intrepid action in the public service; and neither rank nor long service, nor wounds, nor any other circumstance or condition whatever, save merit or conspicuous bravery, shall be held to establish a sufficient claim to the honor."

NIELLO-WORK.—A method of ornamenting metal plates by engraving the surface, and rubbing a black or colored composition, so as to fill the incised lines, and give effect to the intaglio picture. It is by no means quite certain when this art was originated ; Byzantine works of the 12th century still exist to attest its early employment. The finest works of this kind belong to the former half of the 15th century, when remarkable excellence in drawing and grouping minute figures in these metal pictures was attained by Maso di Finiguerra, an eminent painter, and student of Ghiberti and Massacio. In his hands it gave rise to copper-plate engraving, and hence much interest attaches to the art of niello-cutting. Genuine specimens of this art are rare, some of those by Finiguerra are very beautiful and effective, the black pigment in the lines giving a pleasing effect to the surface of the metal, which is usually silver. Those of his works best known are some elaborately beautiful pattines wrought by him for the church of San Giovanni at Florence, one of which is in the Uffizia, and some are in various private collections. In the collection of ornamental art at South Kensington, there are no less than 17 specimens of this art.

NIGHER.—An Indian term for any fortified city measuring at least 8 coss, or 8 English miles, in length and breadth.

NIGHT-FIRING.—Cannon are pointed at night by means of certain marks, or measurements, on the carriage and platform, which are accurately determined during the day. In the case of guns and


NEW ZEALAND
SOUTH ISLAND
NELSON
MARLBOROUGH
WESTLAND
CANTERBURY
OTAGO
SOUTHLAND
STEWART I.
Wellington to Cape Horn, 4,800 Miles (Homeward Route to England)
Melbourne to the Bluff, 1,200 Miles
Foveaux Strait
BANKS PENINSULA
Pegasus Bay
DUNEDIN
Christchurch
WELLINGTON
SCALE OF MILES
0 10 20 30 40 50 100
Railroads
Railroads in Progress
166
168
170
Longitude East
172
from Greenwich
174
176
178
180
42
44
46


REFERENCE TO COUNTIES FORMED, 1876.
NORTH ISLAND
1. Mongonui.
2. Hokianga.
3. Bay of Islands.
4. Whangarei.
5. Hobson.
6. Rodney.
7. Waitemata.
8. Eden.
9. Manukau.
10. Coromandel.
11. Thames.
12. Waikato.
13. Raglan.
14. Waipa.
15. Piako.
16. Tauranga.
17. Whakatane.
18. Cook.
19. Wairoa.
20. East Taupo.
21. West Taupo.
22. Kawhia.
23. Taranaki.
24. Patea.
25. Wanganui.
26. Hawkes Bay.
27. Rangitikei.
28. Manawatu.
29. Waipawa.
30. Wairarapa East.
31. Wairarapa West.
32. Hutt.
SOUTH ISLAND.
33. Collingwood.
34. Waimea.
35. Sounds.
36. Marlborough.
37. Kaikoura.
38. Cheviot.
39. Amuri.
40. Inangahua.
41. Buller.
42. Grey.
43. Ashley.
44. Akaroa.
45. Selwyn.
46. Ashburton.
47. Geraldine.
48. Westland.
49. Waitaki.
50. Waimate.
51. Waikouaiti.
52. Peninsula.
53. Taieri.
54. Maniototo.
55. Vincent.
56. Lake.
57. Tuapeka.
58. Bruce.
59. Clutha.
60. Southland.
61. Wallace.
62. Fiord
63. Stewart Island.
NORTH ISLAND
PACIFIC OCEAN
From Sydney, 1,130 Miles
Sydney to Wellington, 1,200 Miles
Sydney to Auckland, 1,130 Miles
to S. Francisco, 6,956 Miles
North Cape
C. Maria Van Diemen
Bay of Islands
Gulf of Hauraki
Auckland
Bay of Plenty
East Cape
Hawke Bay
C. Egmont
Napier
Black Hd.

howitzers, the elevation may be determined by marking the elevating screw where it enters the nut, or by measuring the distance between the head of the screw and stock. In the case of mortars, the position of the quoin may be determined by marking, or by nailing a cleat on the bolster. The direction of a carriage or mortar-bed is determined by nailing strips of boards along the platform, as guides to the trail and wheels; to prevent the strips from being injured by the recoil, they should be nailed at a certain distance from the carriage, or bed, and the space filled up with a stick of proper width, which should be removed before firing. The chassis of a sea-coast carriage can be secured in a particular direction by firmly chocking the traverse wheels. See *Pointing.*

NIGHTLY CORDON.—In the operation of a siege, the investment of the position is usually performed by a strong body of troops detached from the attacking force, which body moves quickly and suddenly, surrounding the position, and seizing all the avenues of approach. A chain of outposts and sentinels placed just outside of the range of fire of the defence, but close enough to watch all the avenues leading to the position, is established by the investing force. This chain is drawn in nearer to the position at night, and moved back a short distance in day time. The terms nightly cordon and daily cordon are frequently used to designate this chain. See *Cordon.*

NIGHT-SIGNALLING.—An important branch of signalling. It may be effected in various ways. In ordinary service two torches are used,—one on the ground and the other attached to a staff, which is used precisely as the flag for day signals. Lanterns held in the hands can also be used. For long distances and when stations cannot be seen on account of intervening obstacles, such as woods, signal-rockets, candle-bombs, and other pyrotechnic devices are used.

NIHILISTS.—A revolutionary organization in Russia, aiming at the destruction of all existing laws, religions, and political and social systems, while preparing to replace them with nothing. It is stated that the term was first employed by the Rnssian novelist, Ivan Turgenieff, in his stories of Russian society. It was, however accepted by the organization itself, as will appear in the following quotation from a speech by a member, and which may be accepted as fairly significant of the doctrines with which the minds of the advanced Radicals of Russia have become imbued. "Nothing, in the present state of social organization can be worth much, for the simple reason that our ancestors instituted it. If we are still obliged to confess ourselves ignorant of the exact medium between good and evil, how could our ancestors, less enlightened than we, know it? A German Philosopher has said: 'Every law is of use. It rules the conduct of individuals who feel for one another and appreciate their respective wants. Every religion, on the other hand, is useless; for ruling, as it does, our relations with an incommensurable and indefinite Being, it can be the result only of a great terror or else of a fantastic imagination.' Now, we Nihilists say, no law, no religion—Nihil! The very men who instituted these laws ruling their fellow-creatures have lived and died in complete ignorance of the value of their own acts, and without knowing in the least how they had accomplished the mission traced for them by destiny at the moment of their birth. Even taking it for granted that our ancestors were competent to order the acts of their fellow-creatures, does it necessarily follow that the requirements of their time are similar to those of to-day? Evidently not. Let us, then, cast off this garment of law, for it has not been made according to our measure, and it impedes our free movements. Hither with the axe and let us demolish everything. Those who come after us will know how to rebuild an edifice quite as solid as that which we now feel trembling over our heads." Two points will be observed in this manifesto: the one being its positive antagonism to all existing things—because they exist; the other the sophistry with which the accepted position is reasoned out to a logical conclusion. And this brings us naturally to the starting points of Russian Nihilism: in the influence of the Russian history; in the nature of the Russian people; and in the exceptional character of the Russian Political System.

NIP.—A term used in artillery, meaning to stop ropes with a gasket, or with several turns of spun yarn round each, and the ends made fast.

NIPPLE.—The passage of communication in percussion arms between the cap and the charge; the percussion cap is placed on the nipple when the fire lock is primed, and by the action of the lock the piece is discharged. In breech-loading arms, except in the Snider, there is a different arrangement for igniting the charge, which renders the nipple unnecessary; these are fired by means of a needle or some similar method.

NIPPLE WRENCH.—The spanner with sides which fit the square of the nipple, and which is used for screwing it to and unscrewing it from the barrel.

NIQUIBS.—An Indian term for men whose military functions among the Sepoys, correspond with those of Corporals in other services.

NITER—NITRE.—Niter occurs as a natural product in the East Indies, Egypt Persia, where it is found sometimes as an efflorescence upon the soil, and sometimes disseminated through its upper stratum. The crude salt is obtained by lixiviating the soil, and allowing the solution to crystallize. A large quantity of niter is artificially formed in many countries of Europe, by imitating the conditions under which it is naturally produced. The most essential of these conditions seems to be the presence of decaying organic matter whose nitrogen is oxidized by the action of the atmosphere into nitric acid, which combines with the bases (potash and lime) contained in the soil. The method employed in the artificial production of niter consists in placing animal matters, mingled with ashes and lime rubbish, in loosely aggregated heaps, exposed to the air, but sheltered from rain. The heaps are watered from time to time with urine or stable runnings; at suitable intervals the earth is lixiviated, and the salt crystallized. Three years usually elapse before the niter bed is washed; after this interval a cubic foot of the debris should yield between 4 and 5 ounces of niter. As there is always a considerable quantity of the nitrates of lime and magnesia present, which will not crystallize, carbonate of potash, in the shape of wood-ashes, is added so long as any precipitate occurs. The nitrate of lime is decomposed, and the insoluble carbonate of lime separated:

Carbonate of Potash.	Nitrate of Lime.	Carbonate of Lime.	Nitrate of Potash.

$$KO,CO_2 + CaO,NO_5 = CaO,CO_2 + KO,NO_5$$

The clear liquor is then evaporated and crystallized. It has been found that the earth in which niter has once been formed furnishes fresh niter more readily than on the first occasion. Care is taken that the *niter plantations*, as they are termed, shall rest upon an impervious flooring of clay, so that the liquid which drains away from them may be collected and preserved. See *Nitrates* and *Saltpeter.*

NITHING.—An old term for coward or poltroon. Also written *Niding.*

NITRATE OF SODA.—An extensive deposit in the soils of some portions of Peru and northern Mexico. It is cheaper than nitrate of potassa, and for the same weight affords a greater amount of nitric acid, or oxygen. Its affinity for moisture constitutes a serious objection to its use in the manufacture of a gunpowder for war purposes, or one that is to be preserved for any length of time. The nitrate of soda may be used in obtaining the nitrate of potassa by decomposing it with carbonate of potassa—the potash of commerce. See *Chlorate of Potassa* and *Niter.*

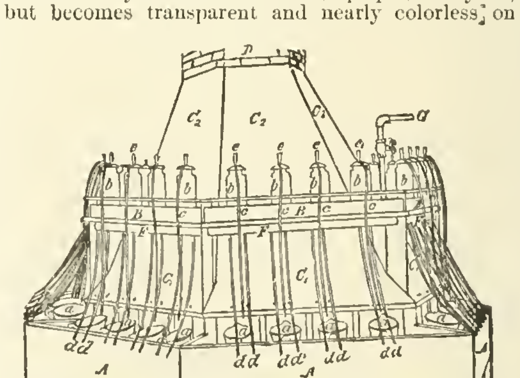
NITRATES.—Salts formed by the union of nitric acid with bases. Some are found in a natural mineral condition, as saltpeter and cubic niter. They are distinguished for their solubility in water. On being heated, they undergo decomposition, being converted either into free nitric acid and a base, or into oxygen and a nitrite. In many respects one of the most important nitrates is the nitrate of silver, or lunar caustic. It is of great use in surgery and the arts. As a caustic it acts powerfully, but rather superficially, producing a white slough, which blackens soon on exposure to the light. It is used in a solid state, or in solutions of all strengths. If dissolved in pure water, it remains colorless; but the smallest particle of organic matter will cause the solution to turn dark. On this account it is employed for making marking-fluids for linen. Indelible ink is usually made by dissolving 1 part of nitrate of silver and 4 parts of gum-arabic in 4 parts of water, and adding a little India ink to give it color, so that it may be seen when the mixture is applied. The place which is to receive the impression is first moistened with a solution of carbonate of soda and dried. After the application of the ink, the writing is exposed to the sunlight. Lunar caustic markings may be readily removed by applying a few drops of tincture of iodine, and dissolving out the iodide of silver thus formed by a solution of hyposulphite of soda, or a dilute solution of caustic potash. Nitrate of silver is used in photography. Nitrate of ammonia, or ammonic nitrate (according to modern nomenclature, ammonium nitrate), NH_4O,NO_5, or, according to later views, NO_3NH_4, may be formed by the action of the galvanic current on a mixture of nitrogen and oxygen with an excess of hydrogen; but the common method is to add a slight excess of aqua ammonia to nitric acid. If crystallization is conducted slowly, six-sided prisms, like those of nitrate of potash, will be formed, having a specific gravity of 1.635. It melts at 226° F., and at 482° decomposes into water and nitrous oxide, or laughing-gas. Nitrate of baryta, or baryta saltpeter, is made by treating the native carbonate of baryta with nitric acid. It crystallizes in anhydrous regular octahedrons, having a specific gravity of 3.184. When heated strongly it is converted into baryta, or baric oxide, with evolution of oxygen and nitrogen. Nitrate of bismuth and also sub-nitrate are important salts in the arts and medicine. Nitrate of cobalt, prepared by the action of nitric acid on the oxide, crystallizes from solutions in beautiful pink-red deliquescent crystals, having a specific gravity of 1.83. It is much used in the chemical laboratory, particularly as a blow-pipe reagent. With magnesium compounds, it yields a pink color; with those of zinc, green; and with aluminum compounds a beautiful blue; for this reason it is much used in coloring porcelain and earthenware. Nitrate of copper is made by the action of diluted nitric acid on copper turnings. Nitric oxide gas is given off during the operation. It crystallizes from cold solutions in beautiful blue, deliquescent, rhomboidal prisms, containing four molecules of water. From solutions above 59° it crystallizes with three molecules of water in needles, having a specific gravity of 2.047, soluble in alcohol. Nitrate of copper is converted, by moderate heat, into an insoluble basic nitrate. By raising the heat, the acid is completely driven off, leaving only the black oxide of the metal. Nitrate of copper is sometimes useful in surgery, as an application to certain ill-conditioned ulcers. The nitrates of iron are important salts. The protonitrate or ferrous nitrate, is formed by digesting iron-turnings in very dilute nitric acid. It crystallizes in pale green rhombohedrons, having the formula $Fe(NO_3)_2$, $6H_2O$. It is much used in dyeing. The pernitrate, or ferric nitrate, is made by dissolving iron-turnings in nitric acid of sp. gr. between 1.2 and 1.3. It is used in surgery. Nitric acid forms several salts with lead, the principal of which is the common nitrate, or plumbi nitrate, $Pb(NO_3)_2$. It crystallizes in anhydrous regular octahedrons, usually milk-white and opaque. It dissolves in 7½ parts of cold water. Is is decomposed by heat, with evolution of peroxide of nitrogen. Nitric acid forms a greater number of salts with mercury than with any other metal, one of which is used in medicine, and the other for the manufacture of corrosive sublimate. See *Niter*.

NITRO-CELLULOSE.—During the last few years great improvements have been effected in the manufacture and application of this material, and in consequence, its use is rapidly extending, especially in Great Britain, where it is found of great advantage in mining operations, owing to its not producing smoke when exploded. For the improvements as well as the invention of gun-cotton, we are indebted to Germany and Austria, the most important improvement being that of Baron Lenk, consisting chiefly in the following precautions in the manufacture: 1. A perfect cleansing and drying of the cotton. 2. The use of the most concentrated and purest acids procurable commercially. 3. Steeping the cotton a second time in a mixture of the strong acids. 4. Continuance of this steep for 48 hours. 5. A thorough purification of the gun-cotton from free acid by washing in a running stream for several weeks. This may be supplemented by washing in a weak solution of potash, but is not absolutely necessary. The following are the important advantages insured by the new method of making nitro-cellulose: 1. The same initial velocity of the projectile can be obtained by a charge of nitro-cellulose one-fourth of the weight of gunpowder. 2. There is no smoke from the explosion of nitro-cellulose. 3. Nitro-cellulose does not foul the gun. 4. Nitro-cellulose does not heat the gun to the injurious degree of gunpowder. 5. Nitro-cellulose gives the same velocity to the projectile with much smaller recoil of the gun. 6. Nitro-cellulose will produce the same initial velocity of projectile with a shorter length of barrel. 7. In projectiles of the nature of explosive shells, nitro-cellulose has the advantage of breaking the shell more equally into much more numerous pieces than gunpowder. 8. When nitro-cellulose is used in shells instead of gunpowder, a quantity equal in weight to one-third of the latter produces double the explosive force.

NITRO-GLYCERINE.—An explosive agent formed by the action of nitric acid upon glycerine at a low temperature. The following reaction occurs:

$$C_3H_3O_8+3HNO_3=C_3H_5(NO_2)_3O_3+3H_2O.$$

When freshly made it is a white, opaque, heavy oil, but becomes transparent and nearly colorless on



standing for a sufficient time. Above 5° (41° F.) it has a specific gravity of 1.6, is odorless and of a sweet taste. It is poisonous, and if placed in contact with the skin, even in small quantities, before the system has become accustomed to its action, produces violent headache. If incompletely freed from acids, it undergoes spontaneous decomposition, is dangerous to handle, and ultimately may lose its explosive properties; when pure it congeals below 5° (41° F.) into a white, crystalline solid, which is nearly incapable of explosion; it may readily be thawed by introducing the vessel containing it into warm water, which restores its full explosive power. Nitro-glycerine, ignited in small quantities by a flame, and unconfined, burns with difficulty; at 217.2° (423° F.) it deflagrates violently; if ignited confined, or if subjected to the explosion of 15 grains of fulminating mercury, it detonates with tremendous force; fully exploded it gives off no injurious gases. It is not ordinarily sensitive to friction or moderate percussion, but is very much so when in a state of decomposition.

In the manufacture, nitric acid is mixed with twice its weight of strong sulphuric acid to take up the water formed during the reaction, and prevent the dilution of the nitric acid. The process consists essentially in the conversion of glycerine into nitro-glycerine, and the separation and washing of the nitro-glycerine. The apparatus is shown in the drawing. *A*, *A*, are wooden troughs placed around the brick chimney, *D*, *D*. In these troughs are the earthenware pitchers, *a*, *a*, which contain the acid mixture. On the shelf, *B*, above the pitcher, are the bottles, *b*, *b*, which contain the glycerine. The bottles are loosely closed by wooden stoppers with broad, rounded tops. Through holes in these stoppers pass loosely the rubber tubes, *c*, *c*, which reach to the bottom of the bottles and carry small glass jets at their outer ends. Conical wooden plugs, *e*, *e*, are placed in the holes through the stoppers alongside the rubber tubes. The steam-pipe, *G*, passes along the shelves, *B*, *B*, just behind the glycerine bottles. The air-main, *F*, passes under the shelf, *B*, and carries on its under side a number of small, short pipes or jets (two for each pitcher), to which are attached the rubber tubes, *d*, *d*, which hang over the pitchers. In these rubber tubes are inserted glass tubes, long enough to extend to the bottom of the acid pitchers. The troughs are made tight to hold the ice-water with which the pitchers are surrounded Partitions, with openings at the bottoms, cut off the corners of the troughs forming clear spaces. These spaces contain water only, as the partitions keep out the ice. These water spaces are convenient as affording opportunities for quickly emptying a pitcher into water if it becomes necessary. In one corner of each trough is placed a pipe, through which the water may be drawn off into the escape, *E*, when the operation is finished. The pitchers stand on narrow strips, which raise them off the bottom about two inches, thus giving the cold water free and perfect access all about them, and when set in proper position are well under the overhanging hoods, C_1, C_2. These hoods are flat wooden boxes, wide at the bottoms and drawn in at the tops, where they fit against openings in the chimneys, *DD*. In the lower part of the chimney, on the floor below, is placed a grate and fire-door. Each pitcher receives 18 to 20 lbs. of the acid mixture according to the strength of the latter. All are then set in place in the troughs, covered with glass plates, surrounded with ice and water, and allowed to stand until completely cooled. Into each bottle is put 2 lbs. of glycerine. When the acid in the pitchers has fallen to the temperature of the surrounding ice water, the covers are removed from the pitchers, and the air-tubes passed through holes in the hoods down into them. Through these air-tubes a strong current of air is forced by means of a pump driven by steam. This current of air keeps the contents of the pitchers in continual agitation. The air for the pump is drawn through sulphuric acid to render it perfectly dry, and just before it enters the air-main over the troughs it is thoroughly cooled. The cooling arrangement is made of 10 coils of small tin pipe, which are surrounded by ice. These coils are so arranged as to give an extensive cooling surface without impeding the current. As soon as the air current has been turned on, the flow of glycerine is begun. Each rubber tube, *c*, is a syphon which is started by suction through a glass tube inserted in the outer end. As soon as the glycerine runs freely, the suction tube is withdrawn and a fine-pointed glass jet put in its place. The glycerine runs from this jet in a fine stream directly into the pitcher under it. In cold weather the glycerine may become too thick to flow easily. To overcome this the bottles of glycerine are warmed by passing steam through the pipe behind them until the glycerine is sufficiently thin. The glycerine dropping into the acid mixture is rapidly acted on and converted into nitro-glycerine. The reaction is accompanied by a considerable evolution of heat. This heat must be removed, for if the temperature be allowed to rise too high the glycerine is not converted into nitro-glycerine, but is oxydized or burned, with formation of other substances. The limits of temperature are very narrow. Starting at 32°, the temperature must never go beyond 48°; at 50° to 55°, there is great danger of "firing" taking place. The liquid in the pitchers is kept cold by surrounding them with ice-cold water and by the stream of cold air passing into the acid. The most important work of the air-current is to keep the acid mixture in constant agitation. In this way the heat generated is quickly diffused through the whole, preventing any sudden local rise of temperature. The glycerine is much lighter than the acid mixture, and would be apt to collect in little pools above it, and when these were broken up and a quantity of glycerine suddenly brought into contact with the acid, the action would be so rapid that it could not be controlled. While the glycerine is running into the pitchers, observations with the thermometer are constantly made of the temperature attained in them. If in a pitcher the temperature is found to be rising too rapidly and to be approaching the higher limit, the glycerine is evidently running in too fast, and its flow must be checked, which is done by pressing down the conical wooden plug in the stopper of the glycerine bottle. This plug passes through the same opening as the rubber glycerine tube; therefore, when it is pressed down, it compresses the latter so that less liquid can pass through. If the temperature is too high or continues to rise, the plug is forced hard down, closing the glycerine tube altogether. The flow of glycerine being checked or stopped, the pitcher rapidly cools down again. As soon as the thermometer shows this to be the case, the plug is loosened and the flow again set up. Constant care is therefore necessary, but the operation is a simple one, easily learned and performed by ordinary workmen. If the limit of temperature is exceeded, "firing" takes place, indicated by the copious evolution of red, nitrous fumes, and in extreme cases by flame. Usually when this occurs it is easily controlled by stopping the glycerine stream and stirring vigorously the contents of the pitcher, but if it is violent the pitcher must be emptied as quickly as possible. During the operation of conversion, acid and irritating fumes are given off in large quantities, greatly to the injury of those compelled to breathe them. In the apparatus here described these are entirely removed through the hoods and chimney. A fire in the grate at the bottom of the chimney causes a powerful draught in the hoods, which overhang the pitchers, drawing upwards all the fumes and discharging them into the open air. Generally a small fire at first is found to be sufficient, and quite frequently no fire at all is necessary.

It does not mix with and is unaffected by water. It has a sweet, pungent, aromatic taste, and produces a violent headache if placed on the tongue, or even if allowed to touch the skin at any point. Those constantly using it soon loose their susceptibility to this action. Freshly made, opaque nitro-glycerine does not freeze until the temperature is lowered to 3°-5° below 0° Fah., but the transparent or cleared nitro-glycerine freezes at 39°-40° F. Nitro-glycerine freezes to a white crystalline mass. When frozen it can be thawed by placing the vessel containing it in water at a temperature not over 100° Fah. Pure nitro-glycerine does not spontaneously decompose at an ordinary temperature; but if it contains free acid, decomposition is apt to occur. It is, therefore, very important that all acid should be removed by thorough washing when it is made. No instance has yet been noticed of the spontaneous decomposition of properly made and purified nitro-glycerine. Pure nitro-glycerine is not sensitive to friction or moderate percussion. If placed upon an anvil and struck with a hammer, only the particle receiving the blow explodes, scattering the remainder. Nitro-glycerine in a state of decomposition becomes very sensitive, exploding violently when it is struck, even when unconfined.

Nitro-glycerine may be conveniently kept in large earthen jars, with a layer of water over the explosive. If it is to be transported, the liquid form is very inconvenient, especially from the danger of leakage. It is therefore advisable to freeze it, and carry it in a frozen state, when it is perfectly safe. For transportation it should be put in strong tin cans holding about 45 or 50 lbs. Each can should be paraffined on the inside, and have passing vertically through its center a tin tube, so that freezing or thawing may be more easily accomplished. All vessels in which nitro-glycerine has been kept should be destroyed when not wanted for the same use, as the nitro-glycerine cannot be easily washed off.

Nitro-glycerine is the most powerful explosive in use. In difficult blasting, where very violent effects are required, it surpasses all others. In spite of the many accidents that have occurred with it, it has been found to be so valuable that its use has steadily and largely increased. Its liquid form is a disadvantage except under favorable circumstances, as when made at the place where it is to be employed. It, however, forms the essential ingredient in a number of solid mixtures. When used in blasting-work it is usually put in tin cans or cartridge-cases. If the bore-holes are tight, it may be poured directly in; but it is rarely safe to do this, as there is great danger that some of it will escape through seams in the rock, and not be exploded, remaining to cause accident at a future time. Since nitro-glycerine is so readily detonated, it has the advantage of not requiring strong confinement. Even when freely exposed it will exert violent effects, such as breaking masses of rock or blocks of iron. So, in blasting, it requires but little tamping. Loose sand or water is entirely sufficient. The relative force of nitro-glycerine is not easily estimated, since the effect produced depends greatly on the circumstances. Thus, a charge of nitro-glycerine in wet sand or any soft material will exercise but a slight effect, while the same charge will shatter many tons of the hardest rock. In the former case much more sand would be thrown out by a slower explosion, which would gradually move it, than by the sudden, violent shock of the nitro-glycerine, which would only compress the material immediately about it. But in the hard rock the sudden explosion is much more effective than the same amount of force more slowly applied. Roughly, it may be said that nitro-glycerine is eight times as powerful as gunpowder, when taken weight for weight.

On explosion, nitro-glycerine is resolved entirely into the gases carbonic, anhydride, water, nitrogen, and oxygen (Nobel), the last named appearing only in small quantity. If explosion is imperfectly accomplished, oxides of nitrogen are formed, and the total quantity of gas is lessened. If fully exploded, no disagreeable or poisonous gases are given off. See *Dualin*, *Dynamite*, *Gun-cotton*, *Gunpowder*, and *Lithofracteur*.

NITRO-MANNITE.—A high explosive resembling nitro-glycerine in its properties, and made in an analogous manner by the action of nitric and sulphuric acids upon Mannite; a peculier saccharine matter which forms the principal constituent of manna; it is also found in several kinds of fungi, in asparagus, celery, onions, etc, It is most readily obtained by digesting manna in hot alcohol. On cooling the filtered solution, the mannite is deposited in crystals, which are very soluble in water, and possess a sweet taste.

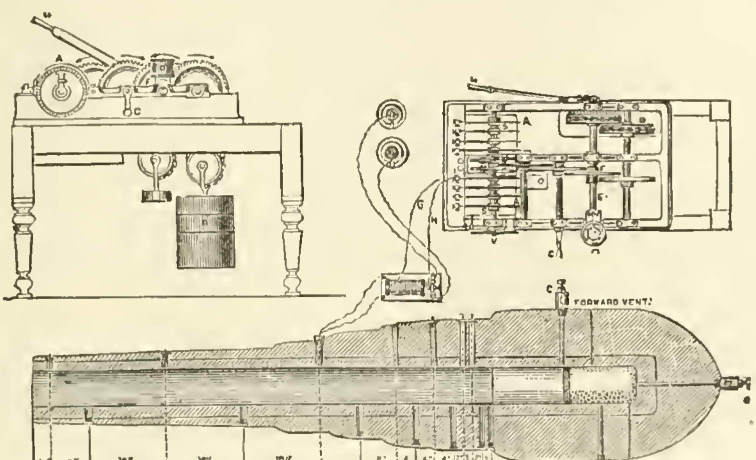
NOBILITY.—That distinction of rank in civil society which raises a man above the condition of the mass of the people. Society has a tendency to inequality of condition, arising from the natural inequality, physical, moral, and intellectual, of those who compose it, aided by the diversity of external advantages, and of the principles and habits imbibed at an early age. This inequality is apt to increase; the son, inheriting the faculties of his father, is more favorably situated than his father was for making use of them; and hence, in almost every nation, in even the very early stages of civilization, we find something like a hereditary nobility. Privileges originally acquired by wealth or political power are secured to the family of the possessor of them; and the privileged class come to constitute an Order, admission into which requires the consent of society or of the order itself. The military tenant who held but a portion of a knight's fee participated in all the privileges of nobility, and an impassable barrier existed between his Order and the people. Over Continental Europe in general, the Nobles, greater and lesser, were in use, after the 10th century, to assume a territorial name from their castles or the principal town or village on their demesne; hence, the prefix "De," or its German equivalent "Von," still considered over a great part of the continent as the criterion of nobility or gentility. Britain was, to a great extent, an exception to this rule, many of the most distinguished family names of the aristocracy not having a territorial origin.

After the introduction of Heraldry, and its reduction to a system, the possession of a coat of arms was a recognized distinction between the Noble and the Plebeian. In the words of Sir James Lawrence: "Any individual who distinguishes himself may be said to ennoble himself. A Prince judging an individual worthy of notice gave him patent letters of nobility. In these letters were blazoned the arms that were to distinguish his shield. By this shield he was to be known or *nobilis*. A Plebeian had no blazonry on his shield because he was *ignobilis*, or unworthy of notice. Hence arms are the criterion of nobility. Every Nobleman must have a shield of arms. Whoever has a shield of arms is a Nobleman. In every country in Europe, without exception, a grant of arms, or letters of nobility, is conferred on all the descendants." On the Continent the term Noble is still generally used in this sense; in England it is now more common to restrict the words noble and nobility to the five ranks of the peerage constituting the greater nobility, and to the head of the family, to whom alone the title belongs. Gentility, in its more strict sense, corresponds to the nobility of Sir J. Lawrence and of Continental Countries. This difference of usage is a frequent source of misapprehension on both sides of the channel; at some of the minor German Courts the untitled member of an English family of ancient distinguished blood and lineage has sometimes been postponed to a recently created Baron or "Herr Von," who has received that title, and the gentility accompanying it along with his commission in the army. It has been taken for granted that the latter belongs to the "Adel" or nobility, and not the former.

The nobility of Spain boasts of a special antiquity and purity of blood, a descent from warriors and conquerors alone, without the infusion of any of the elements derived from the church, law, and commerce that are to be found in other countries. "Hidalgo" (*hijo d'algo*, son of somebody, not *filius nullius*) is a term which implies gentility or nobility. The Hidalgo alone has in strictness a right to the title "Don," which, like "Sir" of English Knights and Baronets, requires the adjunct of the Christian name. When the Christian name is omitted, the title "Senor" instead is prefixed with the addition of "De." "Don" has latterly been used by persons who have no proper claim to it about as extensively as "Esquire" in England. Hidalguia, till recently, conferred important privileges and immunities. The higher nobility are styled Grandees; formerly the title was "Ricohombre," and the ceremonial of creation consisted in granting the right of assuming the pennon and caldron (*penon y caldera*)—the one the rallying ensign of command, the other of maintenance of followers. In contradistinction from the Grandees, the class of nobility below them are called "Los Titulados de Castilla." Red blood is said to flow in the veins of the Hidalgo, blue in that of the Grandee. Formerly there were three classes of Grandees, whose mark of distinction was this—that a Grandee of the first class was entitled to put on his hat in the royal presence before the King spoke to him; the second, after the King spoke to him; the third, after the King had spoken and he had replied. The second and third classes are now absorbed into the first.

of this shaft can be recorded with accuracy to the one-tenth part of a second. The speed usually attained in working this instrument is about 1,000 inches per second, linear velocity, at the circumference of the revolving discs so that each inch travelled at that speed represents the one-thousandth part of a second; and as the inch is subdivided by the vernier, V., into a thousand parts, a linear representation at the circumference is thus obtained of intervals of time as minute as the one-millionth part of a second.

As a small variation in speed would affect the relation between the several records obtained, the uniformity of rotation is ascertained on each occasion of experiment by three observations: one immediately before, one during, and one immediately after the experiment, the mean of the three observations being taken for the average speed. With a little practice there is no difficulty in arranging the instrument so that the discs may rotate either uniformly or at a rate very slowly increasing or decreasing. The arrangements for obtaining the *electrical records* are as follows: the revolving discs are covered on the edge with a strip of white caper, and are connected with one of the secondary wires, G, of an induction coil. The other secondary wire, H, carefully insulated, is brought to a discharger, I, opposite the edge of its corresponding disc, and is fixed so as to be just clear of the latter. When a spark passes from the discharger to the disc, a minute hole



NOBLE CHRONOSCOPE.—The principle of action of this instrument consists in registering, by means of electric currents upon a recording surface, traveling at a uniform and very high speed, the precise instant at which a projectile passes certain defined points in the bore. It consists of two portions: first, the *mechanical arrangement* for obtaining the necessary speed, and keeping that speed uniform; secondly, the *electrical recording arrangement*. The first part of the instrument consists of a series of thin metal discs, A, A, each 36 inches in circumference, fixed at intervals upon a horizontal shaft, SS, which is driven at a high speed by a heavy descending weight, B, through a train of gearing, multplying 625 times. The driving-weight is, during the experiment continually moved up by means of the handle H. If the requisite speed of rotation were got up by the action of the falling weight alone, a considerable waste of time would ensue. To obviate this inconvenience, the required velocity can be obtained with great rapidity by means of the handle C. The precise rate of the discs is obtained by means of the stop-clock D, which can at pleasure be connected or disconnected with the revolving shaft, E; and the time of making any number of revolutions

is perforated in the paper covering upon that part of the disc which was opposite the discharger at the instant of the passage of the spark; but, as the situation of this hole in the paper would be very difficult to find, on account of its extreme minuteness, the paper is previously coated with lamp-black, and the position of the hole is thus readily seen: a distinct white spot is left on the blackened paper, the lamp-black at that point having been burnt away by the spark, so that the white paper is shown beneath. By means of the micrometer the distance between the sparks on the disc is read off.

In order to connect the primary wires of the induction coils with the bore of the gun, so that they may be cut by the projectile in its passage, the gun is tapped in a number of places for the reception of hollow steel plugs carrying at the end next the bore a cutter which projects slightly into the bore. This cutter is held in position by the primary wire, which is carefully insulated and passed down the plug, through the cutter, and back out of the plug, the ends being connected to the main wires leading to the induction coils. When the projectile reaches the point where the plug is screwed in, it presses the cutter in flush with the bore, and, by so doing, cuts the primary circuit. As each plug is reached a spark is delivered, and thus the passage of the projectile along the bore is recorded at regular intervals. Some idea may be conveyed of the minute intervals of time which can be measured by this means, from the fact that the distances between the parts of a X-inch gun at which the time-records have been obtained are in some instances only 2.4 inches, while the total time the projectile takes to reach the muzzle of the gun—a distance of 100 inches—when fired with a full charge, is about the one-hundreth part of a second. By this means the time may be recorded which the projectile occupies, from the commencement of motion, in reaching different parts of the bore, and from these time-records may be deduced the velocity with which the projectile is passing through the different parts of the bore, and the pressures in the gun which correspond to these velocities. See *Chronoscope*.

NOISY.—A term applied to projectiles in flight. The passage of a rifled projectile through the air causes a shrill, tearing sound. An experienced ear at experimental practice can detect from this sound whether the projectile is properly centered; if not,it is said to be *noisy* in flight.

NOIZET SYSTEM OF FORTIFICATION.—The School of Application for engineer and artillery officers, first established at Mézières and subsequently at Metz, has given to France, from about the period of the French Revolution down to the present day, many able officers who have gained universal and deserved celebrity for these two corps. In these schools the precepts of Vauban and Cormontaigne have been jealously regarded as the highest authority,and their manuscripts and works have formed the basis of the instruction given in them. Some slight modifications were proposed in the front of Cormontaigne by two engineers, *Chatillon* and *Durigneau*, and taught by them in the course of permanent fortification given in the school. These changes chiefly consisted in enlarging the demi-lune and making it more salient ; and in placing casemates for cannon in the flanks of its redoubt, with reverse views on the breaches that might be made in the bastion faces. The teaching of the school of Metz has received its principal impress in later years from General Noizet. For nearly fifty years, General Noizet was engaged in the study and practice of his profession, serving for many years as professor of the art of fortification in the school at Metz. He had the good fortune to apply practically on a large scale the principles taught by him in the school. He was for ten years a member of what we would call the Board of Engineers for France, and has visited every fortification in France. He is regarded as *first* among the successors of Vauban and Cormontaigne. The front planned by him has been taken as an elementary exercise for instruction in the art of fortification for the cadets of the U. S. Military Academy at West Point, N. Y. In it, there is no sensible departure from the views and method of Cormontaigne, excepting to introduce such modifications as would remedy some of the acknowledged defects of his method. This front combines the principles of the science of fortification to as great an extent as any one system or method that can be given to the student. Another object has been kept in view in using this front. That is, to present in its combinations, a *problem*, in the solution of which the pupil would have to apply to a special case, both the elementary principles of fortifications, and the geometrical methods used by the military engineer in the practice of his profession. Noizet, in the plan of his enceinte, has adopted dimensions and constructions which gives results for the most part, the same as those of Vauban and Cormontaigne, making the defensive properties of these different methods about equal. The extent of the exterior side, the length of the curtain, the diminished angle, and the direction assumed for the flanks, produce a combination giving an efficient flanking, both as to direction and amount of fire, for the entire scarp, and a powerful cross-fire upon the covered-way and its glacis in advance of the bastion salient. The lines of defense, by this combination, are within the effective range of the most improved small-arms, and the flanks are capable of receiving a battery superior to the counter batteries that can be brought against them from the glacis crest of the opposite covered-way. The dimensions and form of the profile are such as experience has shown will give durability and stability to the masonry from the pressure of the embankments,and the ordinary causes of destructibility to which it is liable when exposed to the weather. The rampart and parapet have sufficient strength to resist the action of the heaviest siege artillery in ordinary use, whilst they offer to the assailed every convenience for their prompt action, and the use of their arms. The width and slopes of the ramps are regulated for the passage of artillery. Where the height to be overcome is slight, as that between the terre-plein and barbette, the slope of the ramp may be as great as $\frac{1}{6}$, and its width be 3.30 yards. Where the height is greater, the declivity of the ramp should be proportionally less steep, and its width be 4.30 yards at least. The position of the terre-plein with respect to the interior crests is that usually considered necessary to give shelter to the troops and *matériel* on it. By inclining that of the bastion, the guns and troops on the faces and flanks are better covered from the enfilading and ricochet fire than they would be if the terre-plain was horizontal; as a ball passing over the salient will of necessity reach an inclined terre-plein at a point much farther from the salient than one which is horizontal. The following is the summary of the principles, and essential details involved in this system. 1st. The enceinte of every permanent work should present an uninterrupted line of scarp wall, which, when the ditch is dry, should be at least 30 feet high above the bottom of the ditch. 2d. All the approaches to the work, beyond the ditch within the effective range of its fire, as well as the ditch itself should be completely swept by this fire. 3d. All scarp walls should be sheltered from the fire of the enemy's artillery, to the latest moment, by earthen masks. 4th. All parapets should be proof against the heaviest projectiles, to which they may be exposed. 5th. The terre-plein of the rampart should be masked by the parapet from the enemy's view ; it should be wide enough for the infantry and artillery service ; should have convenient communications for these between all its parts : and between it and the parade. 6th. All outworks, except the covered-ways, should be regarded as accessories rather than indispensable additions to the main work. When properly placed, they strengthen weak points and delay the enemy's progress, by forcing him to gain possession of them before he can advance beyond the points they occupy. Their scarps, and the gorges liable to be turned by the enemy, should be of masonry, not less than 12 feet in height. The more retired of these works should command the more advanced, and where this rule is violated, the retired work should be defiled from any establishments that the enemy might be able to make on the advanced one by which it is commanded. They should be commanded by the enceinte, and as far as practicable flanked by the fire of its small-arms. 7th. The covered-ways are regarded as indispensable. Without them the communications between the main work and the exterior would not be secure. Their embankments form,in a great majority of cases,the only masks for the scarps of the works in their rear, and by affording advanced cover for the garrison, give the means of annoying the enemy by sharpshooters, and retarding his approach by sorties in small parties. They should be thoroughly swept by the fire of small-arms of all the works in their rear, and have their terre-pleins defiled from all commanding points liable to fall into the hands of the enemy. 8th. The glacis should be thoroughly swept by the fire of artillery and small-arms of the main work and outworks where a fire can be brought to bear upon it. For this purpose, the surfaces should be so arranged that their intersections shall not form hollows or ridges, which might be of advantage to the enemy in advancing upon the work. 9th. The tenaille is an essential addition to all fronts of attack. Without it, the postern in the curtain would be not only insecure but absolutely unserviceable as soon as the enemy could in any manner gain a position where his fire could be brought to bear on its outlet. It also enables the defense to form retrenchments resting either on the flanks or curtain of the enceinte, that cannot be turned by the enemy, and also offers a sheltered place-of-arms, in the ditch, between it and the curtain, which can be used for assembling troops against the enemy in the ditches. Its relief is so determined that it shall not mask the fire of the flanks on the bastion-faces, whilst at the same time it affords cover to the scarp of the curtain and flanks. 10th. The demi-lune, when properly arranged, forms an important addition to the defense. It covers the curtain and portions of the bastion-faces near the shoulder angle from the fire of the enemy's artillery, and secures the main outlet from the enceinte from surprise. The arrangement of the demi-lunes places the bastions in strong re-enterings, thus forcing the enemy to take them before he can attempt the assault of the enceinte; and when the faces of the bastions prolonged fall within the demi-lunes, they mask them from enfilading views. These advantages are the more decided as the demi-lune is the larger and more advanced. Its scarp is taken 22.50 feet high to afford the necessary security against an open assault, and to obtain a very efficient cut across its face. 11th. The demi-lune redoubt adds to the strength of the demi-lune. Its arrangement with flanks adds directly to the strength of the enceinte, as the reverse fire from the flanks on the breach in the bastion-face will force the enemy to carry the redoubt before he can risk an assault on the breach. 12th. The redoubt of the re-entering place-of-arms, adds greatly to the *strength* and *security* of the covered way. From its retired position, it can be occupied after the dimi-lune has fallen, provided there is an efficient cut in the demi-lune face, and the redoubt has been defiled from the establishments of the enemy on the parapet of the demi-lune. It also, in connection with the demi-lune, covers that portion of the curtain which is exposed through the ditch between the tenaille and enceinte flank. Its crest should mask as little as practicable the fire of the bastion-face on the glacis in advance of it. 13th. The cut in the demi-lune face is an important addition, as it secures the redoubt of the re-entering place of arms from being turned. Its position should be so chosen that the face of the redoubt may be flanked through it by the fire from the demi-lune redoubt. A parapet is thrown up behind the cut to defend it after the enemy has gained possession of the demi-lune salient. It should command the salient and its terre-plein should be defiled from the same point. 14th. The ditches should furnish the earth required for the embankments. Their dimensions, therefore, will depend upon the amount necessary for this purpose. When water can be used, it is more advantageous to increase the width at the expense of the depth. The ditches of the different works should afford no communications through which an enemy might penetrate from one into that of another, and thus assault the works by the rear. 15th. The communications, in accordance with our general principles already stated, should be of convenient dimensions, and of easy access; be swept by the fire of the works in their rear; be covered from the fire from all points that the enemy can occupy whilst they are needed; be secure from surprise, and from being approached in the rear by the enemy; and not compromise the safety of any work through which they may lead.

A fortification constructed in keeping with these principles, possesses the advantage of having its ditches thoroughly swept from the main work itself; of bringing a cross and flank fire to bear upon the approaches on the salients of the enceinte; and furnishing a strong direct and cross fire upon the site in advance of the curtains and the faces of the bastions. The principal objections urged against this particular system are: 1. That its chief characteristic, a perfect flanking disposition for the entire line of the scarp, is attainable only under certain relations between the requisite relief for a permanent work and the lengths of the exterior side and curtain, which therefore restricts it in its application to fortifications of a permanent character. 2. That, in order to secure a sufficient length of flank for an effective flanking disposition, the angle between the face of the bastion and the exterior side, termed the *diminished angle* of the polygon, has to be made so great as to decrease considerably the space inclosed within the polygon, whilst the development of the line of the enceinte is greatly increased by it. 3. That the direction necessarily given to the faces from this cause throws their prolongations in positions very favorable to the erection of all the enfilading batteries against them. 4. That the flanks, upon which the whole system is based, lie in positions in which, like the faces, they can be not only easily enfiladed, but are further exposed to a reverse fire, from shot which may pass over the parapet of the faces as well as the opposite flank. 5. And that these objections are much the stronger as the salient angles of the polygon are smaller or as the number of the sides is decreased. See *Cormontaigne System of Fortification*, *Fortification*, and *System of Fortification*.

NOLAN RANGE-FINDER.—The principal parts of this instrument are: 1. Two instruments for measuring angles. 2. One tape-line. 3. One reckoning cylinder. Each of the two instruments consists of two telescopes, which lie crosswise one above the other under an angle of about 90°; the smaller of the two has a long arm, with a vernier at one end; to the other a sector is fastened, which is divided up into degrees. By means of a screw, an angle of about 20° can be described by the upper or smaller telescope. The reckoning cylinder consists of a solid body and two rotating rings. The lower ring and the lower edge of the body are divided into 100 equal parts. On the upper ring are the logarithms of the figures, and on the upper edge of the body are the logarithms of the signs, from 6″ up to 2° 15′.

To find the range, the instruments on their tripods are arranged at the end of the assumed base-line, which is perpendicular to the range; or the instruments may be attached to the right and left guns of a battery. The long telescopes are turned toward the object whose distance is to be found; the smaller ones upon each other, and the cross-threads of each made to cover the cross-lines on the leather disc through which each small telescope points. The coincidence obtained by directing the longer telescope on the object, the two angles at the base are determined; the base-line being measured, one side and two angles of the triangle are obtained. With this data recourse is then had to the reckoning cylinder. The arrow marked "band" is set on the figure that corresponds with the distance between the instruments or base-line—say 34 yards; then set the arrow on the lower ring on the figure corresponding with the angle found through the instrument—say 18°; then find the figure for the number of degrees of the other angle—say 42°, on the lower ring. Just above that is the figures 60 on the other division of the lower ring; coinciding with this on the lower edge of the upper ring is the distance, 1,320 yards. The bases used are conveniently taken from 30 to 40 yards for a range of 3,000 yards and over. See *Pratt Range-finder*.

NOLLE PROSEQUI.—An entry upon the records of a Court-Martial by the plaintiff or the prosecutor, declaring that the proceedings against the defendant shall be discontinued. A *Nolle Prosequi* is not equivalent to an acquittal, but acts merely as a stay of proceedings, and the defendant is liable at any time to be re-indicted. It may be entered as to one of several defendants, and is often done so to allow his testimony to be introduced against the others. It is generally in the discretion of the prosecuting officer to enter a *nolle prosequi*, but in some cases leave must be obtained from the Court.

NOMBRIL POINT.—A term in Heraldry. See *Escutcheon*.

NOMENCLATURE.—Technical designation. The term, as applied to military stores, signifies a systematic classification of words pertaining to each article used in the service. For nomenclature of ordnance, etc., see appropriate headings in this work.

NON COMBATANT.—Any person connected with an army, or within the lines of an army, who does not make it his business to fight, as any one of the Medical Officers and their assistants, Chaplains, and others; also, any of the citizens of a place occupied by an army. In the English Army, the duties of all non-combatants are restricted to the Civil Department.

NON-COMMISSIONED OFFICERS.—Subordinate officers of the General Staff, Regiments and Companies who are appointed, not by commission, but by the Secretary of War or Commanding Officers of Regiments: They are usually selected on account of good conduct or superior abilities. In the British Army, the Non-commissioned Officers constitute a numerous and very important class in the regimental system between the Commissioned Officers and the men. As the former are not permitted to mix with the private soldiers, lest familiarity should diminish the sway of absolute discipline, it is necessary to have an intermediate class to overlook the men in their barracks and at all times when off the parade. None are so suited for this duty as the best conducted of the men themselves, who are promoted by selection to Non-commissioned rank, and hold many privileges and powers unattainable by the privates. The Non-commissioned Officers comprise the Sergeants-Major, and all the Sergeants, the Trumpeters, Drummers, and Buglers, and, in the Life Guards, and Royal Horse Guards only the Corporals. They can be reduced to the ranks by sentence of a Court Martial, or by their Colonel Commandant; but not by a Lieutenant Colonel nor by any Junior Officer. Non-commissioned Officers are entitled to quarters for their wives, or lodging money in lieu of quarters. Accustomed themselves to obey, the Non-commissioned Officers are admirable assistants in preserving discipline; veterans, to whom military life is a second nature, they are looked up to by their comrades as examples, to lead in battle or to teach in drill. The Non-commissioned Officers have a mess to themselves. In a battalion of infantry at home, there were, in 1874, 58 Non-commissioned Officers to 520 rank and file; in India, 66 to 820; but the rank and file may be greatly augmented without affecting the number of Non-commissioned Officers. In the whole British army (European) for the year 1874-75, there were 20, 949 Non-commissioned Officers. This rank is a necessity in all armies; in France, the Non-commissioned Officers are termed *Sous-Officers*; in Germany, *Vinter-Offizieren*.

NON-EFFECTIVE.—The term applied to the portion of the personnel of the army or navy not on active service or in immediate readiness for active service. It thus comprises all officers on retired or half-pay, pensioners, and superannuated officers. In a force liable to frequent augmentations and reductions,the non-effective charge must be considerable, and a large retirement is necessary, in order to rapid promotion. The great French war, also, with the reductions following it, bequeathed to the British an annual non-effective charge of several millions, which is not yet wholly expunged. In 1878-79, the non-effective charges were £2,344,912 for the the army, and £1,887,571 for the navy, being upwards of 16 per cent on the gross cost of the two services.

NOOSE.—A running knot, which binds the closer the more it is drawn. See *Cordage*, *Knots*, and *Lasso*.

NON-POLAR PROJECTILES.—A designation applied to projectiles which do not keep the same end or aspect foremost throughout their courses.

NORDENFELT MACHINE GUN.—In addition to the older mechanism devised by Mr. Nordenfelt for his well-known four-barrel 1-inch gun, he has lately introduced modifications more suitable for two or three barrels, and as several of these new guns have been recently tried with great success at Portsmouth and elsewhere, we give a complete description of all the Nordenfelt volley guns now made. In order to explain the differences in the mechanism used for the several guns, we will commence our description

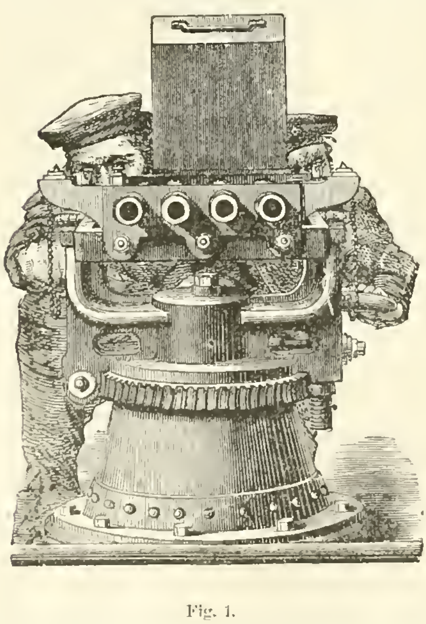


Fig. 1.

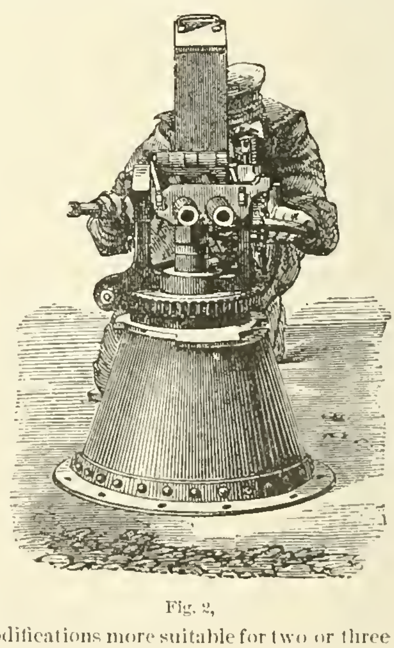


Fig. 2.

with two of the 1-inch guns as representatives of the two systems.

The four-barrel 1-inch gun, Admiralty pattern.—When the use of the torpedo boat became general, it followed as a necessary consequence that a means of defence must be provided against these swift and destructive little vessels, and the British Admiralty searched for a weapon having sufficient penetrating power to damage the boiler of a torpedo boat at a distance of from 300 to 500 yards. Other essential conditions required were that the gun could be fired so rapidly that it would almost certainly score a sufficient number of hits on an approaching torpedo boat to insure its being disabled during its run at full speed from the distance named, before it could reach the vessel attacked, or which could be fired so rapidly as to make it impossible for the boat to discharge a Whitehead torpedo at such a range that the missile would have any reasonable chance of hitting its mark. After various competitions the Admiralty decided in favor of the Nordenfelt gun.

The four-barrel gun, shown in Fig. 1, consists of a rectangular framework of wrought iron, the sides of which are connected by three plates or transoms. The four barrels are placed side by side in the frame, their muzzle ends passing through the front cross-piece, while the breech ends are screwed into the middle transom. In the rear of the middle cross-piece is the action block, which is capable of movement backwards and forwards. In front of this action block are four breech plugs, corresponding to the barrels. These are of steel pierced with a channel, in which a firing pin or striker moves freely, and they are furnished with an extractor on the right side. Behind each plunger is a hammer, with a projecting tenon, and behind the hammer is a strong spiral spring.

The trunnions fit into a cross-head pivoting on a cone, which is firmly fixed to the side or other part of the ship, where the gun is to be fired. The training is given by a hand-wheel, which works a worm gearing into a horizontal toothed rack attached to the top of the cone. The elevation is produced by a wheel working a differential screw. One turn of the training wheel gives 6 degrees of training, and one of the elevating wheel 12 degrees of elevation or depression. The action of the mechanism is as follows. Supposing the discharge to have been just completed, that the lock closes the breech end of the barrels, and is still secured in its place by the two bolts; 1. The handle begins to move to the rear; the friction roller traverses the concentric part of the action plate, and the action block remains steady. The spring and the heel of the lever, acting on the trigger comb, drive it from right to left. 2. As the movement continues, the action lever acts on the locking-bolt plate, and withdraws the bolts leaving the action block free. 3. At the moment these bolts are withdrawn the friction roller engages in the straight part of the action plate, and the action block begins to move back, drawing with it the breech plugs, which extract the cartridge cases 4. When the breech plugs are clear the friction roller on the action block bears against the forked arm and so pushes the carrier to the left. At the same time the cocking cam begins to press against the tooth of the trigger comb, carrying the latter to the right. The empty cartridge cases fall to the ground and are readily replaced by filled ones. The tenons of the hammers pass behind the teeth of the trigger comb, which is driven to the left by the spring, or by the cocking cam, as the action block moves forward. The handle moves forward with the following effects: 1. The friction roller on the action lever acts on the director, and moves the action block to the front. The action block, pressing against the fork, drives the carrier to the right, thus placing the cartridges in line with the barrels. 2. The action block advances to the front and the spiral springs are compressed by the hammers, which are kept back by the trigger comb. The plungers push the cartridges into the barrels. 3. When the cartridges are quite home, the action block stops, and the stud on the action lever causes the closing cam to drive the bolts into the holes in the gun frame, so that the breech closing is complete. 4. The action lever now begins to carry the trigger comb to the right. Each hammer is released in turn from the tooth which retains it, and the striker pertaining to it is driven forward in consequence. The action of the drill stop is this: The hand lever is brought up by it before it has completed the back stroke, so that the hammers cannot pass behind the trigger comb. Thus, the gun is not full cocked, because the springs are not compressed when the action block moves forward. The gun is sighted up to 1,800 yards, and the sight is so fitted that it can be moved up and down by means of a rack and pinion. The following are some of the principal advantages claimed for guns made on the Nordenfelt system: They are strong and simple, and the whole mechanism, as well as the springs and firing pins, can be taken out without the use of any tools; they fire either single shots or volleys of four shots each as desired. The cartridges are fed to each barrel from its own compartment, and independent of the others, so that if one or more barrels become damaged the fire can be continued from the remaining barrels. The gun is free from any possible liability to jam, more especially after some of the improvements recently adopted by the Admiralty. In order to test these improvements, 2,000 rounds were fired very rapidly without any hitch or jam whatever and most of the vessels at the bombardment of Alexandria were armed with these guns, firing many thousands of rounds without any failure or difficulty. Besides their principal object as defense against torpedo boats, these guns are especially useful for firing against the guns and riflemen in the enemy's tops, even if protected by shields—against conning towers and gun-ports—and in Egypt they have been recently used for firing through the port-holes of forts, and mounted on railway trucks, they have served for long range firing against troops. The capacity of the system for very rapid firing of steel projectiles of larger caliber than rifle bullets, makes it a very valuable weapon, even for purposes where, perhaps, strictly speaking, small shells might be more suitable, because with the modern swift vessels a slow-firing machine gun has really very little chance against a quick-volley gun for purposes where the latter has sufficient penetrating power.

The double-barrel 1-inch gun—This double-barrel 1-inch gun, shown in Fig. 2, has been made for the purpose of being mounted on torpedo boats, where the four-barrel 1-inch gun has been considered too heavy. The gun weighs only 1½ cwt., and its naval carriage and stand weigh together 165 pounds. Counting 345 pounds for 500 rounds of ammunition, 80 pounds for hoppers, and 132 pounds for the gunner, the weapon, with mounting ammunition and gunner complete, weighs 8 cwt., which is well within the limits that can conveniently be carried on a torpedo boat. When not in action, *i. e,* when the gunner and ammunition are below, the weight of gun and mounting is only one-third of the weight of the Nordenfelt four-barrel gun. It fires the same 1-inch steel-shot cartridges as the four-barrel gun, and with exactly the same initial velocity of 1,500 feet. Its penetrating power is consequently the same as that of the four-barrel 1-inch gun already described. The accuracy of fire is also the same when firing very slowly, and is somewhat higher when firing more rapidly, because its volley of two shots causes less vibration to the weapon from accumulated recoil than the volley of four shots. The rapidity of fire in proportion to the number of barrels is somewhat greater than that of the four-barrel gun, because the stroke of the lever is shorter. The four-barrel gun fires ten volleys in eight to ten seconds, this two-barrel gun fires ten volleys in six to seven seconds. This gun thus fires twenty shots in six to seven seconds, and it fires sixty shots in the half minute. As will be seen, the rectangular frame is made in one piece, with the center cross-bar dovetailed into it, and the front cross-piece bolted on to its fore end. The barrels are screwed into the center cross-piece and pass through the front cross-piece. The action cam is cut into the cam plate and is driven by the friction roller on the action lever, which again is moved by the firing handle, keyed on to the axis pin. The breech plugs are made in one piece with the cam plate, and contain the firing pins. On the upper face of the cam plate are two studs which pull back the hammers. The action block is moved right and left by the rear end of the action lever. In the action block there are four grooves, two of which receive the breech plugs when drawn back, the other two contain the hammers and spiral springs, which are held within them by the back plate, which carries the pressure of the action block on to the rear of the frame itself. The cartridge receiver is moved right and left in front of the action block by two lugs or cams on the cam plate. The trigger comb is inserted into the action block, and is held by a spring; the sloping surfaces of the hammer studs move it to the one side to catch the hammers, and the trigger comb is pushed against the side of the frame in order to release the hammers when the shots are to be fired, showing the parts separately. The operation of the mechanism of the Nordenfelt machine-gun may be described briefly as follows, supposing a discharge to have just taken place: 1. The firing handle travels to the rear, while the friction roller moves along the concentric part of the action cam, the plungers remaining steady in order to give sufficient support to the cartridge case after the discharge. The rear end of the action lever during this movement brings the action block over to the left and allows the spring to push the of trigger comb into position. 2. The continued rearward movement causes the cam plate to draw back the breech plugs into their grooves in the action block, after which the lugs upon it move the cartridge receiver over to the left to take a fresh layer of cartridges. 3. Just before the rearward movement is completed the hammers are caught by the studs on the trigger comb. The forward movement of the firing handle has the following effect: 1. It forces the lugs on the cam plate against the cartridge receiver and pushes it to the right so that the cartridges are in a line with the chambers in the barrels. 2. The cam plate is driven forward, and the breech plugs enter the grooves in the cartridge receiver, pushing the cartridges into the chambers. 3. When the breech plugs have closed the breech, the rear end of the action lever pushes the action block over to the right until the hammers come in a line with the firing pins, when the action block fully supports the rear of the breech plugs, the back plate of the action block resting firmly against the rear of the frame. 4. The movement of the action block to the right pushes the trigger comb against the inner side of the frame until the hammers are released and the shots fired. The principal advantages claimed for this system, in addition to those mentioned above for the four-barrel gun, and which also apply to this weapon, are the great simplicity of the mechanism, in which the number of parts is 16 in all, or only 8 parts per barrel. The movements of the parts of the mechanism are all inside the frame, so that the action block does not move beyond the rear part of the frame. When the firing handle is held forward in the position in which the gun would travel, the entire mechanism is inclosed, so that not even the slots for the extraction of fired cartridge cases are open. This makes this system especially suitable for guns which are exposed to dust and storms of sand.

In the following article are described all the Nordenfelt volley-firing guns which are at present manufactured: No. 1. *Two-barrel* $1\frac{1}{2}$ *inch gun*—This type weighs $4\frac{1}{2}$ cwt., and fires steel shot and shell weighing 22 ounces, with an initial velocity of 1,600 feet, giving a penetration of $1\frac{1}{2}$ inches into an iron plate at 300 yards; the shells have 580 grains bursting charge. This gun is made to compete with revolving cannon of the same caliber which fire 16 ounce shells with 337 grains bursting charge and 1,390 feet initial velocity, giving a penetration of $1\frac{1}{4}$ inches at 300 yards range. The rapidity of fire is about 40 shots per half minute. Both guns are about the same weight; the Nordenfelt is, however, the more rapid of the two, as it fires a volley of two shots for every single shot fired by the revolving gun. No. 2. *Two-barrel* $1\frac{1}{4}$ *inch gun*. This weighs $3\frac{3}{4}$ cwt., and is made in the same way as No. 1, and for the same purposes. Its shell weighs $14\frac{1}{2}$ ounces, with 460 grains bursting charge, but its greater initial velocity of 1,500 feet gives to this gun the same penetrating power as the $1\frac{1}{2}$ inch revolving gun, with its rapidity of fire and slightly less weight of gun. No. 3. *Two-barrel* 1-*inch* (*heavy*) *gun*.—Is made to No. 2 pattern, with exceptionally long barrels. The weight is 4 cwt. and it fires solid steel shot of $9\frac{3}{4}$ ounces (shells are not allowed for this weight of projectile). This steel shot gave at Portsmouth an initial velocity of 2,000 feet per second and penetrated a 2-inch solid iron plate at 300 yards range. This gun has been made for defense against torpedo boats if in future any country should carry out the idea to arm such vulnerable parts as boiler and engines with 1-inch steel plates. No. 4. *Four-barrel* 1-*inch* (*medium*) *gun*—The type of this gun is illustrated by Fig. 1. It fires 8.9-ounces solid steel bullets, with 1,650 feet initial velocity, and gives greater penetration than the four-barrel 1-inch English Admiralty gun; it

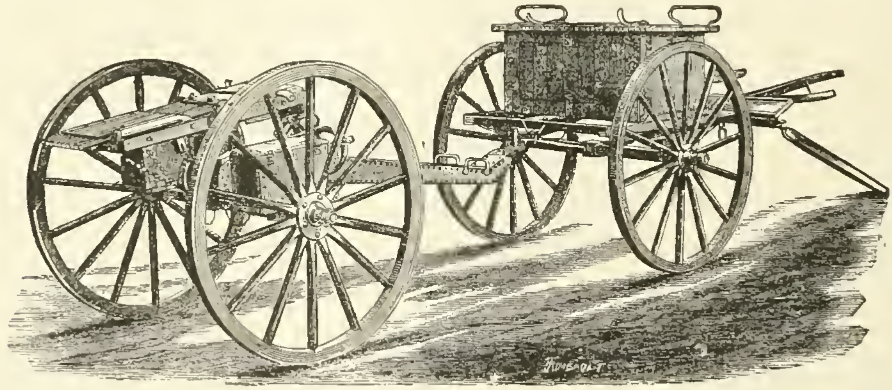


Fig. 3.

weights about ½ cwt. more, and is meant to be used for the same purposes and in the same manner as the ordinary four-barrel 1-inch gun No. 6, by any Navy that may desire to have greater penetrating power at the cost of more expensive ammunition and without reducing the rapidity of fire. No. 5. *Five-barrel 1-inch gun.*—This gun is similar to No. 6 and fires the same ammunition; it consequently has the same penetrating power but fires 20 per cent. more rapidly and weighs ½ cwt. more than the four-barrel gun. No. 6. *Four-barrel 1-inch gun.*—This gun has been already fully described as representing the Nordenfelt volley guns with more than three barrels. No. 7. *Two-barrel 1-inch gun.*—This gun has also been noticed (Fig. 2), as representative of the pattern of volley guns with less than four barrels, and is proposed for arming torpedo boats, as being the lightest volley gun made with sufficient penetrating power for this purpose, the only other gun of less weight of any other system with sufficient penetrating power, being the Nordenfelt single-barrel 1¼ inch shell-gun. No. 8. *Twelve-barrel rifle-caliber gun;* and No. 9. *Ten-barrel rifle caliber gun* fully illustrated in Fig. 3. These machine-guns weigh about 2½ cwt. and 2 cwt., respectively, and fire 1,200 and 1,000 rounds per minute. They are constructed after the same pattern as the four-barrel English gun, and are especially designed for naval as well as for land service, in competition with the five-barrel Gardner gun. At the Shoeburyness trials in February, 1881, the ten-barrel Nordenfelt did not act quite so well as it should have done in consequence of it having been adjusted to incorrect ammunition, but after the extracting and feeding gear had been put in order, the gun worked to perfection at all the Portsmouth trials in July, 1882. On that occasion it fired 3,000 rounds in three minutes three seconds without any hitch or jam whatever, and it worked so easily that the same man fired the whole of the 3,000 rounds without any relief; immediately after the firing ceased, the officers ascertained that the gun was in perfect order and worked quite as easily as at the commencement.

For land service they have been recommended more especially for two purposes. First, for acting on the flanks of artillery for the protection of artillery against infantry fire. The enemy's infantry could never advance so close up to a battery of artillery as to force it to retire if the battery had on each flank a ten-barrel gun firing rifle cartridges, and cavalry would never charge, or could never reach a battery protected thus by two guns capable of a very rapid fire continuously poured out of it, while the gunner who aims the gun would all the time follow the movements of the advancing cavalry. The ten-barrel guns are mounted on an ordinary light field carriage with its limber which holds 4,000 rounds (Fig. 3). Four horses easily manage the gun and limber, three men ride on the limber, and the Captain of the gun is separately mounted. The second purpose for which this type is adapted is especially for position defense. Wherever machine-guns can be used in such positions that there is little or no difficulty to provide ammunition, and where it is not required to lift the gun about too often, the ten-barrel Nordenfelt is to be recommended. Even with its great rapidity of fire it does not require any greater number of gunners to serve it than the five-barrel guns.

It has been stated that a machine-gun wastes ammunition, but this is not the case, because it must score a much greater percentage of hits than has been recorded in recent wars from rifle fire. This is quite natural, because the gun has no nerves and is not fired from the unsteady shoulder of a man panting with fatigue or excitement—and a soldier would commence to fire his rifle at long range (where he wastes his shots) for fear that he might not be able to stop in time an enemy who outnumbers him. If he has a gun that fires 1,000 rounds a minute, he would keep cool and aim carefully, well knowing that when he does commence fire at short range no enemy can face it. The No. 10. *Seven-barrel rifle-caliber gun;* and the No. 11. *Five-barrel rifle-caliber gun* are each made to the pattern of the four-barrel gun, with such alterations in the inner mechanism as are necessary, in consequence of the gun being narrower. They weigh 1½ cwt. and 1 cwt. respectively, and fire with a rapidity of 750 and 600 rounds per minute. The five-barrel gun has fired 3,000 rounds in 5 minutes 5 seconds without any hitch or jam; the same man firing the whole of the 3,000 rounds without relief. It has also fired at 30 degrees elevation, and at 30 degrees depression, the feeding and extraction giving perfect satisfaction. For the very rapid movements of mounted infantry, and to save time in dismounting the gun for firing, and mounting it again when it has to be moved, a very light carriage has been made at the suggestion of Lord Charles Beresford, on four wheels, to be drawn by two horses driven by a man sitting on his box on the two front wheels. The gun is mounted at the rear of the carriage, and is fired from it without taking out the horses; 3,000 rounds of ammunition are carried on the same carriage, as well as the gunner who fires the gun, and a second man who looks after and supplies the ammunition. The remainder of the service for the gun are mounted on spare horses, harnessed so as to replace quickly any of the driven horses that become disabled. The carriage itself is so light that it carries a shield to protect the gun and the gunners, and also to protect the horses against direct fire from the enemy's rifles during the time the gun is fired. This shield enables the gun to advance within shorter distance of the enemy's rifle fire than could otherwise be done, and allows the gun to be kept at shorter and more effective ranges when retiring before infantry. The essential idea of this mode of using the gun is of course to make all possible use of its exceedingly rapid movements, to rush forward to a comparatively close range against infantry or artillery, taking the risk of being disabled while galloping forwards (much in the same way as the men in a torpedo boat take the risk when approaching a vessel). In infantry service the gun is mounted on its own limber (Fig. 4), from which it is fired; the limber, as represented in the drawing, is on two wheels, the pole acting as a trail when the gun is to be fired. In this case, as well as in the previous one, the gun can be trained nearly all round by means of a traversing screw without shifting the position of the carriage. When mounted for infantry on the two-wheel limber carriage it can be served with six men with drag-ropes. If desirable, there can be four men dragging, the other two acting as reliefs when changing the men at the ropes, or as spare men if any of the others are disabled. With the Captain of the gun there would thus be only seven men required. The five-barrel gun can also be used for mountain service with advantage, the gun and the trail being quite light enough to be carried each on a mule, a third mule taking the wheels and axle, and a fourth the ammunition, hoppers, and implements, with other mules for spare ammunition—the only difference from the three-barrel gun being that this would require an additional mule for the gun and carriage and more ammunition. On the other hand its fire would be more effective, and only the same number of men are required to serve it. It could also be placed in an ammunition wagon for the use of infantry, though only four five-barrel guns could be carried, if closely packed, by the wagon within the same weight as six five-barrel guns. No. 12. *Three-barrel rifle-caliber gun;* and No. 13. *Two-barrel rifle-caliber gun.* These are made to the pattern of the two-barrel volley gun. They weigh respectively 55 pounds and 40 pounds, and fire at the rate of 400 and 300 rounds per minute. For naval service they are not used at present, because the five-barrel Nordenfelt is quite light enough for all naval purposes, but for land service they are very useful, in consequence of their lightness and simplicity. The three-barrel gun does not weigh more than the Gardner one-barrel, and the Nordenfelt three-barrel gun consists of thirty-five pieces compared to thirty-three pieces in the Gardner one-barrel. All these light Nordenfelt guns are, like those of larger calibers, made almost entirely of best wrought steel instead of the gun-metal so freely used in some other types of machine-guns. In order not to be exposed to rust, these light Nordenfelt steel guns are carefully and completely covered over in a galvanic bath with a coating of copper which protects the guns as well as all the various parts of the mechanism except the actual wearing surfaces. These types are designed especially for the following purposes: 1. *For cavalry.*—The gun is so light and so convenient in shape that it can be carried on a led horse at the same speed as the cavalry advances without disabling the horse. One led horse would then be required for the gun and implements, one led horse for the stand from which it is to be fired when the gun is dismounted, and one led horse for the cartridge hoppers or feed cases filled with ammunition. Other horses or baggage wagons would carry the extra supply of ammunition. 2. *For mountain service.*—A gun mule which can carry 2 cwt., including sad-

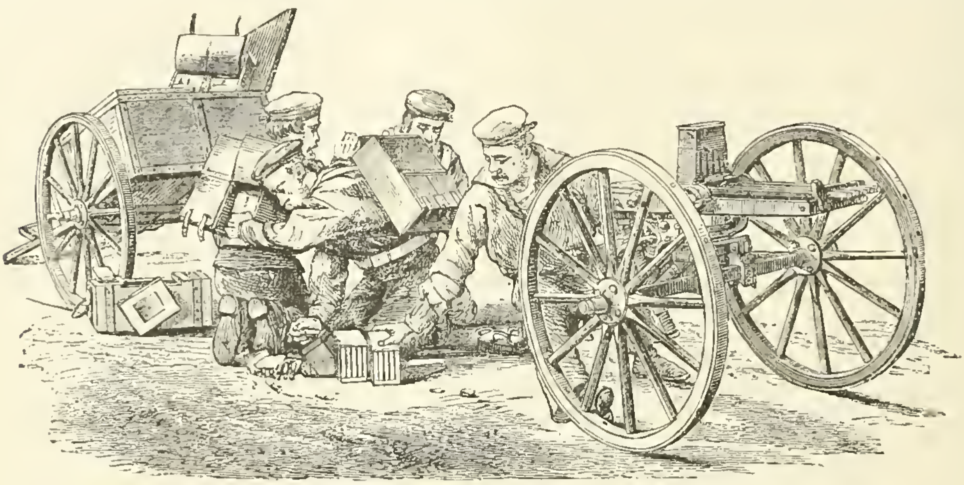


Fig. 4.

dle, would carry the gun and stand. A second mule would carry the wheels, axle, and cartridge hoppers filled, and other mules would carry the extra supply of ammunition wanted for the gun. 3. *For infantry.*—Six of these guns, with their stands, wheels and hoppers can be stowed away in one baggage wagon or extra ammunition wagon, and follow the ammunition train which is nearest to the front. Whenever a comparatively small force of infantry is hard pressed, or when it has to protect a threatened point, a larger cantonment, or temporary intrenchment, the six guns can be lifted off the wagon and be ready to commence fire in a few minutes. Two men can drag each gun on its wheels for considerable distances, and one man can carry the gun with two men carrying the stand, if such difficult ground is met with that such a light gun cannot conveniently be dragged over on its wheels. No. 14. *Single-barrel rifle-caliber gun.*—This gun is made with a different mechanism from the two patterns above named. It weighs 13 pounds, and it fires at the rate of 180 rounds per minute; it has often fired successive spurts of 30 shots each in eight to ten seconds. This gun has been made in order to show that a single-barrel machine-gun need not be more than 4 pounds heavier than an ordinary rifle; at the same time no single-barrel rifle-caliber would really be used in war—except, perhaps, as a wall piece—when it is proved that even a three-barrel gun can be made light enough to be carried by a man on his shoulder. A General would probably not submit to the expense and inconvenience of a machine-gun equipment and service of men and mules for gun and ammunition, when the efficiency of the gun is entirely dependent on one single rifle barrel. See *Machine-gun.*

NORMAL PROFILE.—Profile which would be constructed for a work located upon a level site, and when there is time to build it. It is evident that great variations must occur, influenced largely by the kind of earth and the surrounding circumstances at the time of the construction. Slopes which are practicable in one kind of earth will not retain their shapes in other kinds. Parapets placed on sites commanding all ground in common range need not be so high as those on lower ground commanded by neighboring heights. The principles laid down and the reasons expressed for the normal profile apply equally well to all its variations. A consideration of the following principles will lead to the construction of a strong profile which is essential to a vigorous defense. Men of the greatest ordinary stature, in bringing their muskets to an aim, do not fire at a higher level than about five feet; therefore any mass of this height in front of them will just intercept their fire; but this mass would not shelter a man standing behind it; to effect this, in the case of the tallest men usually found in the ranks, the interior crest should be at least six feet six inches above the terre-plein. The command must then be regulated by these two facts, and this principle may be laid down. The command of a field work over the ground occupied by the assailant, should be at least five feet; and six feet six inches over that occupied by the assailed. In following this rule for the command, we deprive the assailant of a plunging fire upon the parade; but as a breast-height of five feet is too high for men of ordinary stature to fire over it and give their pieces any sensible depression, as is very often requisite, it would be necessary to throw up a sufficient banquette for this purpose behind the parapet, which would add to the time and labor of constructing the work. On this account it is best to give the parapet only the height to admit effective firing over it, which is about four and a quarter feet. But this minimum command would give the assailed only a slight advantage, as the men, when on the banquette, would be still much exposed; and in an assault the height of the parapet would present an inconsiderable obstacle. These defects of low works have led Engineers to adopt *eight feet as the least height of parapet* which will admit of any respectable defense. The *greatest height* has been fixed at *twelve feet*, owing to the difficulty of throwing up a work with the ordinary means at hand, which are usually only the pick and shovel.

The thickness of the parapet, which is always estimated by the horizontal distance between the interior and exterior crests, is regulated by the material used for the parapet; the kind of attack; and its probable duration. The rule adopted for this is to add to the depth of penetration of the projectile, given by experiment, one-half for this thickness. In following this rule there will always be a thickness of earth between the extreme penetration of a projectile, at any point below the exterior crest and the interior of the work, greater than one-third the thickness of the parapet. The superior slope is arranged to defend the crest of the counterscarp; to effect which the fire should not strike below the crest, nor pass more than three feet over it; otherwise, either the counterscarp would be damaged, or the assailed by stooping when near the crest, would find a shelter. The inclination of the superior slope, however, should not be greater than one-fourth, nor less than one-sixth. If greater than one-fourth, it would make the portion of the parapet, about the interior crest, too weak; and if less than one-sixth the ground directly in front of the work would not be so well defended; moreover, as artillery cannot be fired at a greater depression than one-sixth, without injuring the carriage, this inclination of the superior slope serves as a check in rapid firing.

The exterior slope *is the same that the earth naturally assumes*. Any means used to make it steeper would be injurious; because they would be soon destroyed by the enemy's fire, and the earth giving way, the necessary thickness of the parapet would be diminished.

The interior slope *receives a base equal to one-third its height*. This is a result of experience, which has shown that it is the most convenient for the soldier in leaning forward to deliver his fire over a parapet.

The tread of the banquette *is placed four feet three inches below the interior crest;* this will admit men of the lowest ordinary stature, to fire conveniently over the parapet. Its width is *two feet, for a defense with one rank; and four feet for two or three ranks;* because the third rank does not fire, and is therefore placed on the banquette slope, *the base of which is twice the altitude*, to render the ascent convenient. When the tread of the banquette is very high, and particularly in enclosed works, where interior space is wanted, steps may be substituted for a slope.

The berm is a defect in field works, because it yields the enemy a foothold to breathe a moment, before attempting to ascend the exterior slope. It is useful in the construction of the work for the workmen to stand on; and it throws the weight of the parapet back on the scarp, which might be crushed out by this pressure. In firm soils, the berm may be only from *eighteen inches to two feet wide;* in other cases, as in marshy soils, it may require *a width of six feet*. In all cases, it should be *six feet below the exterior crest*—to prevent the enemy, should he form on it, from firing on the troops on the banquette.

The ditch should be regulated to furnish the earth for the parapet. To determine its dimensions, the following points require attention: its depth should not be less than six feet, nor its width less than twelve feet, to present a respectable obstacle to the enemy. It cannot, with convenience, be made deeper than twelve feet; and its greatest width is regulated by the inclination of the superior slope, which, produced, should not pass below the crest of the counterscarp. The slopes of the scarp and counterscarp will depend on the nature of the soil, and the action on it of frost and rain. The scarp is less steep than the counterscarp, because it has to sustain the weight of the parapet. It is usual to give the slope of the scarp a base equal to two-thirds of the base of the natural slope of a mound of fresh earth whose altitude is equal to the depth of the ditch; the base of the counterscarp slope is made equal to one-half the same base. In excavating the ditch it will be found that more earth will be furnished at the salients than is required there for the parapet; and that the re-enterings will not always furnish enough. On this account, the width of the ditch should not be uniform, but narrower at the salients than the re-enterings. The salients of the parapet on horizontal sites, are sometimes made higher than the re-enterings, a gradual slope being given to the interior crest from the salients to the re-enterings, with a view to cover better the terre-plein, towards these last points, from the plunge of an enfilading fire on the faces. The effect of this, however, is but trifling, as the descending plunge of the projectile is the greater, as the salient is higher over which it passes. On such sites, therefore, the profile of the parapet is usually uniform throughout. See *Field Fortification* and *Profiling*.

NORTON LIQUID FIRE.—In the character of its effects, this rivals all that has been recorded of the old *Greek fire*. The composition here used consists of a chemical combination of sulphur, carbon, and phosphorus. The composition is enclosed in a shell, and is instantly ignited upon the shell striking any object.

NORWEGIAN ARMY.—By the terms of the laws of 1866 and 1876, the army of Norway is composed of Troops of the Line, the Military Train, the Militia or Landevaern, the Civic Guards, and the Landstorm, or final war levy. In 1878 the Troops of the Line numbered 12,000 men and 750 officers. All young men above twenty-one years of age are liable to serve, with the exception of the inhabitants of the three northern amts of the kingdom. The only fortified spots are Fredericksteen at Frederickshald, Frederickstad, Akershuus, Bergenshuus, Munkholm, and Vardohuus.

NOSE-BAG.—A bag of stout canvas with a leather bottom, and having straps at its upper, open end. by

which it may be fastened to a horse's head while he is eating the contained provender. It is generally used for feeding the grain out of the stables. The drawing represents a nose-bag properly provided with means for ventilation. Horses suffer much when their noses are confined in a close nose-bag, where the jaws cannot be opened without compressing the nostrils and preventing the ingress of sufficient air.

NOSE-BAND.—The lower band of a military bridle, passing over in front and attached to the cheek-straps.

NOTABLES.—The name formerly given in France to persons of distinction and political importance. As the States General were inconvenient to the despotism of the Monarchy, the Kings of the House of Valois adopted the expedient of calling in their stead *Assemblies of the Notables*, the time of calling them and the composition of them being entirely dependent on the pleasure of the Crown, by which also their whole proceedings were guided, so that they generally consented at once to whatever was proposed to them. They showed a particular readiness in granting subsidies, to which they themselves, as belonging to the privileged classes, were not to contribute. An Assembly of Notables, convened in Paris by Richelieu in 1626, and presided over by Gaston, brother of Louis VIII., consisted of only 35 members. For more than a century and a half even this poor acknowledgment of any other mind or will in the nation than that of the Sovereign ceased to be made; but when the state of the finances brought the monarchy into difficulties and perils, Louis XVI., at the instigation of the Minister Calonne, had recourse again to an Assembly of Notables, which met Feb. 22, 1787, and was dissolved May 25. It consisted of 137 members, among whom were 7 Princes of the Blood, 9 Dukes and Peers, 8 Marshals, 11 Archbishops, 22 Nobles, 8 Councilors of State, 4 Masters of Requests, 37 Judges, 12 Deputies of the Pays d'Etats, the Civil Lieutenant, and 25 persons belonging to the Magistracy of different cities of the kingdom. Calonne's representations of the state of the finances induced the Notables to adopt many reforms in the matter of taxation; but no sooner was the assembly dissolved, than many of them joined the Parliaments in opposition to resolutions adverse to their private interests, so that the King was compelled to determine upon assembling the States General. Necker, who had meanwhile been placed at the head of affairs, assembled the Notables again, Nov. 6, 1788, to consult them concerning the form in which the States General should be convened. The Notables declared against every innovation, and so compelled the court to half measures which helped to prepare the way for the Revolution. The Parliament of the new principality of Bulgaria is spoken of as the Assembly of the Notables.

NOTE.—A brief writing intended to assist the memory. Members of Courts-Martial sometimes take notes. They are frequently necessary to enable a member to bring the whole body of evidence into a connected view, where the case is complex.

NOT GUILTY.—The form of verdict in a criminal prosecution, and also in some civil actions, when the Court find in favor of the defendant or accused party. The verdict is conclusive, and the accused cannot, in criminal cases, be tried a second time.

NOT PROVEN.—A form of verdict used in criminal prosecutions when the Court thinks there is some foundation for the charge, but the evidence is not strong enough against the prisoner to warrant a verdict of guilty. In such a case, a verdict of "Not Proven" is substantially a verdict of acquittal. The prisoner cannot be tried afterward, even though new and conclusive evidence come to light after the verdict.

NOYADES.—The execution of political offenders in great numbers at once by drowning them, one of the atrocities of the French Revolution, practiced at Nantes by Carrier, the deputy of the Convention. This mode of execution was also called, in cruel sport, *Vertical Deportation.*

NOYAN.—1. The whole of the vacant space or bore of a cannon, under which are comprehended the diameter of the mouth, the vacant cylinder, the breech, and the vent. 2. With respect to bombs, grenades, and hollow balls, that which is called *Noyan* consists of a globular piece of earth, upon which the cover is cast. The metal is poured in between the cover and the Noyan, after which the Noyan, or core, is broken and the earth taken out.

NUGGAR.—A term in the East Indies for a fort.

NUMEROS.—Round pieces of brass or other metal, which were numbered and used in the old French service in the detail of guards.

NUNCIO.—The name given to the superior grade of the Ambassadors sent by the Pope to Foreign Courts, who are all called by the general name of Legate. A Nuncio is an Ambassador to the Court of an Emperor or King. The Ambassador to a Republic, or to the Court of a Minor Sovereign, is called Internuncio.

NUNCUPATIVE WILLS.—A nuncupative will, so termed from naming an executor by word of mouth, is a verbal testamentary declaration or disposition. By the common law, it was as valid in respect to personal estate as a written testament. A will could not only be made by word of mouth, but the most solemn instrument in writing might be revoked orally. In a rude and uncultivated age, to have required a written will would have been a great hardship, but with the growth and progress of letters, the reason for permitting a verbal testament diminished in force, until an effort to establish such a will by means of gross fraud and perjury gave rise to the provisions of the Statute of Frauds. Nuncupative wills, not being regulated by statute as to their mode of celebration or execution, the single question for the judgment of the Court is, whether the nuncupation was made by a person entitled to that privilege. The restrictions of the Statute of Frauds were not applied to wills made by "any soldier being in actual military service, or any mariner or seaman being at sea." By the revised statutes of New York it was provided that nuncupative wills should not be valid, "unless made by a soldier while in actual military service, or by a mariner while at sea." The terms of the exception in the statute are briefly stated as follows:—"Any soldier being in actual military service, or any mariner or seaman being at sea." The phraseology is slightly different in these statutes; but the rule is substantially the same in all—that the nuncupation is only valid when made by a soldier in actual military service, or a mariner at sea, at the time of the testamentary act. It is not enough to be a soldier or a sailor, but there must be actual service. The military testament was first conceded by Julius Cæsar to all soldiers, but it was subsequently limited by Justinian to those engaged in an expedition—*solis qui in expeditionibus occupati sunt.* The exception was borrowed with the rule from the civil law, and the courts have invariably adhered to the principle that there cannot be actual warfare and the soldier not be engaged *in expeditione.* So also the nuncupation of a mariner to be valid must be made at sea. It is sometimes difficult to determine when the mariner is to be considered at sea. For example, Lord Hugh Seymour, the Admiral of the station at Jamaica, made a codicil by nuncupation while staying at the house on shore appropriated to the admiral of the station. The codicil was rejected on the ground that he only visited his ship occasionally, while his family establishment and place of abode were on land at the official residence. But when a mariner belonging to a vessel lying in the harbor of Buenos Ayres, met with an accident when on shore by leave, made a nuncupative will, and died there, probate was granted for the reason that he was only casually absent from his ship. The will of a shipmaster made off Otaheite has also been allowed. The principle upon which the privilege of nuncupation is conceded applies to all persons of whatsoever classes engaged in the marine service, whatever may be their special duty or their occupation on the vessel. As in the army, the term "soldier" embraces every grade, from the private to the highest officer, and includes the gunner, the surgeon, or the general; so in the marine, the term "mariner" applies to every person in the naval or mercantile service, from the common seaman to the captain or admiral. It is not limited or restricted to any special occupation on shipboard, but a purser, or any other person whose particular vocation does not relate to the sailing of the vessel, possesses the same right as the sailor. A cook is certainly as much a necessary part of the effective service of a vessel as the purser or the sailor; and there would seem to be no reason why he should be excluded from the advantage of a rule designed for the benefit of men engaged in the marine, without reference to the particular branch of duty performed in the vessel. As well because the wills of soldiers and mariners were excepted from the operations of the provisions of the Statute of Frauds, as for the reason and ground of the exception, and the peculiar character of the military testament, it was never held requisite that their nuncupations should be made during the last sickness. Nor has any particular mode been prescribed in respect to the manner of making the testament. The very essence of the privilege, however, consists in the absence of all ceremonies as legal requisites—or, as Merlin states the proposition, "their form was properly to have no form." It is true the Roman law prescribes two witnesses; but this, however, did not relate to the essence of the act, but only to the proof. In respect to evidence, we do not follow the civil or canon law; no particular number of witnesses is required to verify an act judicially, and all the court demands is to be satisfied by sufficient evidence as to the substance of the last testamentary request or declaration of the deceased. This ascertained, the law holds it sacred, and carries it into effect with as much favor and regard as would be paid to the most formal instrument executed with every legal solemnity. And so, according to numerous decisions, made in Great Britain, quoted by Prendergast, "whenever a military officer on full pay makes an informal will its validity can only be supported by showing the testator to have been on actual military service at the time the will was made. And the result of the decisions appears to be, that an officer serving with his regiment, or in command of troops in garrison or quarters, either in the United Kingdom or the Colonies, is not deemed on *actual* military service. To satisfy the meaning of the Act of Parliament in that respect, he must be on an expedition, or on some duty associated with positive danger."

NURSE.—A person whose whole business is to attend the sick in hospital. In the United States service, nurses are detailed in post hospitals from the companies who are serving at the post. Ordinarily one nurse is allowed to every ten persons sick in hospital. In Continental Armies the "Sisters of Charity" usually carry their mission of mercy into the military hospitals. Protestant England having no such organization to fall back upon, the soldiers have been dependent on the regular male hospital attendants for their care during sickness, or when suffering from wounds. The Crimean campaign, however, disclosed so melancholy a picture of the want of women's co-operation, that a band of self sacrificing ladies, headed by Miss Nightingale, proceeded to Turkey, and were soon acknowledged as messengers of health and life by the unfortunate wounded. The example thus set has not been without effect. In the Franco-German war of 1870-71 lady-nurses in large numbers and of various nations ministered in all the military hospitals, and the like took place again during the Russo-Turkish war of 1877-78.

NUTHALL RIFLE.—In the ordinary mode of grooving rifles, sharp angles are left between the groove and "land" (those parts of the smooth-bore left in their original state after the process of grooving has been completed). These create great friction with the projectile, both in loading and discharging. Major Nuthall removes these objections by rounding off the "lands" into the grooves, that is, making them a series of convex and concave curves, the bore assuming a beautiful appearance to the eye, for the smoothness and evenness with which the lands and grooves blend into each other.

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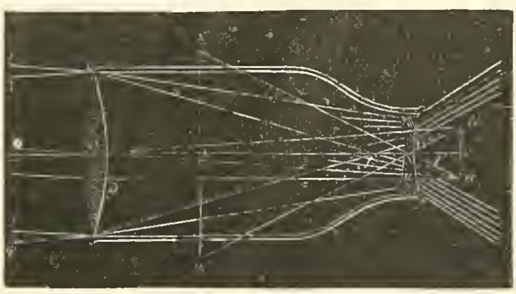
OAKUM.—A tangled mass of tarred hempen fibers, made from old rope by untwisting the strands and rubbing the fibers free from each other. Its principal use is in caulking the seams between planks, the space round rivets, bolts, etc., for the purpose of preventing water from penetrating. It is much used in artillery for packing shot and shell, wiping the vents of guns after firing, cleaning elevating screws and implements, and in making washing sponges.

OATHS.—The taking of the oath of fidelity to Government and obedience to Superior Officers, was, among ancient armies, a very solemn affair. A whole corps took the oath together, sometimes an entire army. In modern times, when so many other checks are used for maintaining discipline, the oath has become little more than a form. In the United Kingdom a recruit enlisting into the army or militia, or a volunteer enrolling himself, swears to be faithful to the Sovereign, and obedient to all or any of his Superior Officers; also to divulge any facts coming to his knowledge which might affect the safety of his Sovereign, or the stability of that Sovereign's Government. The Members of a Court-Martial take oath to try the cases brought before them justly, according to the evidence, to keep secret the finding until confirmed by the proper authority, and to keep secret always the opinions given by the members individually. The only other military oath is the common oath of a witness before a Court-Martial to tell the truth the whole truth, and nothing but the truth. See *Articles of War*.

OBEDIENCE.—Submission to the lawful orders of a Superior. Two questions arise under this article: Who is to judge of the *legality* of the command, and who may constitute a *Superior Officer?* It is evident that if all officers and soldiers are to judge when an order is *lawful* and when not, the captious and the mutinous would never be at a loss for a plea to justify their insubordination. It is, therefore, an established principle, that, unless an order is so manifestly against law that the question does not admit of dispute, the order must first be obeyed by the Inferior, and he must subsequently seek such redress against his Superior as the laws allow. If the Inferior disputes the legality before obedience, error of judgment is never admitted in mitigation of the offense. The redress now afforded by the laws to Inferiors is not, however, sufficient; for doubtful questions of construction of Statutes, instead of being referred to the Federal Courts of Law for their true exposition, have received variable expositions from the Executive, and left the army in an unfortunate state of uncertainty as to the true meaning of certain laws, and this uncertainty has been most unfavorable to discipline. Again, while the punishment of death is meted to officers and soldiers for disobedience of *lawful* commands, the law does not *protect*, officers and soldiers for obeying *unlawful* commands. Instances have occurred in our country, where officers and soldiers have been subjected to vexatious prosecutions, simply for obeying orders, according to their oath of office. Would it not be just if the law, instead of requiring officers and soldiers thus nicely to steer between Scylla and Charybdis, should hold the Superior who gives an illegal order, alone responsible for its execution? By *Superior* Officer in the Articles of War, is meant an officer who has the right to command his inferiors in the military hierarchy. The word superior, therefore, embraces, within their appropriate circle of of command, Commanding Generals, Superior Regimental and Company Officers, Superior Officers of Corps or Departments, and the Commanding Officer on guards, marches, or in quarters of whatever corps of the line of the army, marine corps or militia authorized to command the whole, whenever different corps come together. This construction of the words "officers appointed over me, according to to the Rules and Articles of War," is manifest by an attentive examination of those articles. See for example, ART. 24, which gives authority to "all officers of what condition soever to part and quell all quarrels, frays, and disorders, *though the persons concerned should belong to another regiment, troop, or company*." Here it is seen that the ordinary subordination, by grades, is found only in the same "*regiment, troop, or company*." The power to part and quell quarrels, is, however, made an exceptional case, in favor not only of officers of *different* regiments, but the power is even extended to those of an "inferior rank." In a company, regiment, or corps, subordination by grades is established by the terms of the commission held in such regiment or corps. So, also, where officers hold commissions in the army at large, their right to command when on duty is co-extensive with their commissions. Within regiments and corps the muster-roll, then, at once determines the question of superiorty of officers on duty.

OBERER.—One of the three parts of which the enciente is formed, in the German system of fortification.

OBJECT-GLASS.—The glass in a telescope or microscope, which is placed at the end of the tube nearest the object, and first receives the rays of light reflected from it. The office of the *object-glass* will be clearly understood by an examination of the common opera-glass, shown in the drawing. This is a double tele-



scope, constructed optically on the same principle as the telescope invented by Galileo, and is used for looking at objects that require to be clearly seen rather than greatly magnified—such as scenery and performances in theaters and public halls. Each tube contains a convex achromatic object lens and a double concave eye lens, which are placed at nearly the difference of their focal length apart. Thus, if the object-glass is five inches focus, and the eye-piece one inch negative focus, the length of the bodies will be about four inches, and the power will be nearly five times—that is, the objects looked at through the opera-glass will be seen as distinctly as they would be with the naked eye if brought four times nearer the observer. Opera-glasses, are short and light, and can be easily managed with one hand; they have small magnifying power, say from two to four times. The two object-glasses or large lenses are the most important ones, and upon their perfection the quality of the opera-glass depends.

With the opera-glass a low magnifying power and large and clear field of view are the great objects to be desired, on account of the comparative nearness of the objects looked at; but when the objects are one or more miles distant, power becomes a more important quality than field of view. To obtain a greater magnifying power with glasses constructed upon the principle of the opera-glass, the distance between the object-glasses and eye-pieces must be increased, and the greater that distance the higher the power. In order to keep up fair proportion of light with the increase of power, the object-glasses must increase in diameter. Such glasses, as they are only intended for outdoor use, are called Field or Marine-glasses, have shades to extend beyond the object-glasses to keep off the sun or rain, and are made throughout very substantially, in order to bear rough handling of field or sea service. They are put up in strong leather cases, with strap to sling over the shoulder. The power of field-glasses varies from five to eight times, and their clearness and efficiency depend upon the accuracy of finish of the object-glasses, and their durability to the strength and good workmanship of the body. See *Spy-glass*.

OBJECTIVE POINT.—The point to be reached or gained by an army in executing a movement, has been termed the *objective point*. There are two classes of objectives, viz: *natural* and *accidental*. The term *geographical* is frequently used to designate the first of these. A *natural objective* may be an important position, strong naturally, or made so by fortifications, the possession of which gives control over a tract of country, and furnishes good point of support or good lines of defense for other military operations. Or, it may be a great business center, or a capital of the country, the possession of which has the effect of discouraging the enemy and making him willing to sue for peace. *Accidental objectives* are dependent upon the military operations which have for their object the destruction or disintegration of the enemy's forces. These objectives are sometimes called "*objective points of manœuver*." The position of the enemy determines their location. Thus, if the enemy's forces are greatly scattered, or his front much extended, the central point of his position would be a good objective point, since the possession of it would divide the enemy's forces, and allow his detachments to be attacked separately. Or, if the enemy has his forces well supported, a good objective would be on that flank, the possession of which would allow his communications with his base to be threatened. It is well to remark that the term "point" used in this connection is not to be considered merely in its geometrical sense, but is used to apply to the *object* which the army desires to attain, whether it be a position, a place, a line, or even a section of country. See *Base of Operations* and *Line of Operations*.

OBLAT.—A disabled soldier formerly maintained by abbeys.

OBLIQUE.—This term, in tactics, indicates a direction which is neither parallel nor perpendicular to the front, but more or less diagonal. It is a command of warning in the tactics for the movement. It is used when referring to diagonal alignments, attacks, orders of battle, squares against cavalry, changes of front, fires, etc. The *oblique step* is a step or movement in marching, in which the soldier, while advancing, gradually takes ground to the right or left at an angle of about 25°. It is not now practiced.

As soon as recruits are well established in the principles of the direct march, they should be exercised in marching obliquely. The squad marching in line, the Instructor commands: 1. *Right* (or *left*) *oblique*, 2. MARCH. At the command *march*, each man makes a half face to the right, and then marches straight in the new direction. As the men no longer touch elbows, they glance along the shoulders of the nearest files, toward the side to which they are obliquing, and regulate their steps so that their shoulders are always behind those of the next man on that side, and that his head conceals the heads of the other men in the rank. The men preserve the same length of pace and the same degree of obliquity, the line of the rank remaining parallel to its original position. To resume the original direction, the instructor commands: 1. *Forward*, 2. MARCH. At the command *march*, each man makes a half face to the left in marching, and then moves straight to the front. If the squad be at a halt, the men half face to the right at the command *right oblique*, and step off at the command *march*. If halted while obliquing, they will, after halting, face to the front without further command. In the oblique march in line, the guard is always on the side toward which the oblique is made, without any indication to that effect being given; and, when the direct march is resumed, the guide is, equally without indication, on the side where it was previous to the oblique. *This rule is general.* The squad in column of files obliques by the same commands and means as when in line, the leading file being the guide.

OBLIQUE EMBRASURE.—A direct embrasure is one in which the directrix is perpendicular to the interior crest at the point of intersection with the crest; an *oblique embrasure* is one in which the directrix makes an angle with the interior crest. When possible, direct embrasures are the ones which are made. If oblique embrasures are to be made, their method of construction is practically the same as that given for direct embrasures. Oblique embrasures do not admit of the muzzle of the gun being inserted so far as the direct ones, and they weaken the parapets more. Oblique embrasures are not used, as a rule, if the directrix makes with the normal to the crest an angle exceeding ten degrees. In case the angle is greater, the embrasure is provided for, in field works, by modifying the interior crest. The manner of laying out an oblique embrasure is similar to the direct; the mouth is of a rectangular form, but is made wider in proportion to the obliquity, in order that the part of the embrasure which corresponds to the muzzle of the gun may be nearly of the same width in both the direct and oblique embrasures. The exterior width of the sole is made equal to one-half the length of the directrix, measured on the sole. The cheeks are laid out as in the last case. The muzzle of a gun should enter at least six inches into the embrasure, to prevent the blast from injuring the cheeks; this limits the obliquity of the directrix to about sixty for long guns. The height of the cheeks must not be more than four feet for the same reason; it will, therefore, in most cases, be necessary to raise the ground on which the wheels rest, giving to the top surface the same dimensions as for a barbette, and forming the side slopes and ramps in like manner. See *Embrasure*.

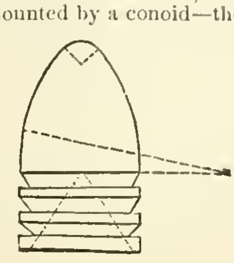
OBLIQUE FIRE. When two batteries bring their fire obliquely upon one point of the enemy's line, they make, what is called, a cross or concentrated fire, which is very destructive upon columns, though not so effective as enfilade fire. If a pointed projectile strike an iron plate at a less angle than that formed by a tangent to the curve of the head, it will probably glance off, as the tendency of the shoulder will be to slide along the plate, and the point will find a difficulty in "biting." If the angle be greater than about 50 degrees, the resistance will approximately be increased in the proportion of the extra thickness to be traversed. In this case the sharp point of the projectile "bites" the plate on striking, and the shot has a tendency to bring its axis perpendicular to the face of the target; perforation then depends upon the energy with which the projectile may be animated. Thus the side of the *Monarch* (7-inch plates) could be perforated "directly" by a projectile having a zone-energy of 90 foot-tons, but it would require 120 foot-tons to send the same projectile through at an angle of 60 degrees. The defense, therefore, should not rely too much on the chance of shot striking "obliquely"; for the projectiles fired from large modern rifled ordnance would probably perforate all thinly armored ironclads at all fighting angles and ranges.

OBLIQUE FLANK.—In fortification, that part of the curtain from whence the face of the opposite bastion may be discovered; and is the distance between the lines *rasant* and *fichant*, which are rejected by some engineers, as being liable to be ruined at the beginning of a siege, especially when made of sandy earth. This oblique or second flank defends very obliquely the opposite face, and is to be used only in a place attacked by an army without artillery.

OBLIQUE ORDER OF BATTLE. Military writers describe this order of battle as one in which the primitive parallel order has been departed from, with the design of giving the one force, by maneuvering, a superiority over the other, or, in other words, if an army attacks its enemy in flank, say the right, its own right must be refused, and hence, when it arrives on the enemy's line, the army will be in oblique order. In order to make use of the oblique order with success, the enemy must be deceived as to the intention to attempt it, otherwise it may be in his power to frustrate its execution by reinforcing the menaced flank; extreme caution, therefore, in the preparation for such a maneuver, and the utmost rapidity in its execution, are indispensably requisite. The aim of using this order of battle is to turn or outflank the enemy. See *Order of Battle*.

OBLIQUE STEP.—A step or movement in marching, in which the soldier, while advancing, gradually takes ground to the right or left at an angle of about 25°. It is not now practiced.

OBLONG BULLET.—This form of bullet at present used in the United States' service, is composed of a cylinder surmounted by a conoid—the conoid being



formed of the arcs of three circles. The cylinder has three grooves cut in it, in a direction perpendicular to its axis, to hold the grease necessary for lubricating the bore of the piece in loading, and possibly to guide the bullet in its flight, after the manner of the feathers of an arrow. A conical cavity is formed in the bottom, in which the gas of the charge expands, and forces the sides of the bullet into the grooves or rifles of the gun. From these grooves it receives a rotary motion around its long axis, which prevents it from turning over in its flight. See *Bullet*, *Projectiles* and *Round Bullet*.

OBSERVATORY.—For the purpose of observing the flight and effect of the projectiles, a look-out termed an observatory, is arranged on one of the flanks of the battery; in most cases the end of an epaulement will afford a safe point, where a secure shelter of sand-bags can be made so as to enable an officer with a field-glass to note the range and effect of the fire, so as to regulate it and give the greatest efficiency.

OBSERVER SERGEANTS.—In the United States, Sergeants in the Signal Service, stationed in large towns and important commercial centers to give timely warning of the approach of storms, rise of rivers, and all other important weather news for the guidance of merchants and others.

OBSIDIONAL CROWN.—A crown so called among the ancients, which was bestowed upon a Governor or General, who by his skill and exertions, either held out or caused the seige to be raised of any town belonging to the Republic. It was made from the grass which grew on the spot, and was therefore called *graminens*.

OBSTACLES.—No obstacle is insurmountable. Obstacles may hinder, and even stop for a while, an enemy's approach, but they can be overcome. Their passive resistance must be aided by the active resistance of the defense. These obstacles, in order that they should be *accessory* means of defense, should detain the enemy in a position where he will be under the fire of the defenders at close range. Hence, the following conditions should be observed in arranging the obstacles in front of a field work. 1. The obstacles should be placed within close musketry range of the defense. 2. They should be arranged so as not to afford shelter to the enemy. 3. They should, as a rule, be protected from the fire of the enemy's artillery. 4. They should be arranged so as not to interfere with an active defense of the work. Their uses as obstacles will depend upon the degree of resistance which they offer in harmony with the foregoing conditions. Abatis placed in the ditch will, in one case, be in the best position: in another, it should be placed some distance in front of the work. A fraise placed in the scarp, when the ditch is swept by a fire from the work or from ditch defenses, will be better than if along the counterscarp. Torpedoes, military pits, entanglements, etc., may all be combined. In some cases the ground in front of the work will be the better position; in others, the crest of the counterscarp and the ditches offer the best conditions for their use. As a general rule, it is advisable to place the obstacles not nearer than fifty yards to the interior crest, if the profile is a weak one. When the profile is strong, it is not a matter of so much importance, so long as the assaulting columns are exposed to the fire of the defense. It is well to remark with respect to inundations, that they should not be used until the last moment. The unhealthiness due to the presence of stagnant water is apt to produce more casualties than are to be feared from the enemy's attacks. If the dams can not be protected or hidden from the enemy's artillery fire, they should be built, as far as possible, so that the enemy can bring his fire to bear only upon the upper side. The amount of the dam exposed to his fire will then only be the portion between the top and the surface of the water. See *Accessory Means of Defense*.

OBSTRUCTIONS.—Water may be made a very important accessary means of defense in many localities, as in a flat, marshy country where the level of the natural surface lies but at a slight elevation above the water-level; or as, in the case of an undulating surface, where small streams running through valleys, can be dammed back, so as to produce an inundation of some extent.

In the former case, the defensive works can be easily girdled by a zone of marshy ground, which will give an assailant great trouble to construct his trenches and other siege-works upon, whilst the work itself can be secured from attempts at surprise, by keeping its ditches filled with water to the depth of six feet at least. In such a locality—moreover, if in a climate where the winters are mild—revetted scarps and counterscarps, the chief use of which is to prevent an attempt at an open assault, may be replaced by earthen ones, a strong stockade being formed along a wide berm, answering as a corridor, to give greater security on the more exposed fronts of the work.

In the latter case, portions of the ground, in the immediate vicinity of the works, may be covered by a sheet of water, of sufficient depth to prevent their being used by the assailant in his approaches; and within the inundation thus artificially produced detached works may be erected, which, by taking flank and reverse views over other lines of approach of the assailant, may force him to make his approach upon other points which will have been strongly fortified to meet this condition of things.

To form these artificial inundations the locality must lend itself to the construction of dams, in such a position that they cannot be reached by the assailant's missiles, and will be secure from any other means he may take to destroy them. This supposes, then, that the stream should either run through the works, so that the dam could be erected within them or so near to them that, in combination with some advanced work, the dam may be made secure.

In a locality having these features, the inundation would, as a general rule, have to be formed on the upstream side of the work, since, if made below it, the dam would have to be placed further from the work, and the inundation itself might spread up too far within. Besides these objections to this position, an assailant would evidently have greater facilities for tapping the inundation and running the water off than when it occupies the upstream position. The position and extent of the dams, and the other necessary constructions connected with them, as sluices, waste weirs, etc., will depend entirely upon the local features of the site, and will form a particular study in each case for the engineer.

Besides these uses of water as a passive obstruction, arrangements may be made, when the locality is favorable to it, for producing a powerful current to sweep away the assailant's works in the ditches by letting loose a large body of water, which has been dammed back for the purpose, with a rush into the ditches. This, in like manner, will require the same constructions as in the preceding case, and flash gates which can be suddenly turned about a horizontal or a vertical axis, so as to give an outlet to the water in considerable volume and with great velocity. These gates have to be placed in some secure point of the ditches, inaccessible to the assailant and covered from his missiles, and, if effectively used, may prove a source of great annoyance to him by frequently frustrating his attempts to make a passage of the ditch.

Solid hard rock, or even thin layers of soft rock alternating with layers of soil, as was the case at Sebastopol, are great obstructions to an assailant's siege works, as the rock has, in many cases to be blasted out to gain partial cover, and a large amount of earth, with trench materials, has to be brought forward at great risk of life to form the parapets. In constructing a work, nothing should be omitted which, if placed on the line of the assailant's approaches, will delay his operations and force him to greater efforts and exposure. To this end, where fragments of rock can be readily had in sufficient quantities, it should be used in forming the embankment of the glacis, and also be thrown in upon other points, over which important lines of trenches must necessarily run.

Besides these accessory means of delaying the progress of the besieger's works, a site of solid rock offers the farther advantage of giving natural scarps and counterscarps, where the ditches are excavated out of the rocks, of far greater resistance to the assailant's means of destruction than any masonry, however solidly and carefully constructed, can offer; besides forcing the assailant to construct galleries through the rock to attain the level of the bottom of the ditch where his passage of it is to be constructed. With a similar purpose, the stumps of large trees may be left in like positions, and trees may be planted when the work is constructed with the object of cutting them down and leaving their stumps when the work is threatened with a siege.

Mines, when properly arranged and well planned, are so important a defensive means that they should constitute a part of the permanent dispositions of defense of every work where the character of the soil will admit of it, at least on those points which are otherwise weakest, and therefore most liable to be assailed. The general arrangement of a combination of galleries and mine chambers, as well as the details for their construction, are given in the articles, MINES, and COUNTERMINES; therefore, nothing further is called for here than to state that the principal galleries of the combination should be constructed with the work, and of durable materials, leaving the other parts to be done when the exigency calling for them may happen. See *Accessory Means of Defense*.

OBTURATEUR.—A kind of stopper, which is usually made of wrought iron, and used with the Baden, and similar fuses. The *obturateur* is screwed into the table, and assists in preventing the soft metal of the fuse from being driven into the shell by the force of the charge.

OBTURATION.—The escape of gas at the junction of the breech-block and the end of the bore must be prevented; the system of *obturation* employed by the English in their modern B. L., (interrupted screw) ordnance was a carefully made steel cup attached to the breech-block; when the gun was fired the expanding gases pressed the sides of the steel cup against the bore and over the junction with the block, thus closing all small orifices. Immediately afterwards the elasticity of the steel caused the cup to regain its former shape, and the breech could be opened again. The French have obtained good results from the lateral expansion of a wad of asbestos and tallow acted on by a hemispherical steel block at the end of the bore. With B. L. small arms the *obturation*, is effected by the use of a metallic cartridge-case.

OBUS—OBUSIER.—A species of small mortar, resembling a mortar in everything but the carriage, which was made in the form of that belonging to a gun, only shorter. It has been frequently used at sieges; and was well calculated to sweep the covered-way and to fire ricochet shots. They were usually loaded with cartouches. A howitzer, called *Obusier*, was known under the name of *Husenieze*, in 1434.

OC.—An arrow used by Turkish archers and bowmen.

OCCUPATION ARMY.—An army that remains in possession of a newly conquered country, retaining it as a kind of hostage, until peace is signed and the war indemnity paid. Armies of Occupation are generally fed at the expense of the defeated nation.

OCTAGON.—A plane closed figure of 8 sides. When the sides are equal, and also the angles, the figure is called a "regular octagon"; in this case, each angle is 135°, or equal to three half right angles. If the alternate corners of a regular octagon be joined, a square is constructed; and as the angle contained between the sides of the square and of the octagon is one-fourth of a right angle, the octagon may easily be constructed from the square as a basis. The octagon in fortification is well calculated in its ground for the construction of large towns, or for such as have the advantage of neighboring rivers, especially if the engineer can so place the bastions, that the entrances and outlets of the rivers may be in some of the curtains. By means of this disposition, no person could come in or go out of the garrison without the Commandant's permission, as the sentinels must have a full view from the flanks of the neighboring bastions.

ODA.—A name given to the different corps or companies into which the Janissaires were divided. The word *Oda* means a room, and the companies were so called from messing separately.

ODA-BACHI.—A term applied to a Captain superintending the gunners at Constantinople.

ODIUS.—A herald in the camp of the Greeks before Troy.

ODOMETER.—An instrument attached to a carriage or other vehicle, for the purpose of registering the distance it has traveled. Such machines have been in use from an early period, and one is described by Vitruvius in that part of his work *De Architectura*, which is devoted to machines. The instrument, as commonly employed, consists of a train of wheel-work, which communicates motion from the axle of the carriage wheel to an index which moves round the circumference of a dial fixed in one side of the carriage over the axle. The wheel-work is arranged so as to produce a great diminution of the velocity impressed by the axle of the vehicle, and the dial is so graduated that the index can show the number of miles, furlongs, yards, etc., traversed. The instrument is also constructed to work independently, being in this case provided with wheels and an axle of its own; when this is done the wheel is made of such a size that its circumference is an aliquot part of a mile, an arrangement which greatly simplifies the calculation of the distance traversed. The complete Odometer can then be drawn along by a man on foot, or attached behind a carriage.

The Odometer, shown in Fig. 1, consists essentially of a square brass weight or pendulum, hung within a rectangular frame which revolves with the wheel, while the pendulum remains vertical. Upon the front face of the pendulum are two brass wheels,

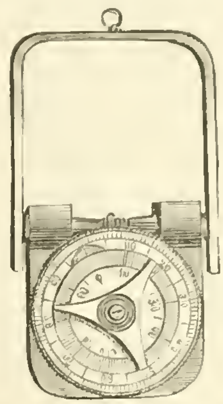


Fig. 1.

two inches in diameter, the inner surfaces of which are in contact, the edges of both uniting to make a groove corresponding to a worm cut in the middle of a shaft fastened to the sides of the frame. The front wheel has one hundred teeth, the rear one ninety-nine, and both pitch into and are moved by the revolving worm of the frame. There are also the same number of divisions as of teeth on each wheel, and they are figured, the front wheel from 0 to 100, the rear one from 0 to 9000. The front wheel has three spokes, an index being also cut down on its perimeter to read the divisions of the rear wheel. the front wheel itself being read by a slender steel wire fastened to the brass weight and curving over the worm, so as to be immediately over the divisions of the wheel. Now when the frame is made to revolve by the revolution of the wagon wheel, the worm will turn both wheels, and each will be moved forward one tooth by every turn, and when one hundred turns are made, the front wheel will have moved completely around, and the index of its zero division will have been carried over one division of the inner wheel. And thus by noting the positions of the indices of both wheels, the number of revolutions of the wagon wheel can be easily obtained up to 9900, when both wheels will be at zero again. The wagon wheel being of a given size, the number of feet traveled can be at once ascertained by noting the readings of the wheels, at the beginning and end of the journey, subtracting one from the other, and multiplying the perimeter of the wagon wheel by the number of turns made.

An excellent form of Odometer devised by Messrs Gurley, United States, is represented in Fig. 2. The pendulum is fastened to a shaft turning in the center of a strong circular metal box on this shaft, and turning with it is a pinion giving motion to a train of wheels, each of which has also a shaft to the end of which an index is fastened. There are dials for each index as shown, and the number of turns of the wagon wheel can thus be counted up to 100,000. A strong bezel ring with thick glass covers the dials and allows them to be easily read. The Odometer is securely fastened to the spokes of the wheel by three carriage-bolts, there being also a thick leather washer on each side confined between the bottom of the projecting arms, and a metal washer of same shape on the other side of the spokes. In using this Odo-

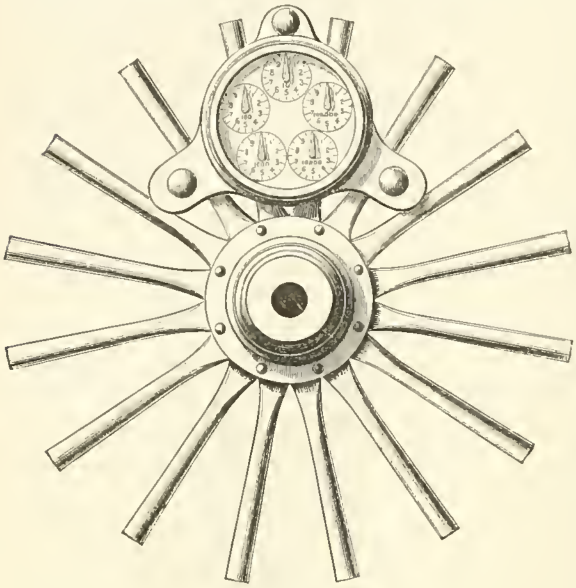


Fig. 2.

meter the reading of the dials must be taken at both ends of the journey, the one subtracted from the other, and the remainder showing the number of turns of the wagon wheel, multiplied into its perimeter. See *Pedometer*.

ŒIL DE BŒUF.—A French term literally signifying ox's eye, applied in architecture to those small round or oval openings in the frieze or roof of large buildings, which serve to give light to spaces otherwise dark. The most famous is that in the anteroom (where the courtiers waited) of the Royal Chamber at Versailles, which gave name to the apartment. Hence the expression, *Les Fastes de l' Œil-de-Bœuf*—i. e., the history of the courtiers of the Grand Monarque, and by extension, of courtiers in general.

OFF.—Most distant; a term commonly used in speaking of horses harnessed to a carriage, in contradistinction to *near*. It means the animal which is harnessed on the right hand facing the front of a team. The term is variously compounded, as in the expressions, *to march off, to sound off, to tell off*, etc.

OFFENSE.—A crime committed by an officer or soldier for which he deserves punishment. All acts that are contrary to good order and discipline, omissions of duty, etc., may be called military offenses, and subject the offender to be tried by Court-Martial. The principal offenses are specified in the Articles of War.

OFFENSIVE BATTLE.—In a purely Offensive Battle, an army seeks the enemy and attacks him wherever he is to be found. To know what we are going to encounter is half the battle in almost all affairs of life; for we are, thus far, secure from the surprise of finding something in our way that we had not counted upon. In no transaction is this beforehand knowledge more important than in preparing for a battle. There is hardly any labor, any personal risk to which a General should not subject himself to gain precise and accurate information on this head. Here he must see for himself, at the risk of finding his orders misconstrued, and his plans defeated by the carelessness or stupidity of his subordinates.

A personal reconnoissance therefore of the enemy's position is indispensable, and if this is made on the eve of the attack the General should take another last look in the morning, before moving, to see that the enemy has not anticipated him, and taken steps that call for changes on his part. Of course, whatever is advantageous to the defensive will particularly engage his attention; but, as his great object is, not only to drive back the enemy, but to bring on him a great disaster, the chief point to which he will bend his thoughts, will be to see by what mode and by what point of attack he can secure the greatest strategical results.

Considerations therefore both of tactical and strategical character must receive the careful examination of the Commanding General, in deciding upon his plan of attack. The first, as carrying with it the most important advantage, is the strategical result; the two principal of which are, first, either to direct the main effort upon that wing of the enemy which, if overthrown, will naturally bring us on the line of retreat of his forces, or, second, upon some point between his two wings which, if pierced, may force his disconnected forces on divergent lines of retreat, and thus expose them to the disaster of being beaten in detail, or to the capture or destruction of one of the fractions. In the battle of Austerlitz, for example, in which the Allies at first acted offensively, their plan was made subservient wholly to the strategical result. The right of the French position was nearest to their line of retreat on Vienna; by forcing this point, the Allies would have been brought between the French and Vienna, thus throwing them further from their base. If repulsed in this attempt, which was possible, the Allies still covered their own line of retreat, so long as their center and right held firm. The strategical object of Napoleon, on the contrary, was to pierce the Allied center, and thus secure the advantages of a successful operation of this kind. Next in importance come what may be termed the *grand tactical* considerations; that is, the means of doing most damage to the enemy on the field of battle itself. For example, if the enemy's position is such that he has an impassable obstacle on one of his wings, as a river, lake, or a narrow defile, tactical considerations alone would suggest to direct our main attack on the opposite wing, since it is evident that by defeating this, the center and the remaining wing may be very easily thrown upon the obstruction which it either cannot pass, or must pass with difficulty, and thus be captured or greatly cut up. In like manner, tactical considerations would engage us to attack a height on the enemy's position which, if gained, would give our forces a decided advantage; or, if his line of battle presents a very salient point, upon which our efforts can be concentrated to attack this point; or if his line at any point presents a wide break, into which we can force our way, to do so; any one of these points, if gained, would give decided tactical advantage.

Though not necessarily leading to the same decisive results as the two preceding, a third consideration, in choosing the point of attack, is the facility which the natural features of the ground, over which we must move upon it, afford for the combined operation of the troops of the different arms that are to make the attack. Too much weight, however, is not to be given to this, in selecting the point of attack; as ground, however difficult, may almost always be got over by troops of all arms, and very often it more than compensates for the labor of doing so, by the cover and other advantages it may afford in advancing.

In the battle of Austerlitz the tactical advantages were greatly against the Allied point of attack, as they, in the first place, had to advance against the villages occupied by the French and through narrow, hollow roads, in which their columns became confused and disordered; and they had, moreover, on the flank and rear several ponds, with only narrow causeways between them, on which, if thrown, there was no outlet of escape except over these narrow defiles, all of which were exposed to the artillery of the French. The result, as we know, was a frightful disaster. Prudence counsels, in all such cases, to forego the tempting object of a grand result if to gain it we expose ourselves, if unsuccessful, to a great disaster. The General who looks forward alone, not providing for his own rear or flanks, or who, intent only upon some striking success, rushes recklessly in the pursuit of it, within the jaws of destruction, has learned but half his trade, and that the most easily acquired and the most dangerous in its application in such hands. It is in nicely weighing these considerations and selecting the best, that the great General shows his powers. Recognizing settled principles as his guides, he does not apply them blindly.

Although but one point, known as the *key-point*, is usually selected for the main effort of the assailant, still the whole line of the assailed is more or less menaced, to prevent the key-point from receiving reinforcements. A different course, one by which we endeavor, so to speak, to envelop the assailed, can only be attempted with a prospect of success, when we are greatly superior in force. Had the Allies at Austerlitz, instead of pressing with such vigor the French left whilst they weakened their center in moving on the French right, thus leaving the plateau of Pratzen a comparatively easy prey to the French, simply menaced the left and held the plateau with a strong force, not succeeded in their main attack, they would at least have avoided the subsequent disaster. Connected with enveloping attacks is that of sending a strong detachment, by a circuitous route, to fall on the enemy's rear, whilst an attack is made on him in front. Such maneuvers are wrong in principle, and military history presents stiking instances of their failure in practice. The topographical features of the immediate theater of operations can alone determine whether to risk turning operations. When this is in a very broken or obstructed country so that such a movement may be concealed for the time necessary to perform it, the risk will be less, but the chances are still against it.

An attack on the center is the obvious operation when the enemy's line is too extended for the number of his forces. It may also be the best course when the enemy's line of retreat is through a defile in the rear of his center, as, in case of success, each wing is cut off from the line of retreat, and the troops of the center, if forced upon the defile, cannot escape from a serious disaster. Where both flanks of the enemy's position are secure, and it becomes a case of necessity to attack some point of the front must be selected for the main effort, which, if gained, will give a decided advantage. For example, if there is a commanding eminence on his front, every effort should be made to carry it, as, from there, the field of battle being overlooked the enemy would be obliged to fall back. In this case the order of battle would necessarily become *convex;* the divisions of the center, to make the assault, being in advance whilst their flanks and rear would be secured by the divisions of the wings advancing in echelon, those nearest the center being most advanced. Eliminating all exceptional local features, the general case which presents itself is that, where the entire line of the enemy is equally exposed, and where success therefore depends upon the ability of the assailant to keep the whole line so threatened that its reserve alone can be moved with safety from one point to another, whilst a powerful effort with concentrated forces is made on some one point, usually one of the wings. In this case the assailing wing will be strongly reinforced, particularly with artillery; the center also strengthened, whilst the opposite wing will be refused, the divisions receding from towards the center, in echelon, so as to parry any attempt at turning them, or at making a flank attack on this part. The only general rules that can be well laid down for the distribution of the different arms on the field of battle have already been given. Details on this point must be necessarily left to the subordinates, who, if well acquainted with the true functions and resources of their respective arms, will seldom fail to post them so as to do as much injury to the enemy and be exposed to as little danger to themselves as the natural features of the field of battle will admit of. The plan of the battle having been decided on, the maneuvers to carry it out should be as simple as possible, so as to guard against the failures that almost invariably attend any attempt at complex movements, within striking distance of the enemy. All distributions for what are termed passages of lines should be avoided, even in the case of thoroughly drilled troops. The distribution of infantry in echelons, wherever it can be adopted, is one of the best, as each division has its support at hand on its flank, whilst the interval left between the flank of the one in advance and that of the one next it in rear, should offer sufficient space for cavalry or artillery to move forward to the front if wanted. See *Battles, Defensive Battle*, and *Mixed Battle*.

OFFENSIVE PATROLS.—That class of patrols made exterior to the line of out-posts, with a view of gaining intelligence of the enemy's whereabouts. They are composed of larger bodies of men than defensive patrols, the number being proportioned both to the distance to be gone over, and the extent of front to be examined. In a position, presenting but few cross-roads, and sparsely settled, a patrol of ten or twenty horsemen may be found ample, to search, with all desirable thoroughness, from twenty to forty miles in advance of the position, along the principal avenues to it ; whereas, with a more extended front, presenting many lateral avenues, double this number might be required for the same duty. From the information obtained, through the ordinary channels of maps, and by questioning the inhabitants at hand, the commanding-officer can usually settle, with sufficient accuracy, the strength of a patrol.

OFFENSIVE WAR.—Military acts of aggression constitute what is called an *Offensive War.* Those who assail an opposite or adverse army, or invade the dominions of another power, are said to wage an *Offensive War.* See *War.*

OFFENSIVE WEAPONS.—All arms of the present day, such as cannon, small-arms, swords, and other weapons which would be used on an army taking the field for offensive operations. See *Ordnance* and *Small-arms.*

OFFICER.—*Military Officers* are combatant and non-combatant, the latter term including Paymasters, Medical Officers, Commissariat, and other Civil Officers. Commissioned Officers in the English army are those holding commissions from the Crown, or a Lord-Lieutenant, and comprise all holding the rank of ensign, or corresponding or superior rank. Divided by duties, they are Staff Officers (see Staff), or Regimental Officers (see Regiment) : divided by rank, General Officers, Field Officers, and Troop or Company Officers. The last are Captains, Lieutenants, and Sub-Lieutenants, and, except in the cavalry, are unmounted. The only Warrant Officers in the army are Master Gunners and Schoolmasters. Non-commissioned Officers are described under that heading.

OFFICER IN CHARGE.—An officer, at the United States Military Academy, charged with the enforcement of all regulations governing the Corps of Cadets. Each of the Assistant Instructors of Tactics are in turn detailed as *Officer in Charge ;* his tour of duty to commence at guard-mounting, at which time he reports for orders to the *Commandant of Cadets*. Between thirty minutes after *reveille roll-call* and *taps* he stations himself in, or near his office, and at no time during his tour absents himself from it, except on duty or at meals, without the sanction of the *Commandant of Cadets*. He is in the Cadets' mess-hall at their meals, is present at every parade and roll-call during his tour, and sees that all duty during the day which does not require the presence of the *Commandant of Cadets* is performed in a soldier-like manner, and according to regulations and orders. He sees that all signals are sounded at the proper time, and takes effectual measures to suppress all irregularities and disturbances that may occur in the quarters or their vicinity, and corrects all violations of orders or regulations coming to his knowledge. He visits the sentinels at his discretion during his tour, to see that they are well acquainted with their duties. On being relieved, he embraces in his report all suggestions that may be of service to the Commandant for the preservation and promotion of health, police and discipline, and reports all offenses against discipline, coming to his knowledge, which have occurred during his tour of duty.

OFFICER IN WAITING.—In the British service, the Officer next for duty. He is mentioned in orders, and ought to be ready for the service specified at a minutes warning. He must not on this account quit the camp, garrison, or cantonment.

OFFICER OF THE DAY.—An officer whose immediate duty is to attend to the interior economy of the corps or garrison to which he belongs, or of those with which he may be doing duty. The Officer of the Day has charge of the guard, prisoners, and police of the garrison; and inspects the soldiers barracks, messes, etc. Both the old and the new Officer of the Day are present at guard-mounting. While the old guard is being relieved, they inspect the guard-house, or tents, and verify the number of prisoners. They then proceed to report to the Commanding Officer, when the Officer relieved presents the report of the Officer of the Guard, upon which he previously makes such remarks as circumstances reqnire. At the same time, the new Officer of the Day receives his instructions. The Officer of the Day is responsible for the enforcement of the police regulations, and the cleanliness of the post or camp. Fatigue parties are furnished him when the number of prisoners is insufficient for police purposes. The Officer of the Day visits the guards during the day at such times as he may deem necessary, and makes his rounds at night at least once after 12 o'clock. The Officer of the Day sees that the Officer of the Guard is furnished with the parole and countersign before *retreat*. In war time, the Officer of the Day satisfies himself frequently during the night of the vigilance of the police guard and advanced posts. He prescribes patrols and rounds to be made by the Officer and Non-commissioned Officers of the Guard. The Officer of the Guard orders them when he thinks necessary. He visits the sentinels frequently.—

OFFICER OF THE GUARD.—An officer detailed daily for service with the guard. It is his duty, under the Officer of the Day, to see that the Non-Commissioned Officers and men of his guard are well instructed in all their duties; he inspects the reliefs, visits the sentinels, and is responsible for the prisoners and the property used by them and the guard. He is also responsible for good order, alertness, and discipline. Officers remain constantly at their guards, except while visiting their sentinels, or necessarily engaged elsewhere on their proper duty. The Officer of the Guard inspects his guard at reveille and retreat, and sees that the countersign is duly communicated to the sentinels at the proper time before twilight. See *Guard Report*.

OFFICIAL COURTESIES.—The interchange of official compliments and visits between foreign military or naval officers, and the authorities of a military post, are international in character. In all cases it is the duty of the Commandant of a military post, without regard to his rank, to send a suitable officer to offer civilities and assistance to a vessel-of-war (foreign or otherwise) recently arrived. After such offer it is the duty of the Commanding Officer of the vessel to send a suitable officer to acknowledge such civilities, and request that a time be specified for his reception by the Commanding Officer of the post. The Commanding Officer of a military post, after the usual offer of civilities, is always to receive the first visit without regard to rank. The return visit by the Commanding Officer of the military post is made the following day, or as soon thereafter as practicable.

When a Military Commander officially visits a vessel-of-war he gives notice of his visit to the vessel previously thereto, or sends a suitable officer (or an orderly) to the gangway to announce his presence, if such notice has not been given. He is then received at the gangway by the Commander of the vessel, and is accompanied there on leaving by the same officer. The officer who is sent with the customary offer of civilities is met at the gangway of a vessel-of-war by the Officer-of-the-Deck; through the latter he is presented to the Commander of the vessel, with whom it is his duty to communicate. A vessel-of-war is approached and boarded, by commissioned officers, by the star-board side and gangway, when there are gangways on each side. In entering a boat, the *junior* goes first and other officers according to rank; in leaving a boat, the *senior* goes first. The latter is to acknowledge the salutes which are given at the gangway of naval vessels. Naval vessels fire personal salutes to officers entitled to them when the boat containing the officer to be saluted has cleared the ship. It is an acknowledgment for his boat to "lie on her oars" from the first until the last gun of the salute, and for the officer saluted to uncover, then at the conclusion to "give way." The exchange of official visits between the Commanding Officers of a post and vessel, opens the door to both official and social courtesies among the other officers

To a boat with the flag of an Admiral, Vice-Admiral, or Rear-Admiral, or the broad pennant of a Commodore, boats with narrow pennants "lie on their oars" or "let fly their sheets," and boats without pennants "toss their oars." In both cases officers in them salute. In the case of two boats meeting or passing each other, each with the same insignia of a Commanding Officer, the junior is the first to salute. Officers of inferior grade to a Commanding Officer passing him in a boat, "lie on their oars" or "let fly their sheets," and salute. All other officers passing each other in boats are to exchange salutes, the junior saluting first. Cockswains steering boats are, whenever commissioned officers are saluted, to stand up and raise their caps, and whenever warrant officers are saluted they raise their caps only. The officer or Cockswain of a loaded boat, or of boats engaged in towing, salute a boat with the flag of an Admiral, Vice-Admiral, or Rear-Admiral, or the broad pennant of a Commodore, by standing and raising their caps. When boats are rowing in the same direction, an inferior is not to pass a superior in grade unless he is on urgent duty, or authorized by the superior. When boats are pursuing opposite directions, the rule of the road to prevent fouling is, that both shall "put their helms to port"—*i. e.*, to pass to the right, circumstances permitting. When boats are approaching the same landing or vessel, an inferior is always to give way to a superior in rank. Boats about leaving a ship's side or landing are to give way in ample time to others approaching. It is not proper to land over another boat without permission, and only when it cannot be avoided is permission to be asked. Boats display their ensigns when they shove off, and keep them flying until their return.

To distinguish officers in boats, Commanding Officers of fleets, squadrons, or divisions carry the distinguishing marks of their rank on the bow of their barges. Flags and pennants distinguishing rank are also worn at the bows of boats. An Admiral's flag is a blue flag bearing four white stars; that of a Vice-Admiral bears three stars; a Rear-Admiral, two stars; a Commodore's pennant, one star, and is a swallow-tailed flag. The narrow pennant is worn by Commanding Officers of lesser rank. In addition, Captains in the Navy wear a gilt ball on the end of their boat staffs, and Commanders a gilt star. To the ships, boats, and officers of the United States Navy, as well as foreign officers, the foregoing is due; and courtesy between the land and naval services is indispensable to good order and discipline, as well as necessary to the national dignity and honor. Military officers of assimilative rank are entitled to and should carry the above boat insignia. Navy regulations require officers and men never to omit, on any occasion, to extend the same compliments to officers of the Army as are paid by them to officers of the Navy.

When a civil functionary entitled to a salute arrives at a military post, the Commanding Officer meets or calls upon him as soon as practicable. The Commanding Officer will tender him a review, providing the garrison of the place is not less than four batteries of artillery, or their equivalent of other troops. When an officer entitled to a salute visits a post within his own command, the troops are paraded and he receives the honor of a review, unless he directs otherwise. When a salute is to be given an officer junior to another present at a post, the senior will be notified to that effect by the Commanding Officer. Military or naval officers of whatever rank, arriving at a military post or station, are expected to call upon the Commanding Officer. Under no circumstances is the flag of a military post *dipped* by way of salute or compliment.

OFFICIAL ENVELOPES.—In the United States, it is lawful to transmit through the mail, free of postage, any letters, packages, or other matters relating exclusively to the business of the Government of the United States: *Provided*, That every such letter or package to entitle it to pass free bears over the words "Official business" an indorsement showing also the name of the Department, and, if from a bureau or office, the names of the Department and bureau or office, as the case may be, whence transmitted. And if any person makes use of any such official envelope to avoid the payment of postage on his private letter, package or other matter in the mail, the person so offending is deemed guilty of a misdemeanor, and subject to a fine of three hundred dollars, to be prosecuted in any court of competent jurisdiction. For the purpose of carrying this act into effect, it is the duty of each of the Executive Departments of the United States to provide for itself and its subordinate offices the necessary envelopes; and in addition to the indorsement designating the Department in which they are to be used, the penalty for the unlawful use of these envelopes is stated thereon. These Envelopes, with the penalty clause printed thereon, are confined to the War Department and its bureaus and offices in Washington City. For small packages of public property, weighing not more than four pounds, the mails may be used, as authorized by law, provided the cost of freight is not less than the postage at legal rates. Such packages may be prepaid with official postage stamps at the rates required by law for the matter inclosed; and by authority of the Post Office Department packages containing public property *may be sealed*, provided a written certificate is affixed, signed by the officer mailing the same, that they contain no matter subject to a higher rate of postage than has been prepaid thereon. Under the provisions of the Universal Postal Union Convention, concluded at Paris on the 1st of June, 1878, the prepayment of postage on every kind of correspondence exchanged in the mails between countries of the Postal Union can only be effected by means of postage stamps valid in the country of origin for the correspondence *of private individuals*. The only correspondence exempted from this requirement is official correspondence relative to the postal service and exchanged directly between Postal Administrations. Correspondence addressed to Postal Union countries and colonies can only be prepaid by means of the ordinary United States postage stamps which are furnished to the public. See *Franking Letters*.

OFF RECKONINGS.—An allowance formerly given to the Commanding Officers of regiments and Captains of companies, out of the annual clothing money set aside for their men The allowance was subsequently paid only to the Colonels of regiments, and was a fluctuating sum, depending on the amount of the surplus left after the clothing was made up. About twenty-five years ago, an average of thirty years was struck, and a fixed sum from that period allowed yearly to Colonels, termed *Colonel's Allowance*, amounting to about £600 a year in line regiments, in addition to the regular pay. The term *off-reckonings* is therefore now obsolete.

OGEE.—A molding consisting of two curves, one concave and the other convex. It is called (in classic architecture) *cymatium* or *cyma reversa*. The ogee is also much used in Gothic architecture. An arch having each side formed with two contrasted curves is called an ogee arch. The ogee, sometimes written *ogive*, frequently constituted the ornamental molding on guns, mortars, and howitzers.

OGIVAL.—The form usually given the head of oblong projectiles. It was found by Borda that this shape experienced less resistance from the air than any other. See *Oblong Bullet*, and *Projectiles*.

OHM'S LAW.—This law is singularly in accordance with experimental results. It assumes that the electro-motive force for a particular galvanic pair is constant, and that the strength of the curent it produces is the quotient which results from dividing it by the resistance of the circuit. This resistance arises from two sources, the first being the resistance within the cell offered by the exciting liquid, and the second the interpolar resistance. If e represent the electromotive force; l, the resistance within the cell; w, the interpolar resistance; and S. the strength of the current, or the quantity of electricity actually transmitted, the statement of the law for one couple stands thus: $S=\frac{e}{l+w}$. The application of the law in a few particular cases will best illustrate its meaning. If we increase the number of cells to n, we increase the electromotive force n times, and at the same time we increase the liquid resistance n times, for the current has n times as much of it to travel, then $S=\frac{ne}{nl+w}$. If w be small compared with nl—that is, if the external connection be made by a short, thick wire—it may be neglected, and so $S=\frac{ne}{nl}=\frac{e}{l}$. This shows that one cell gives in these circumstances as powerful a current as a large battery. But if nl be small with respect to w—as in the interpolar circuit of an electric telegraph battery—nl may be neglected, and $S=\frac{ne}{w}$. Here we learn that the strength of the current increases directly as the number of cells. We may learn from the same that the introduction of the coil of long, thin wire of a galvanometer into such a circuit, introducing but a comparatively small increase of resistance, causes a very slight diminution of the current strength. If, again, we increase the size of the plates of a galvanic pair n times, the section of the liquid is proportionately increased, so that whilst the electromotive force remains the same, the cell resistance diminishes n times; therefore $S = \frac{e}{l + \frac{w}{n}}$, or $S = \frac{ne}{l + nw}$. If the exterior resistance is small, nl may be neglected, and $S = \frac{ne}{l}$, and the strength is thus shown to increase n times. These are only a very few of the conclusions arrived at by this law. With the aid of a tangent galvanometer, which gives the value of S expressed in absolute magnetic units, or centimeters of voltameter gas, we ascertain e and l for any pair. By making two observations with two wires of known resistance separately included in the circuit, we have two simple equations with two unknown quantities, from which e and l can be easily found. In doing so, we must adopt a *unit of resistance*. The unit proposed and determined by the British Association, the B. A. unit, or the ohm, is the only one now used in this country. The resistance of the liquid of the pair would be expressed in units of this, and the electromotive force in absolute units or centimeters of gas, with a circuit offering a unit of resistance. See *Galvanism*.

OIL-BATH.—A bath employed in tempering steel. The tube of steel is drawn out of the furnace and sunk into a large iron tank about twenty feet deep, containing several hundred gallons of oil. The heated steel in passing into oil will sometimes cause the surface-oil to take fire, which is extinguished by closing the top of the tank. A covering of coal is also formed round the steel by the burned oil, which greatly retards transmission of heat. The tank has a water-space surrounding it, and as the steel parts with its heat, raising the temperature of the oil, the temperature of the water is also raised. The water, as it is heated, is drawn off by an escape-pipe, and a supply of cold water is continually running in, thus the heat is gradually taken from the mass. Exceeding toughness is the result of the operation; the tensile strength of the steel is made higher, and it is harder and more elastic. See *Tempering*.

OILLETS.—Small openings often circular, used in mediæval buildings for discharging arrows, etc., through. Also written *Oeillets*.

OIL TEMPERING.—In English gun construction, all tubes being procured by contract with the different steel producers in great Britain, are delivered at Woolwich as solid ingots, and, of course, untempered. The facilities at that place are ample for all needs for tempering in oil. The general details of this process as practiced at Woolwich have been published in the English text-books, and need not be in consequence described in this work. The effects of Oil-tempering are to increase the hardness, tensile strength, and elastic limit of the metal, but somewhat at the expense of its ductility. It is a process, however, which is applied to all steel products for heavy ordnance in England, and also in France, and has been so long practised, with confidence in it remaining so long unshaken, and, in fact, increasing, that it must be recognized as probably an important process to be employed in constructions where steel tubes of about equal diameters throughout their entire length are designed for use in built-up guns. For ingots, however, wherein unequal diameters find place, the process becomes one of doubtful benefit in its application, as it evidently disturbs the molecular conditions of the metal; sections of different diameters being unequally acted upon by the tempering process, injurious strains are introduced similar to those produced by unequal cooling in masses of cast iron where the areas of adjacent cross-sections are sensibly and abruptly different.

The increased hardness and diminution of the percentage of elongation in the metal introduced by the application of the process are subjects for consideration, and should leave the question of tempering one for consideration and further experiment. The increased tenacity and hardness secured by the process was a matter of great moment to the English constructors when the Palliser stud system of projectiles was standard in the British service, as the enormous strains brought to bear on the bearing edges of a few deep rifle grooves required these qualities to be present in the highest degree attainable; but now, when the Palliser stud system for securing rotation is a thing of the past, it remains to be considered if the merits of the oil-tempering process should not be further inquired into, both theoretically and experimentally, if praticable, and the result may be that a modification of the process, securing an increase in toughness and tenacity to a more limited extent, may be attained without sacrificing too much the extensibility of the metal, which, by permitting a *yielding* at the critical period in gun practice with high pressures, instantaneously produced, adds largely to the ability of the construction to withstand the effects of those powerful, dangerous, and suddenly applied strains.

The steels used have not changed in quanties since 1872, and about the same physical properties obtain now as then, as exhibited by their tests. A soft steel of 31 tons per square inch at the breaking point, and when tempered in oil raising to 47 tons, is now, from the latest information in print, about the standard required at the Woolwich arsenal. The untempered steel reaches its elastic limit, at, say 13 tons per square inch, and the tempered at 31 tons per square inch. It is thus apparent that the oil-tempering not only increases the tensile strength of the metal, but also increases in much greater ratio its elasticity. It is stated on good authority that no standard of heat required for tempering has been established—different specimens requiring different heats—and hence tests for the required temperatures are made for each tube from specimens taken from their ends. The more hammered steels require less heating than the less denser or softer ones, and hence the degree of heat required varies in every case depending on the grade of the steel under treatment as to its physical properties as determined by tests. See *Tempering*.

OIL TESTER.—A machine used for ascertaining the relative value of lubricants, giving the co-efficient of friction, and pressure per square-inch of journal; also the temperature at the same time. The drawing on the opposite page shows such a contrivance with the following:

DIMENSIONS

Extreme height	21 inches.
Extreme length	46 "
Extreme width	28 "
Weight	350 pounds.

ADAPTATION.

Provided with three sizes of journals, viz, 2 inches, $2\frac{3}{4}$ inches, and 3 inches, also a cone-pulley to run at 3 different speeds.

Capacity . . . . . 2,200 pounds.

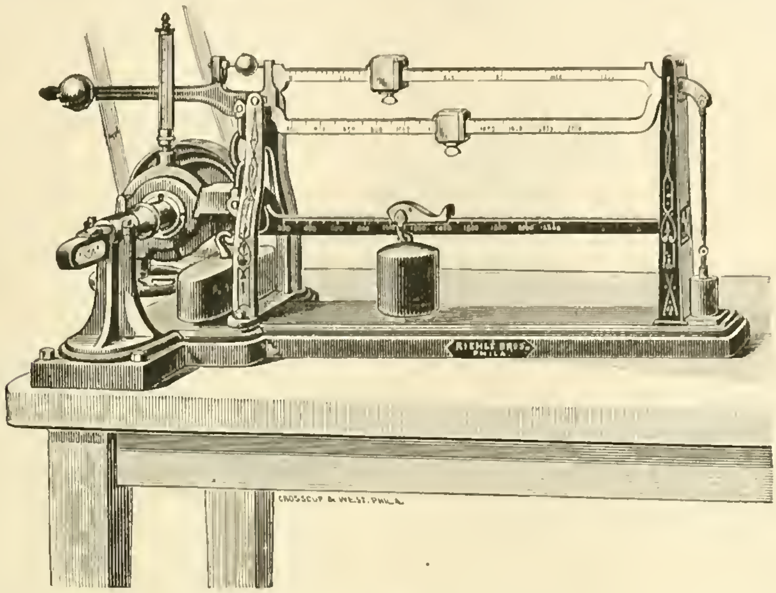
In using the machine, a small and determinate quantity of the oil to be tested is placed on the journal, the pressure is adjusted to that at which the oil is desired to run under test; and the machine is started at a speed which will give the desired relative velocity of rubbing surfaces. Observations are made at short intervals, and recorded, until the test is closed by rapid heating, as shown by the thermometer, and excessive increase of friction is indicated. Competing oils are similarly tried, and the records afford a perfect means of comparison. The relative power of resisting high temperatures without decomposition is another important point which may be tested. See *Testing-machine*.

OLEOMETER.—An instrument for ascertaining the densities of fixed oils. It consists of a very delicate thermometer-tube the bulb being large in proportion to the stem. It is divided into fifty degrees, and floats at zero in pure oil of poppy-seed, at 38° to 38½° in pure oil of almonds, and at 50° in pure olive oil. Also written *Elaiometer*.

OLIFANT.—A horn which a Paladin or Knight sounded in token of defiance, or as a challenge. Commonly written *Oliphant*.

OLINDE.—A term applied to an early form of sword-blade.

OLYMPIC GAMES.—The most splendid National Festival of the Ancient Greeks, celebrated every fifth year in honor of Zeus, the father of the gods, on the Plain of Olympia. Their origin goes back into Prehistoric Ages. According to the myth elaborated or preserved by the Elean Priests, they were instituted by the Idæan Herakles in the time of Kronos, father of Zeus; according to others, by the later Herakles, son of Zeus and Alkmene; while Strabo, rejecting the older and more incredible legends, attributes their origin to the Herakleidæ after their Conquest of the Peloponnesus. But the first glimpse of anything approaching to historic fact in connection with the games is their so-called revival by Iphitos, King of Elis, with the assistance of the Spartan lawgiver, Lycurgus, about 884 B. C.; or, according to others, about 828 B. C., an event commemorated by an inscription on a disc kept in the *Heræum* at Olympia, which Pausanias saw. That festive games were celebrated here—in other words, that Olympia was a sacred spot long before the time of Iphitos, can indeed hardly be doubted: the universal tradition that the Elean King had only "revived" the games proves this; but nothing whatever can be historically ascertained concerning their origin, character, or frequency, in this remoter time. Iphitos may, therefore, be regarded as their founder, yet the reckoning of time by Olympiads—the real dawn of the historical period in Greek history—did not begin till more than a century later. At first, it is conjectured, only Peloponnesians resorted to the Olympic Games, but gradually the other Greek States were attracted to them, and the Festival became *Panhellenic*. Originally, and for a long time, none were allowed to contend except those of pure Hellenic blood; but after the Conquest of Greece by the Romans, the latter sought and obtained this honor, and both Tiberius and Nero figure in the list of Roman victors. Women—with one exception, the Priestess of Demeter Chamyne—were forbidden to be present, on pain of being thrown headlong from the Typæan rock. The games were held from the 11th to the 15th of the Attic month *Hekatombæon* (our July–August), during which, first throughout Elis, and then throughout the rest of Greece, heralds proclaimed the cessation of all intestine hostilities; while the territory of Elis itself was declared inviolable. The combatants were required to undergo a preparatory training for 10 months in the gymnasium at Elis, and during the last of these months the gymnasium was almost as numerously attended as were the games themselves. Much uncertainty prevails as to the manner in which the contests were distributed over the different days. Krause suggests the following order: On the first day the great initiatory sacrifices were offered, after which the competitors were properly classed and arranged by the Judges, and the contests of the trumpeters took place; the second day was set apart for the boys who competed with each other in foot-races, wrestling, boxing, the *pentathlon*, the *pankration*, horse-races; the third and principal day was devoted to the contests of men in foot-races of different kinds (as, for example, the simple race, once over the course; the *diaulos*, in which the competitors had to run the distance twice; and the *dolichos*, in which they had to run it seven or twelve times); wrestling, boxing, the *pankration*, (in which all the power and skill of the combatants were exhibited), and the race of *hoplites*, or men in heavy armor; on the fourth day came off the *pentathlon*, (contest of five games—viz: leaping, running, throwing the discus, throwing the spear, and wrestling), the chariot and horse races, and perhaps the contests of the heralds; the fifth day was set apart for processions, sacrifices, and banquets to the victors (called *Olympionikoi*), who were crowned with a garland of wild olive twigs cut from a sacred tree which grew in the Altis, and presented to the assembled people, each with a palm branch in his hand, while the heralds proclaimed his name, and that of his father and country. On his return home; he was received with extraordinary distinction; songs were sung in his praise, statues were erected to him, both in the Altis and in his native city; a place of honor was given him at all public spectacles: he was in general exempted from public taxes, and at Athens was boarded at the expense of the State in the Prytaneion. The regulation of the games belonged to the Eleans, from whom were chosen the *Hellanodikai*, or Judges, whose number varied. At

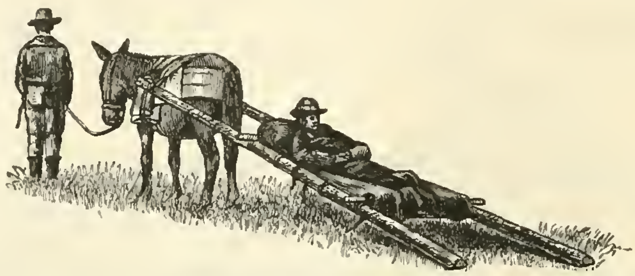


Oil Tester.

first there were only two, but as the games became more and more national, and consequently more numerous, they were gradually increased to ten, sometimes even to twelve. They were instructed in their duties for ten months beforehand at Elis, and held their office only for one year. The officers who executed their commands were called *Alytiæ*, and were under the presidency of an Alytarch.

ONAGER.—A warlike machine, which was used by the ancients to throw stones of different sizes. It is mentioned by Vegetius. See *Balista*.

ONE-HORSE LITTER.—A litter intended to be dragged by one horse or mule. It is variously extemporized from such material as may be at hand. The drawing, from a photograph of one of these



contrivances, used in the Powder River Indian Campaign, in 1876, shows the manner of its construction and use. When two animals can be spared, or when the country to be passed over is exceedingly rough, the *two-horse* litter will usually give better satisfaction. See *Litter*, *Stretcher* and *Travée*.

ONEIN.—An offensive weapon of mediæval times, consisting of a staff with a hooked iron head.

OPEN.—A term frequently used in military movements and dispositions, in contradistinction to *close;* as *open column*, *open distance*, *open order*, etc. It also constitutes part of a word of command; as, *rear open order*. By *open distance in column* is meant that the intervals are always equal in depth to the extent in front of the different component parts of the column.

OPEN DEFENSES.—To this class belong the arrangement of the parapet which has already been described; simple *loop-holed walls* for musketry used as inclosures of gorges, etc.; *exterior corridors* which are covered either by a wall or an earthen parapet; and *barbettes and embrasures* for artillery. Walls of this class, when used as the inclosures of the gorges of lunettes or other isolated works, placed in advance of the enciente, but within the reach of its artillery fire, should be high enough to secure the work from an open assault, and sufficiently thick to resist the occasional shot which may reach them over the parapet by which they are covered. For these purposes the height should be from 12 to 15 feet, and the thickness from 4 to 5 feet. The loop-holes are not placed nearer to each other than from 3 to 4 feet, estimated between their axes. They should be at least 6 feet above the exterior foot of the wall, and 4½ feet above the ground or banquette within. The loop-holes are usually placed at regular intervals along the line of the wall; or only opposite that portion of the exterior ground upon which a fire is to be brought to bear.

The form and dimensions of the loop-hole will depend upon the thickness of the wall and the field of view, both vertically and horizontally, which is to be covered by its fire. The plan is either trapezoidal, widening from the front of the wall inwards, or else it widens from the center each way to the front and back; or, as is the more usual form in our works, the interior portion from the center widens inwards, whilst the exterior part is rectangular in plan, and of the same width as the width on the interior or the back of the wall. The first form is best adapted to walls not more than 2½ feet thick, the others to heavier walls; the object being to lessen, as far as practicable, the weakness which loop-holes necessarily cause to the wall; this defect increasing as the exterior or interior opening is greater.

For thin walls, where the plan of the loop-hole is trapezoidal, the width of the exterior opening may be from 2 to 4 inches, and that of the interior from 15 to 18 inches. These dimensions, however, may vary according to the field of fire to be brought within the range of the loop-hole, the more or less cover to be given to the troops, and the strength of the masonry of which the wall is formed. The vertical dimensions of the loop-hole, both on the interior and the exterior, will depend upon the field of fire to be embraced in this last direction, and they will be regulated accordingly; the top and sole of the loop-hole receiving a suitable slope or direction for this purpose.

The foregoing details can only be determined upon from the special object to which the loop-holed defenses are to be applied. Care only is to be taken that in attempting to give cover to the troops their field of view be not too restricted by too narrow an opening for the use of the firearms. Where the throat or narrowest part of the loop-hole is within the wall, the exterior opening leaves a wider mark for the missiles of the assailed, and when the sides of the loop-hole gradually widen outwards, a shot striking one of them may glance inward and do injury. To prevent this accident, the sides and sometimes the sole are made in offsets. A more convenient form for construction, and one better adapted to arresting the enemy's balls, is to make the exterior portion rectangular in plan for half the width of the wall, as already described.

In open exterior corridors the troops covered in front either by an earthen parapet, which is usually only musket-proof, the scarp wall being run up to the superior slope; or else the scarp wall serves as the cover, in which case it is pierced either throughout its length or at suitable points with loop-holes. The floor of the corridor serves as a banquette tread for the loop-holes, and is therefore placed with reference to the direction of the fire from the loop-holes. The height at which the scarp wall rises above the floor of the corridor will depend upon the level of the floor and that of the bottom of the ditch; this height, however, should not be less than 6½ feet to afford a sufficient cover to the troops. See *Barbette Battery*, *Covered Defenses*, *Embrasure Battery*, and *Machicoulis*.

OPEN FLANK.—In fortification, that part of the flank which is covered by the orillon.

OPENING OF THE TRENCHES.—This operation, in the progress of a siege, supposes that all the measures preparatory to it have been taken; the *depots* of trench materials established and well provided; careful reconnaissances of the site and the defenses made; an accurate map made from such instrumental surveys as were practicable, and other information gained; the positions of the defenses marked out upon the map giving the directions of the faces and capitals of the principal works; the distances and heights of their salient points from that of the first parallel, etc.; and the approximate positions of the first parallel and of the approaches to it from the depôts in its rear, and of those leading from it upon the defenses. With the *data* furnished from these sources the engineers can proceed to stake out upon the ground the directions of the portions of the trenches upon which ground is to be first broken, either on the same night, or a night or two before, as opportunity may serve. This duty is readily performed with the aid of rough sketches, dark lanterns, small pocket compasses, and pickets painted white, with all of which the officers are provided, and with the aid of several intelligent non-commissioned officers or soldiers of the engineer troops.

Everything being in readiness, the workmen are assembled in detachments, at the proper moment towards night-fall, at the depots of the trenches, where they receive their trenching tools, and whatever else is necessary to carry on the work with. They are then led, in single file, to the positions they are to occupy in breaking ground, by an officer or engineer soldier; sometimes each man grasping with the right or left hand a tracing rope or tape, on which his position is marked in the usual way, or else the tracing-tape is first stretched and the men placed in their position near it. When once in position, the working parties are commanded to lie down and keep perfectly quiet until ordered to rise and commence work; to give time to the engineer officers to rectify any mistakes of direction in the lines. So soon as this is done, the order is given to rise and break ground. This will be done by each man digging a hole as speedily as posssible, and throwing the earth towards the defenses, so as to give cover for himself, and from which he can gradually, and with security, work forward in the direction of the trench he is to excavate. This operation is supervised by the engineers on duty, who see that any mistakes made by the men digging are corrected at the proper moment. In the prosecution of the works during this period, the simple trench, flying sap, or full sap will be used, as opportunity may offer, and as the fire of the defenses is more or less certain and destructive. As the flying sap will afford the most speedy cover against case shot, it will be employed generally so soon as the trenches have been advanced within destructive range of this; using, however, the simple trench at night, or at any other opportune moment. The full sap must be used when within the certain range of small-arms, and when the cannon fire of the defenses is very deadly; resorting, however, to the flying sap whenever the risk is but slight. See *Siege*.

OPEN ORDER.—In tactics, an interval of about three yards between each rank. See *Rear Open Order*.

OPERATIONS.—Under the term Military Operations are included: field operations; offensive and defensive operations; underground operations; siege operations, etc. All consist in the resolute application of preconcerted measures in secrecy, dispatch, regular movements, occasional encampments, and desultory combats or pitched battles.

OPHICLEIDE.—A musical wind-instrument of brass or copper, invented to supersede the serpent in military bands. It consists of a conical tube, terminating in a bell like that of the horn, with a mouthpiece similar to that of the serpent, and ten ventages or holes, all stopped by keys like those of the basson, but of larger size. Ophicleides are of two kinds, the bass and the alto. The bass ophicleide offers great resources for maintaining the low part of masses of harmony. Music for it is written in the bass clef, and the compass of the instrument is from B, the third space below the bass staff to C, the fifth added space above it, including all the intervening chromatic intervals. The alto ophicleide is an instrument of very inferior quality, and less used. Its compass is also three octaves and one note. The music for it is written in the treble cleff, and an octave higher than it is played. Double bass or monster ophicleides have sometimes been used in large orchestras, but the amount of breath which is required to play them has prevented their coming into general use.

OPINION.—1. Decision, determination, and judgement formed upon matters that have been laid before a Court-Martial or Court of Inquiry. 2. The technical name for the advice given by an Advocate. The Attorney or Solicitor writes a statement of facts, called "a case" in England, and "a memorial" in Scotland, which ends by asking certain queries, and the answer written by the Counsel is his opinion. A Counsel is not liable for any damages caused by his giving a wrong opinion, though the result of gross ignorance, this being one of the privileges of Counsel.

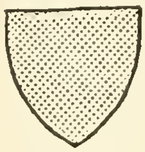
OPLITAI.—A Grecian army, at the period when the military art was in the greatest perfection among them, was composed of infantry and cavalry. The former was made up of three different orders of soldiers; termed, 1. The *Oplitai*, or heavily armed, who wore a very complete defensive armor, and bore the *sarissa*, or Macedonian pike, a formidable weapon either for the attack or defense, about 24 feet in length. 2. The *Psiloi*, or light infantry, who were without defensive armor, and carried the javelin, bow, and sling. 3. The *Peltastæ*, who were intermediate between the other two, carrying a lighter defensive armor, as well as a shorter pike than the oplitai.

The oplitai, when formed for exercise or parade, were drawn up in open order; leaving an equal interval between the men of each rank and between the ranks. When ready to charge, each man occupied a square of 3 feet, and the six leading ranks brought their pikes to a level; thus presenting an array in which the pikes of the sixth rank extended 3 feet in advance of the front one. In attacks on intrenchments, or fortified cities, the men of each rank closed shoulder to shoulder, a sufficient interval being left between the ranks to move with celerity; the leading rank kept their shields overlapped to cover their front; the others held them above their heads for shelter against the weapons of the enemy.

OPTICAL ILLUSION.—Of all the senses none is more deceptive than the sense of sight; it often deceives us as to the distance, size, shape, and color of objects; it frequently makes them appear as if in situations where their existence is impossible; and often makes us think them movable when they are not so, and *vice versa*. An object appears to us as large, near or distant, according as the rays from its opposite borders meeting at the eye form a large or a small angle: when the angle is large, the object is either large or near; when small the object must be small or distant. Practice alone enables us to decide whether an object of large apparent size is so on account of its real size, or of its proximity; and our decision is arrived at by a comparison of the object *in position* with other common objects, such as trees, houses, etc., which may chance to be near it, and of which we have by experience come to form a correct idea. The same is, of course, true of apparently small objects. But when all means for comparison are removed, as when we see a distant object floating on an extensive sheet of water, or erect in an apparently boundless sandy plain, where no other object meets the eye, then our judgment is completely at fault. Imperfection in the acquired perceptions of sight, as it is called, produces many other illusions: it leads us to consider spherical solids at a distance as flat discs, and deceives us regarding the size of objects, by their color; the sun appears larger than he would if illumined by a fainter light, and a man in a white habit seems larger than he would if he wore a dark dress. Illusions are also produced by external causes. The property which the eye possesses of retaining an impression for a very brief, though sensible period of time (about one-quarter of a second), after the object which produced the impression has been removed, produces a third class of illusions. Common examples of this are the illuminated circle formed by the rapid revolution of an ignited carbon point, piece of red-hot iron, or other luminous body, and the fiery curve produced by a red-hot shot projected from a cannon.

OPTIMATES AND POPULARES.—In the politics of republican Rome, the conservative or aristocratic, and the democratic or progressive parties respectively. The *Populares* comprised the great body of the people, including not only the proletariat but many men of wealth, but without personal influence. The *Optimates* were the aristocracy, the great official houses, and their followers. The two parties perpetuated the old contests between the patricians and plebians. The *Populares* triumphed under the leadership of C. Gracchus, and were crushed by Sulla.

OR.—In Heraldry, the metal gold represented in heraldic engravings by an unlimited number of dots.



Or.

ORB.—In tactics, the disposing of a number of soldiers in circular form. The orb is a good formation for a body of infantry in an open country when resisting cavalry, or a superior force of infantry, inasmuch as it is regular and equally strong, and gives an enemy no reason to expect better success by attacking one place than another. Cæsar drew up his whole army in this form when he fought against Labienus. The whole army of the Gauls was formed into an orb, under the command of Sabinus and Cotto, when fighting against the Romans. The orb was generally formed six deep.

ORDER.—This word is applied to an aggregate of conventual communities comprehended under one rule, or the societies, half military half religious, out of which the institution of Knighthood sprang. Religious Orders are generally classified as Monastic, Military, and Mendicant.

The earliest comprehension of Monastic Societies under one rule was effected by St. Bazil, Archbishop of Cæsarea, who united the hermits and cenobites, in his diocese, and prescribed for them a uniform constitution, recommending at the same time a vow of celibacy. The Basilian rule subsists to the present day in the Eastern Church. Next in order of time was the Benedictine Order, founded by St. Benedict of Nursia, who considered a mild discipline preferable to excessive austerity. The offshoots from the Benedictine Order include some of the most important Orders in ecclesiastical history, among others the Carthusians, Cistercians, and Præmonstrants. The order of Augustinians professed to draw their rule from the writings of St. Augustine; they were the first Order who were not entirely composed of laymen, but of ordained priests, or persons destined to the clerical profession.

The Military orders, of which the members united the military with the religious profession, arose from the necessity under which the monks lay of defending the possessions which they had accumulated, and the supposed duty of recovering Palestine from the Saracens, and retaining possession of it. The most famous Orders of this kind were the Hospitallers or Knights of St. John of Jerusalem, the Knights Templars, and the Teutonic Order. Many other Military Orders existed, and not a few continue to exist, particularly in Spain and Portugal. The phraseology of the old Military Orders is preserved in the Orders of Knighthood of modern times, into which individuals are admitted in reward for merit of different kinds, military and civil.

The three Mendicant Orders of Franciscans, Dominicans, and Carmelites were instituted in the 13th century. Their principal purpose was to put down the opposition to the Church, which had begun to show itself, and also to reform the Church by example and precept. At a later period the Order of Jesuits was founded, with the object of increasing the power of the Church, and putting down heresy.—Notices of the more important Orders, Monastic, Military, and Mendicant, will be found under separate articles. See *Orders*.

ORDER ARMS.—A position in the Manual of Arms, executed as follows: The Instructor commands 1, *Order*, 2. ARMS. Grasp the piece with the left hand, the forearm horizontal, let go with the right hand; lower the piece quickly with the left; regrasping it with the right above the lower band, the little finger in rear of the barrel, the hand near the thigh, the butt about three inches from the ground, the left hand steadying the piece near the right, the fingers extended and joined. (Two.) Lower the piece gently to the ground with the right hand, drop the left hand by the side, and take the position to be described. The position of Order Arms has the arm hanging naturally, elbow close to the body, the back of the hand to the right, the fingers extended and joined; the barrel between the thumb and forefinger extended along the stock; the butt against the toe of the right foot, the barrel to the rear and vertical. See *Manual of Arms*, *Fig.* 4.

ORDER BOOK.—A book kept at all military headquarters, in which orders are written for the information of officers and men. Every order in this book should be *signed* by the Officer whose signature was attached to the originals sent from the office, and each order should be separated from the one following by a red line. The mode of numbering, distribution, and general form of orders are prescribed by the regulations; but the distribution in each particular case should be noted in red ink in the margin to show that the regulations have been complied with; and where orders, are sent to one officer, under cover to his Commander (which course ought always to be pursued), or furnished at a date subsequent to that of their issue—these facts should likewise be added: where the order has been *printed*, it will be sufficient to write the word "*printed*" in red ink in the margin, to indicate that the widest circulation has been given to it. There are *two* indexes attached to the book—one of *names*, the other of *subjects*—every order will be indexed in the *latter* immediately after being copied. For *names*, a *detached* index will first be used until the record book is full, when they will be arranged under each letter as in City Directories, and thus classified, transferred to the *permanent* alphabetical index attached to the record book. Every proper name will be indexed and a red line drawn in the body of the order under it, to facilitate a reference to it.

ORDER OF BATTLE.—The combination which is made to attack one or more points of an army in position, is called the *order of battle*. The four principal orders of battle are the *parallel*, *oblique*, *concave*, and *convex*. The lines of battle of the opposing forces being sensibly *parallel* to each other is an example of the *parallel* order of battle. This order of battle naturally results when a simultaneous attack is made along the whole front of an enemy's position. The results will usually be very decisive for the army which gains the advantage, but the price paid for success will also be very dear. When the line of battle of the assailant makes an angle with that of the assailed, the order of battle is said to be *oblique*. This order of battle results when the attack is made with one wing, the other wing at the same time being held back, or *refused*. When the attack is made by both wings, the center being *refused*, the order of battle is *concave*; and, when made by the center, with the *wings refused*, *convex*. The *order* of battle then results from the dispositions made to atttack the enemy's position; so it naturally follows, that when the enemy is found, the first point to be decided is, *how to make the attack with the greatest damage to the enemy and with the least to the attacking force*. Owing to the great loss which usually follows attacks along the whole line, even when successful, they should seldom be made, except when the chances of success and the probable results of victory are very great.

ORDERLIES.—Non-commissioned officers and soldiers appointed to wait upon General and other Commanding Officers, to communicate their orders, and to carry mes ges. The *Orderly Officer*, or Officer of the Day, is the officer of a corps or regiment, whose turn it is to superintend its interior economy, as cleanliness the goodness of the food, etc. *Orderly Non-commissioned Officers* are the Sergeants in each company who are "orderly,' or on duty for the week. On the drum beating for orders, they proceed to the Orderly Room take down the general or regimental orders affecting their respective companies, show them to the Company Officers, and warn the necessary men for any duties specified in those orders An *Orderly Book* is provided by the Captain of each troop or company in a regiment for the insertion of general or regimental orders from time to time issued.

ORDERLY DRUMMER.—The drummer that beats the orders, and gives notice of the hour for messing, etc.

ORDERLY ROOM.—The court of the Commanding Officer, where charges brought against the men of his regiment are investigated, and sentence passed. It is also the office of the Commanding Officer, usually in the barracks, from which all orders emanate.

ORDERLY SERGEANTS.—The First Sergeant of a company is commonly so called. On hearing the drum beat for orders, Orderly Sergeants repair to the Adjutant's Office, and, having taken down the orders in writing, they are immediately to show them to the officers of their company, and to warn the men for duty.

ORDER OF MARCH.—The formation assumed by troops on the march, and which depends on the nature of the country they are moving in, the object to be attained, and the characteristic of the enemy, as well as the number of troops composing the force. If at any distance from the enemy, the comfort of the men, as well as the means of giving them the necessary supplies, must be studied. When in the proximity of the opposing force, tactical considerations must alone weigh in disposing of the order of march. In all cases an army is preceded by an advance guard, covered by the main force, the rear of which is followed by a rear guard.

ORDER OF MERIT.—A military distinction given to officers or soldiers for some signal service, the badge of which is generally expressive of the service. Such was the Medal or Order of Merit, presented by the Austrian Emperor to the Officers of the 15th British Light Dragoons for their bravery in the affair of Villers en Couché in 1794.

ORDERS.—The intructions, injunctions, or commands issued by superior officers. The orders of Commanders of Armies, Divisions, Brigades, and Regiments are denominated orders of such Army, Division etc., and are either General or Special. Orders are numbered, General and Special in separate series, each beginning with the year. Those issued by Commanders of Posts, Battalions, Companies or Detachments are simply denominated "Orders," and numbered in one series, beginning with the year. In the British service, orders are General, Divisional, Brigade, or Regimental. General Orders are issued by the Commander-in-Chief of an army, and affect the whole of his force. The others emanate from Generals of Division or Brigade, or from officers commanding Regiments, and severally affect their respective commands. In the United States, a General Order or an important Special Order, is read and approved by the officer whose Order it is before it is issued by the Staff Officer. An Order states at its head whether it is Special or General; its number, date, and place of issue; and at its foot, the name of the Commander by whose authority it is issued. An Order may be put in the form of a letter addressed to the individual concerned, through the proper channel. Such Orders should be in strict military—not semi-official—forms. Every Commander who gives an Order involving an expenditure of public money sends a copy, without delay, to the Bureau of the War Department to which the expenditure appertains, and if such Commander be serving in a Military Department, he sends a copy of the order to the Headquarters of the Department. If a Military Commander gives to a disbursing officer any order in conflict with orders received by him from the officer in charge of his Department at any superior headquarters, such Commander forthwith transmits the order to such headquarters, with explanation of the necessity which justifies it. Commanding officers of Military Divisions, Departments, and Districts forward, direct, copies of all the orders affecting the officers of the General Staff under their command to the Departments at Washington to which the duties of the officer pertain. It is important that advices of leaves of absence, changes of locality, duties, etc., of subordinate officers of the General Staff be early communicated to the heads of their respective Departments. Orders and instructions are transmitted through intermediate Commanders, in the order of rank, except when they are of such a character as to leave the intermediate Commanders no discretionary power to modify or suspend them. In such exceptional cases, the Orders or instructions will be sent direct to the officer under whose authority they are to be executed, copies being furnished to the intermediate Commanders. Orders for any body of troops are addressed to its Commander, are opened and executed by the Commander present, and are published and distributed by him when necessary. Copies of all orders of the Commanders of Armies, Departments, Divisions, and detached Brigades, and of the Superintendents of the Recruiting Service, are forwarded at their dates, or as soon thereafter as practicable, in separate series on full sheets of letter-paper, or as printed, to the Adjutant General's Office. A file of the printed orders is kept with the headquarters of each Regiment, with each Company, and at each Military Post, and is regularly turned over by the Commander, when relieved, to his successor. The orderly hours being fixed at each headquarters, the Staff Officers and chiefs of the special services either attend in person or send their assistants to obtain the orders of the day; and the 1st Sergeants of companies repair for that purpose to the Adjutant's office. During marches and active operations, and when the regular orderly hours cannot be observed, all orders are either sent direct to the troops, or the respective Commanders of Regiments or Corps are informed when to send to headquarters for them. Under the same circumstances, orders are read to the troops during a halt, without waiting for the regular parades. See *General Orders*, and *Special Orders*.

ORDINAIRE.—The common French term for the soldiers' mess.

ORDINARIES.—In Heraldry, certain charges composed of straight lines, and in very common use, to which writers on Heraldry had assigned abstruse symbolical meanings, but whose real chief peculiarity seems to be that they originally represented the wooden or metal fastenings of the shields in use in actual warfare. The Ordinaries are usually accounted nine—the chief, pale, fess, bar, bend, bend sinister, chevron, saltire, and cross. Heralds vary a little in their enumeration, some taking in the pile in place of the bar. Each is noticed under a separate article. See *Heraldry*.

ORDINARY OF ARMS.—In Heraldry, an index or dictionary of armorial coats, arranged, not according to names, like an armory, but according to the leading charges in the respective shields, so as to enable any one conversant with heraldic language, on seeing a shield of arms, to tell to whom it belonged. A very imperfect Ordinary for England is appended to Edmonson's *Heraldry*: a far more complete and elaborate work of the same kind, Papworth's *Ordinary of British Armorials*, partly edited by Alfred Morant, was published in 1874.

ORDNANCE.—The term ordnance includes cannon of all kinds fired from carriages, slides, beds, tripods, etc. Cannon are classified according to their nature, as guns, howitzers, mortars, and machine-guns, and according to their uses as field, mountain, siege, and sea-coast. Guns are further classified as to their construction, as smooth-bore and rifle; as muzzle-loading and breech-loading; and as cast and built up cannon. All ordnance for land service in the United States is made by private Contractors, under the direction of officers of the Ordnance Department. Rifled howitzers and mortars, and guns with chambers for large charges, are now under consideration. Rifled breech-loading field-guns are also under trial. For the present, until superior armament can be provided, guns of obsolete patterns and kinds are retained in service. Standard guns, howitzers, and mortars take their denomination from the caliber in inches.

Heavy modern ordnance dates properly from the casting of the great Rodman smooth-bores in the United States. To the impetus thus given may be ascribed the origin of the powerful guns of the present day. In Rodman's study of gunpowder and the improvements introduced by him, lay the germ of all subsequent progress in ordnance. His most important invention, *perforated cake powder*, was transplanted bodily to the Continent of Europe, where, under the name of *prismatic powder*, it has been used ever since. So perfect is the theory of this powder, that invention and science toiling over the subject for twenty years has produced nothing better. Since the first half of the decade—1860-70—the United States has fallen behind the nations of Europe in the power of her armament. Having been committed by her two great inventors, Rodman and Dahlgren, to cast-iron smooth-bores, which were fabricated in great numbers, her attitude has been that of Micawber—"waiting for something to turn up." England occupies the other extreme,—of all the powers she has ventured the greatest sums upon the theories of her gun-makers. Her private manufacturers have received such encouragement at home or abroad that they are now able to supply the whole world. Their only great rival on the Continent is Krupp, who finds his market principally in Germany, Russia and Turkey.

The early adoption of the rifle principle by all European powers placed them at once on a plane of advancement. The vexed questions of breech and muzzle-loading and of gun construction have been decided by each nation in the manner most satisfactory to itself. Opinions differ widely, and it is probable that many changes may be made in these matters. Still they all possess powerful guns which have certain features in common, essential to heavy ordnance in the present stage of its development. Large-grained powder, the first of these requisites, is universally used. Great length of bore, to utilize the whole force of the powder, is another characteristic. Great power is secured by immense charges of powder and weight of shot. A caliber of at least 12 inches, giving an oblong shot of about 700 pounds, seems to be regarded as a *sine qua non* for all armaments. England has taken the lead in all these improvements, and though it would appear from recent events that her choice of gun systems is unfortunate, there is no question that all great advances since Rodman's day have been based upon her expensive experiments. The work of the celebrated "Committee on Explosives," 1875, of which Col. Younghusband and Capt. Noble (now a member of Sir Wm. Armstrong's firm), were members, did more to this end than any other investigation since General Rodman's experiments in gunpowder. Acting upon the obvious idea that the peril to the life of the gun is relieved by air-space, the Committee recommended the enlargement of the bore at the seat of the charge, or the use of a chamber larger than the bore. This simple expedient led at once to an increase in the power of guns while the pressure endangering them was kept at a point lower than before. Every good thing can be pushed too far. The immense charges made possible by the English chamber have been continually added to by the Italians in their 100-ton Armstrong monsters and the vital air-space greatly reduced till a charge of about 552 pounds of powder has recently (1880) burst one of these magnificent guns.

The following table gives an interesting comparison between the largest guns at present existent:

Type of Gun.	Calibre.	Length of gun.	Weight.			Initial velocity.	Total energy at the muzzle per kilogramme of the weight of gun.
			Gun.	Shot.	Charge.		
	Mm.	Met.	Kilogrammes.			Met.	
Krupp, 35-cal. 30.5 c. m	305	10.70	48,550	455	141	530	.104
Krupp, 35-cal. 35.5 c. m	355	12.40	81,350	725	225	530	.103
German, 30.5 c. m. mar	305	6.70	36,600	325	72	488	.103
Russian, 12 in. (long)	305	9.14	43,341	344	128	597	.14
French, pat. 1870, 32 c. m	320	6.70	39,000	341	86	470	.104
English, 80-ton m. l	406	8.15	82,300	771	204	498	.114
English, 63-ton b. l	343	10.97	64,000	567	283	624	.175
Italian, 100-ton b. l	432	11.89	103,100	908	300	558	.118
French, pat. 1875, 34 c. m	340	6.7	48,340	420	117	480	.101
Bange, 34 c. m	340	11.20	37,500	450	180	600	.221

Tables I, II, III, and IV, on pages 443, 444, 445, and 446, embody the principal dimensions and weights of ordnance and ammunition of the United States Land Service. The tables, pages 447-456, together with the descriptions of ordnance referred to in this Encyclopedia, at the close of this article, will enable the reader to trace the history of ordnance, ancient and modern, and at the same time, to make comparisons of that pertaining to the various military services. See *Armstrong Guns*, *Artillery*, *Blakely Gun*, *Breech-insertion*, *Bronze Guns*, *Built-up Guns*, *Cannon*, *Cannon Metals*, *Cast-iron Guns*, *Cast-steel Guns*, *Converted Guns*, *Cooling of Castings*, *Dahlgren Gun*, *Elswick Gun Works*, *Fabrication of Tubes*, *Fifteen-inch Gun*, *Fraser Gun*, *French Army Ordnance*, *Gun Construction*, *Inspection of Ordnance*, *Mann Gun*, *Moffatt Gun*, *Mortar*, *Palliser Gun*, *Parrott Gun*, *Parsons Gun*, *Rifled Howitzers*, *Rodman Gun*, *Schultz Wire Gun*, *Sutcliffe Gun*, *Systems of Artillery*, *Thompson Gun*, *Uchatius Gun*, *Whitworth Guns*, *Wire Guns*, and *Woolwich Gun*.

Table I.—Standard Ordnance.

Nature of ordnance.	Material.	Caliber.	Weight.	Preponderance.	Windage	Lengths. Of entire piece.	Lengths. Of bore in inches.	Lengths. Of trunnions.	Diameters. At base line.	Diameters. At muzzle.	Diameters. Maximum.	Rifling. Twist in feet.	Rifling. Number of grooves.	Rifling. Width of grooves.	Rifling. Depth of grooves.	Rifling. Width of lands.	Venting. Diameter of vent.	Venting. Dis. from bottom of bore.	Venting. Dis. fr'm ver. plane thro' axis of bore.	Venting. Height of head.	Venting. Diameter of head.
SEA-COAST PIECES.																					
Guns		*In.*	*Pounds*	*Lbs.*		*Inch.*		*In.*	*Inch.*	*Inch.*	*Inch.*			*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*In.*	*In.*
12 inch rifle (model 1874)	Cast iron, wrought iron lined.	12	89,600	0	0.09	262.8	227	6.3	55	27.50	55	70	21	0.8976	0.09	0.8976	0.2	9.5	3.0	0.75	1.75
12-inch rifle (model 1870)	Cast iron.....	12	82,878	0	0.09	240	209	5	54	28	54	80	21	1.045	0.1	0.75	.2	4	3	0.75	1.75
10-inch rifle	Cast iron, wrought iron lined.	10	40,681	0	0.08	180	158.5	4.5	45	21	45	50	17	0.924	0.08	0.924	.2	3	2	0.75	1.75
8-inch rifle (converted).............	......do	8	16,160	0	0.05	136.66	117.25	3.25	32	16.2	32	40	15	0.8377	0.075	0.8377	.2	3.5	2.5	0.75	1.75
20-inch smooth bore...	Cast iron	20	115,200	0	0.19	243.5	210	6.5	64	34	64	......	......	....	....	....	.2	7.5	4	0.75	1.75
15-inch smooth bore (model 1874)	......do	15	70,778	......	0.15	215	190	4.5	51	24.7	51	......	......	....	....	....	....	....	....	0.75	1.75
15-inch smooth bore (model 1861)	......do	15	49,099	0	0.15	190	165	4.5	48	25	48	......	......	....	....	....	0.2	4	3	0.75	1.75
13-inch smooth bore	......do	13	38,500	0	0.14	177.61	155.85	4.5	45	21	45	......	......	....	....	....	.2	3	....	0.75	1.75
Mortars.																					
15-inch smooth bore	Cast iron.....	15	33,675	0	0.13	75	51.25	5	......	50	52	......	......	....	....	....	0.2	3	3.5	......	......
13-inch smooth bore	......do	13	17,250	0	0.13	56.5	35	4.5	......	43	43	......	......	....	....	....	.2	3	2	......	......
SIEGE PIECES.																					
Guns.																					
4.5-inch, rifled	Cast iron	4.5	3,450	300	0.05	133	120	4	15.6	9	16	15	9	0.97	0.075	0.6	0.2	1.75	0	0.62	1.25
Howitzers.																					
8-inch smooth bore	Cast iron.....	8	2,600	380	0.12	60	46.5	5	17.5	15	17.5	......	......	....	....	....	0.2	2	0	......	......
Mortars.																					
10-inch smooth bore	Cast iron	10	1,900	0	0.13	29.25	20.5	3.25	20	20	20	......	......	....	....	....	0.2	2	1.5	......	......
8-inch smooth bore..................	......do..	8	1,050	0	0.12	23.25	16	3.25	16	16	16	......	......	....	....	....	.2	1	1.5	......	......
5.82-inch smooth bore, Coehorn	Bronze........	5.82	164	0	0.14	16.32	13.07	2.5	......	7.65	8.65	......	......	....	....	....	.2	.4	0	......	......
FIELD PIECES.																					
Guns.																					
4.62-in.(12-pounder)smooth bore	Bronze........	4.62	1,230	105	0.10	72.55	63.6	3.25	11	7.5	11	......	......	....	....	....	0.2	1.15	0	......	......
3.5-inch rifle	Wro'ght iron	3.5	1,156	0	0.05	73.84	65	3.25	......	6.7	11.2	12	7	1.07	0.075	0.5	.2	1.5	0	......	......
3-inch rifle..............................	......do	3	830	40	0.05	72.65	65	2.8	9.27	6	9.7	10	7	0.84	0.075	0.5	.2	1.25	0	......	......
1.65-inch rifle (breech-loader), mountain	Steel...........	1.65	116.85	......	0	45.86	41.35	1.77	......	2.55	5.03	4.1	10	0.362	0.012	0.157	....	0	....	0.98	0.70
1.45-in. cannon-revolver, Hotchkiss	......do	1.457	1,212.605	......	0	66.75	50.39	......	......	......	......	4.1	6	0.314	0.019	0.447	....	....	....	......	......
0.45-inch Gatling......................	....	0.45	195.5	......	0	49.7	32	......	......	5.82	6.56	1.16	......	0.1413	0.010	0.1413	....	....	....	......	......
0.45-inch Gatling (cavalry)	....	0.45	....	......	0	....	....	......	......	......	......	......	......	....	....	....	....	....	....	......	......
Howitzers.																					
4.62-inch smooth bore, mountain	Bronze........	4.62	220	30	0.10	37.21	30.91	2.25	......	6.9	7.6	......	......	....	....	....	....	0.4	0	......	......

Table II.—Ammunition.

Nature of ordnance.	Charge.			Projectiles.*						
	Windage.	Kind of powder.	Weight, maximum.	Shot.	Shell, empty.	Bursting charge.	Initial velocity.	Muzzle energy.	Elevation.	Range.
SEA-COAST PIECES.—*Guns.*	*Inches.*		*Pounds.*				*Feet.*	*Ft-tons.*	° ″	*Yards.*
12-inch rifle (model 1874)	0.09	Hexagonal	110	700			1,396	9,443		
11-inch rifle (model 1870)	0.05	do	100	600			1,310	7,182		
10-inch rifle	0.05	do	80	400	360		1,430	5,670		
8-inch rifle (converted)	0.05	do	35	180	150		1,414	2,510		
10-inch rifle (Parrott, 300-pounder)		Cannon	25	300	250				13 30	4,920
8-inch rifle (Parrott, 200-pounder)		do	16	200	150				11 47	4,272
6.4-inch rifle (Parrott, 100-pounder)		do	10	100	80 to 100		1,222 to 1,335		35 00	8,453
7-inch rifle (banded, 42-pounder)										
6.4-inch rifle (banded, 32-pounder)										
20-inch smooth bore	0.13	Mammoth	200	1,080	725				25 00	8,000
15-inch smooth bore (model 1874)	0.13			450	330	17				
15-inch smooth bore (model 1861)	0.13	Hexagonal	125	450	330	17	1,735	9,449		
13-inch smooth bore	0.13	Mammoth No 5	70	283 to 300	224	7	1,597	5,337		
10-inch smooth bore	0.13	Cannon No. 5.	25	128	100	3	1,500	1,996		
8-inch smooth bore	0.13	Cannon	15	68	48	1.8				
Mortars.										
15-inch smooth bore	0.13	Mortar			330					
13-inch smooth bore	0.13	do	20		216	7			45 09	4,636
10-inch smooth bore	0.13	do	12		101.67	2			45 00	4,536
SIEGE PIECES.—*Guns.*										
4.5-inch rifle	0.5	New mortar	7	35	25		1,420	503.2		
4.2-inch rifle (Parrott, 30-pounder)		do		25 to 30	29		1,293		25 00	6,700
Howitzers.										
8-inch smooth bore	0.12	Mortar	4		45	1.8	1,070		12 30	2,280
5.82-inch smooth bore (flank defense)	0.14	do	2		17	0.75			5 00	1,322
Mortars.										
10-inch smooth bore	0,13	Mortar	4		88	3			45 00	2,064
8-inch smooth bore	0.12	do	2.25		44	1.8			45 00	2,225
5.82-inch smooth bore, Coehorn	0.14	do	0.5		17	0.75			45 00	1,200
FIELD PIECES.—*Guns.*										
3.5-inch rifle	0.05	New Mortar	3	16.75			1,314			
3-inch rifle	0.05	do	2	10	9.5		1,418			
3-inch rifle (Parrott, 10-pounder)		do	1	10.5	9.75		1,232		20 00	5,000
1.65-inch rifle (breech-loader) mountain, Hotchkiss	0									
1.457-inch cannon revolver, Hotchkiss			1,851 grs.		7,716 grs.	617 grs.	1,476			
4.62-inch (12-pounder) smooth bore	0.10	Mortar	2.5	12.3	8.34	.702	1,495		10 00	2,000
1-inch Gatling		Musket	325 grs.	3,500 grs.						1,200
0.5-inch Gatling		do	70 grs.	450 grs.			1,350		4 45	1,000
0.45-inch Gatling		do	70 grs.	405 grs.						
Howitzers.										
6.4-inch smooth bore	0.10	Mortar	3.25	Case, 30.75	23.03	1.4	1,182		15 00	2,344
4.62-inch smooth bore mountain	0.10	do	0.5	Canister, 12.17	8.34	1.10			5 00	1.005

* Except for machine-guns and the Hotchkiss mountain breech loading gun, shot and shell for rifled guns are fitted with an expanding sabot, to communicate to the projectile the rotation due to the rifling. No special sabot, however, has as yet been adopted as standard. The Butler, Parrott, Arrick, and Dana all give good results.

Table III.—Retained Ordnance.

Nature of Ordnance.	Material.	Caliber.	Weight.	Preponderance.	Windage.	Lengths. Of bore.	Lengths. Of rifled part of bore.	Lengths. Of semi-axis of ellipse, bottom of bore.	Lengths. Of trunnions.	Distances. From axis of trunnions to face of muzzle.	Distances. Between rimbases.	Distances. From base line to face of muzzle.	Diameters. At muzzle.	Diameters. Maximum.	Diameters. Of trunnions.	Rifling. Twist.	Rifling. Number of grooves.	Rifling. Width of grooves.	Rifling. Depth of grooves.
SEA-COAST PIECES.																			
Guns.		*In.*	*Lbs.*	*Lbs*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*Ft.*	*In.*	*In.*	*In.*
10-inch rifle (Parrott, 300-pounder)	Cast-iron with wrought-iron jacket.	10	26,500	0	......	144	......	5 rad.	4.5	105	36	......	20	40	10	......	15	1.0472	0.1
8-inch rifle (Parrott, 200-pounder)	do	8	16,300	0	......	136	......	4 rad.	4.5	96	26	......	16.2	32	10	......	11	1.1424	0.1
6.4-inch rifle (Parrott, 100-pounder)	do	6.4	9,700	0	......	130	......	3.2 rad.	5	91.8	22	......	13	25.9	8	......	9	1.1170	1.1
7-inch rifle (banded, 42-pounder)	Cast-iron	7.018	......	....	......	109	106	......	6.5	70.491	22	......	12.4	25.9	7.018	35	15	0.869	0.075
6.4-inch rifle (banded, 32-pounder)	do	......	......	....	......	107.59	104.59	......	6	68.595	21	......	11.75	25.9	6.41	30	13	0.946	0.075
10-inch smooth bore, Rodman	do	10	15,059	0	0.13	120	......	7.5......	3.25	87.76	32.1	110	16.2	32	10	......	......	......	......
8-inch smooth bore, Rodman	do	8	8,490	0	0.12	110	......	6	3.25	79.83	25.7	101	13.2	25.6	8	......	......	......	......
Mortars.																			
10-inch smooth bore	Cast-iron	10	7,300	0	0.13	32.5	......	7.5	3.25	22	30.4	......	30	30	12	......	......	......	......
SIEGE PIECES.																			
Guns.																			
4.2-inch rifle (Parrott, 30-pounder)	Cast-iron with wrought-iron jacket.	4.2	4,200	....	......	120	......	2.1 rad.	2.75	82.15	16.8	......	8.6	18.3	5.3	.. ...	5	1.319	0.1
Howitzers.																			
5.82-in. smooth bore, flank-defense	Cast-iron	5.82	1,476	70	0.14	58	......	......	3.25	35	12.8	......	11.17	13.8	4.62	......	......	......	......
FIELD PIECES.																			
Guns.																			
3-inch rifle (Parrott, 10-pounder)	Cast-iron	3	890	....	......	70	......	1.5 rad.	2.8	46.1	9.5	......	5.8	11.32	3.67	6	3	1.5708	0.1
1-inch Gatling	Steel	1	1,008	110	0	33	......	......	......	......	......	......	......	6.8	......	3.6	6	......	0.01
0.5-inch Gatling	do	0.5	365	45	0	32	......	......	......	—...	......	......	......	6.0	......	......	6	......	0.01
Howitzers.																			
6.4-inch smooth bore	Bronze	6.4	1,920	160	0.15	71	......	......	3.5	41.99	12	......	11.2	13.8	4.62	......	......	......	......

Table IV.—Obsolete Ordnance.

Nature of Ordnance.	Material.	Weight.	Preponderance.	Natural angle of sight.	Lengths: Of bore, exclusive of chamber.	Lengths: Of chamber.	Distances: From rear base-ring to muzzle.	Distances: From axis of trunnions to face of muzzle.	Distances: Between rim-bases.	Diameters: Maximum.	Diameters: At swell of muzzle.	Diameters: Of trunnions.	Diameters: Chamber: Maximum.	Diameters: Chamber: Minimum.	Windage.
SEA-COAST PIECES.															
Guns.		*Lbs.*	*Lbs.*	° ″	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
10-inch smooth-bore columbiad, model 1844....	Cast-iron.	15,400	740	1 21	99	12	120	73.5	31	32	21.5	10	8	....	0.13
8-inch smooth-bore columbiad, model 1844.....	do....	9,240	635	1 23	100	11	119	73.5	25	26	17	8	6.4	....	0.13
7 inch smooth-bore 42-pounder, model 1841....	do....	8,465	600	....	110	....	117	70.3	22	24.4	16.8	7	....	....	0.16
6.4-inch smooth-bore 32-pounder, model 1841..	do....	7,200	695	....	107.6	....	114	68.6	20.7	23.4	15.4	6.4	....	....	0.15
Howitzers.															
10-inch smooth-bore, model 1841....................	Cast-iron.	9,500	475	....	96	9.5	112	67	25	26.5	20.25	8	7	....	0.13
8-inch smooth-bore, model 1841.....................	do....	5,740	462	....	85.5	7.5	98	57.4	20.7	22.2	16.5	6.4	6.4	....	0.12
Mortars.															
13-inch smooth-bore, model 1841....................	Cast-iron.	11,500	....	....	26	13	....	47		36	35.5	12	9.5	7.25	0.13
10-inch smooth-bore, model 1841....................	do....	5,775	....	....	25	10	....	41.5	27.5	27.5	27.5	9	7.15	5.64	0.13
SIEGE PIECES.															
Guns.															
5.82-inch smooth-bore 24-pounder, model 1839.,	Cast-iron.	5,790	395	1 30	108	....	114	68.09	18	21.4	15.586	5.82	....	....	0.14
5.3-inch smooth-bore 18-pounder, model 1829...	do....	4,913	305	1 30	108.5	....	114	67.85	16.8	19.75	13.87	5.3	....	....	0.13
4.62-inch smooth-bore 12-pounder, model 1829.	do....	3,590	270	1 30	103.4	....	108	63.69	14.8	17.4	11.864	4.62	....	....	0.10
Howitzers.															
8-inch smooth-bore, model 1841.....................	Cast-iron.	2,614	420	1 00	38.5	8	52	25.09	18	18.25	16.45	5.82	4.62	....	0.12
Mortars.															
10-inch smooth-bore, model 1841....................	Cast-iron.	1,852	....	....	15	5	....	24	20.5	20.75	20.75	8	7.6	5	0.13
8-inch smooth-bore, model 1841.....................	do....	930	....	....	12	4	....	19.5	16.25	16.5	16.5	6	6.08	4	0.12
FIELD PIECES.															
Guns.															
4.62-inch smooth-bore, 12-pounder, model 1841.	Brass....	1,757	108	1 00	74	....	78	44.99	12	13	10.34	4.62	....	....	0.10
3.67-inch smooth-bore 6-pounder, model 1841..	do....	884	47	1 00	57.5	....	60	34.91	9.5	10.3	8.25	3.67	....	....	0.09
Howitzers.															
5.82-inch smooth-bore 24-pounder, model 1844.	Brass....	1,318	146	1 00	56.25	4.75	65	35.4	11.5	12	9.75	4.2	4.62	....	0.14
4.62-inch smooth-bore 12-pounder, model 1841.	do....	788	95	1 00	46.25	4.25	53	27.91	9.5	10	8.2	3.67	3.67	....	0.10

The following Tables show the comparative power of American and European heavy rifled ordnance.

Kind of gun.	Caliber.	Weight of guns.	Length of bore.	Charge of powder.	Weight of shot.	Muzzle velocity.	Pressure per □″ of bore.	Energy per inch of shot's circumference at— Muzzle.	1,000 yds.	2,000 yds.	3,000 yds.	4,000 yds.
	Inches.	*Tons.*	*Inches.*	*Pounds*	*Pounds.*	*Feet.*	*Pounds.*	*Ft. tons.*	*Ft.-tons.*	*Ft.-tons.*	*Ft.-tons.*	*Ft.-tons.*
Armstrong breech-loader	12	38.89	264	179.6	697.5	1,614	41,587					
English muzzle-loader (wrought-iron, steel tube)	12	35	162.5	110	700	1,300	52,861	217.7	184	157.5	136.4	124.9
Krupp breech-loader (steel)	12	35.30	227.167	110	664	1,329	29,106	215.8	180	152.6	130.9	113.6
Italian breech-loader (cast-iron, steel-hooped)	12.6	37	252	110	770	1,220	19,845	200.8	171.4	147.9	130.2	113.4
American muzzle-loader (cast-iron, wrought-iron tube)	12.25	40	227	110	700	1,403	31,750	248.4	205.8	173.2	147.9	127.7
II.—11-INCH RIFLES.												
English muzzle-loader (wrought-iron, steel tube)	11	25	145	85	535	1,315	....	185.7	154.1	130	111.1	96.1
Krupp breech-loader (steel)	11	27	207	88	495	1,410	....	188.7	159.4	131.3	110.1	93.7
French breech-loader (cast-iron, steel-hooped, and tubed)	10.803	21.7	163.7	79.38	476.4	1,378	....	184.9	149.8	123.9	104.1	88.7
American muzzle-loader (cast-iron, wrought-iron tube)	11	23.7	161	85	535	1,359	....	198	163.7	137.4	116.9	100.7
III.—10-INCH RIFLES.												
English muzzle-loader (wrought-iron, steel tube)	10	18	145.5	70	400	1,364	47,040	164.3	132.9	109.7	92.9	78.4
Krupp breech-loader (steel)	10	19.41	169.6	66	374	1,426	....	167.9	132.7	107.5	88.6	74.6
Italian breech-loader (cast-iron, steel-hooped)	9.448	17	157.5	66	330	1,426.8	32,000	157	123.7	99.6	82.4	69.2
French breech-loader (cast-iron, steel-hooped, and tubed)	9.499	13.8	162.55	61.74	317.6	1,427	....	150	117	93.8	76.8	64
American muzzle-loader (cast-iron, wrought-iron tube)	10	18	147.22	70	400	1,381	22,600	168.4	135.6	111.8	93.8	79.7
IV.—8-INCH RIFLES.												
English muzzle-loader (wrought-iron, steel tube)	8	9	118	35	180	1,413	....	99.2	73	56.1	44.5	36
Krupp breech-loader (steel)	8.26	9.7	161.8	37.4	216	1,384	....	110	84.6	66 9	54.1	44.7
French breech-loader (cast-iron, steel-hooped, and tubed)	7.638	7.9	135.39	33.1	165.4	1,486	....	105.6	76.9	58.5	45.9	37.1
American muzzle-loader (cast-iron, wrought-iron tube)	8	7.66	117.25	35	180	1,414	29,423	99.4	73.2	56.2	44.5	36

The following Table exhibits a comparison between United States and European light siege-rifles.

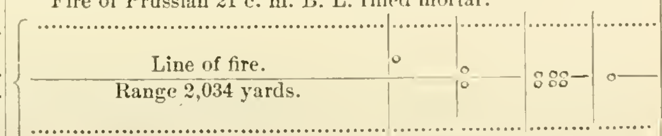
Nature of piece.	Caliber.	Weight.	Nominal exterior length.	Length of bore. Inches.	Length of bore. Caliber.	Nunmber of grooves.	Rifling. Twist. Caliber.	Rifling. Twist. Feet.	Powder. Kind.	Powder. Weight.	Projectiles. Kind.	Projectiles. Length.	Projectiles. Weight.	Ratio of Weight. Of charge to weight of projectile.	Ratio of Weight. Of weight of projectile to weight of piece.	Initial velocity.	Pressure per square inch of bore.	Muzzle energy, foot-tons. Total.	Muzzle energy, foot-tons. Per square inch of shot's cross-section
	Ins.	*Lbs.*	*Ins.*							*Lbs.*		*Cal.*	*Lbs.*			*Feet.*	*Lbs.*		
Woolwich forty-pounder muzzle-loading rifle having steel-tube.	4.75	3,920	114.75	104.5	22	3	Uniform. 35	13.8	W.A.R.L.G.	7	Studs.....	2½	40	1 to 5.7	1 to 98	1,399 1,380	59,480	542.7	30.6
Armstrong forty-pounder breech-loading rifle having the French mechanism.	4.75	2,904	112	104.5	22	27	Increasing to 40	15.8	Pebble.	7¾ 8 8¼	Copper banded.	2½	32.94	1 to 4.25 1 to 4.11 1 to 3.98	1 to 87	1,496 1,542 1,548	17,540	542.9	30.6
Krupp, 12 centimeters, breech-loading rifle.	4.72	3,124	115	102	21.5	18	Increasing to 63	25	Prismatic, 7 holes D. 1. 64. Pebble, 0.5&0.63	7 7.7	Copper banded.	2.8	36.3 38.5	1 to 5.1 1 to 5	1 to 87 1 to 81	1,542 1,542	....	593.3	33.9
United States 4.5 in. muzzle-loading rifle.	4.5	3.570	128	120	26.6	9	Uniform. 40	15	H.D.No.3. H.D.No.4. H.D.No.4.	7 7½ 6 7 7	Absterdam sabot.	2.35	25 25 35	1 to 3.57 1 to 3.33 1 to 4.16 1 to 3.57 1 to 5	1 to 143 1 to 103	1,510 1,545 1,450 1,595 1,420	21,500 36,000 23,000 28,000 31,250	.... 451.1 503.2	.... 31.6

The following table shows the percentage of velocity realized and energy per pound of powder with United States service guns using maximum battering charges.

Nature of piece.	Bore. Diameter.	Bore. Length.	Charge. Nature.	Charge. Weight.	Charge. Weight per cubic inch.	Weight of projectile.	Gas. Total volume in bore.	Velocity. Actual.	Velocity. Calculated.	Velocity. Percentage realized	Energy per pound of powder. Actual.	Energy per pound of powder. Calculated maximum.	Energy per pound of powder. Percentage realized
	Inches.	*Calibers.*		*Lbs.*	*Lbs.*	*Lbs.*		*Feet.*	*Feet.*		*Foot-tons.*	*Foot-tons.*	
12.25-inch rifle	12.25	18.53	Hexagonal..	110	.03862	700	9.393	1,403	1,541	91.18	86.83	104.8	82.85
12-inch rifle, model 1870	12	17.41	......do........	100		600	9.125	1,310	1,579	82.96	71.82	103.8	69.17
10-inch rifle	10	15.85	......do........	80		400	6.009	1,430	1,612	88.71	70.87	90.15	78.61
8-inch rifle	8	14.66	......do........	35	.03818	180	6.434	1,414	1,610	87.83	71.71	92.4	77.6
4.5-inch rifle	4.5	26.67	Cannon.......	7	.0361	35	9.842	1,420	1,748	81.23	71.88	106.1	67.74
3.5-inch rifle	3.5	18.57	New mortar.	3	.0373	16.75	7.779	1,314	1,596	82.33	66.66	98.9	67.40
3-inch rifle	3	21.66	......do.......	2		10	8.566	1,418	1,718	82.53	69.7	102.4	67.09
20-inch smooth-bore gun	20	10.50	Mammoth ...	200	.0355	10.80	11.71	....	....	....	....	111.6	....
15-inch smooth-bore gun	15	11	Hexagonal...	125	.03818	450	8.906	1,735	2,036	85.21	75.59	103.5	73.03
13-inch smooth-bore gun	13	11.98	Mammoth ...	70	.0355	300	10.481	1,557	1,907	81.64	76.24	108.1	70.52
10-inch smooth-bore gun	10	12	......do.......	25	.034	128	12.893	1,500	1,795	83.56	79.84	114.4	69.90
8-inch smooth-bore gun	8	13.75	......do..	10		65	18.71	1,400	1,671	83.78	88.32	125.78	70.21
12-pounder smooth-bore gun	4.62	13.76	Mortar........	2.5	.0306	12.3	13.043	1,495	1,832	81.59	76.24	114.5	66.58

The following table shows the comparative practice with rifled howitzers and S. B. mortars.

Nature of piece.	Weight in cwts.	Caliber in inches.	Length— Of piece in inches	Length— Of bore in inches	Charge in pounds.	Weight of projectiles.	Bursting charge.	Elevation.	Range, yards.	Deviation in yards. Lateral.	Deviation in yards. In range	Remarks.
English.						*Pounds.*	*Pounds.*	°				
13-inch mortar	100	13	53	39	10	204	11	15	2,930	55	62	This table does not give the results with the service 8-inch R. M. L. howitzer, but only the experimental practice, through the results of which we can compare S. B. mortars and rifled howitzers generally when firing about same charges.
9-inch howitzer	76.2	9	76	54	10	200	7	39	4,742	10	23	
10-inch mortar	52	10	46	35	4.75	95	5.25	45	2,720	100	78	
8-inch howitzer.......	64	8	65.9	48	6	120	5.75	39	4,534	20	57	Fire of Prussian 21 c. m. B. L. rifled mortar.
American.												
13-inch S. B. mortar.	152.85	13.	56.5	35.1	10	216	7	45	3,187	....	....	
					20				4,636	....	....	
10-inch S. B. mortar.	65 17	10	49.25	32.5	7.5	101.67	2	45	3,471	....	....	
					12				4,536	....	....	



I.—Table showing the weights, dimensions, charges, etc., of the most powerful service and experimental guns existing or proposed at the commencement of 1880.

NATURE OF GUN.	Caliber.	Weight.	Total length.	Length of bore.	Twist in number of calibers.	Number of grooves.	Powder-Chamber. Length.	Powder-Chamber. Diameter.	Powder charge. Weight	Powder charge. Nature of powder.	Projectile. Length.	Projectile. Weight.	Projectile. Means of rotation.	Initial velocity.	Muzzle energy. Total.	(Calculated.) Penetration in Iron. At muzzle.	(Calculated.) Penetration in Iron. At 1,000 yards.
	Inch.	Tons.	Feet.	Feet.			Inch.	Inch.	Lbs.		Calibers	Lbs.		Feet.	Ft.-tns.	Inch.	Inch
ENGLISH.																	
Woolwich.																	
M. L. cannon of coiled wrought-iron, lined with tube of cast-steel. Frazier's System..	16.	80.	26.9	21.	Increasing from 0 to 1 in 35.	11	Not enlarged.		370.	W. A.: P², cubes 1½ inch edge.	2.5	1,700	Bronze studs and expanding gas-check.	1,520	27,237	28.62	22.13
	12.5	38.	18.75	16.5			59.6	18.	425.	W. A. exptl.	2.5	1,760		1,584	30,612	32.17	28.08
							59.6	18.	460.	W. A. prismatic.	2.5	1,760		1,626	32,257	33.90	29.19
						9	Not enlarged.		130.	W. A.: P², cubes 1½ inch edge.	2.5	800	Bronze studs.	1,451	11,676	20.10	16.84
B. L. cannon of coiled wrought-iron, lined with tube of cast steel. Proposed model..........	12.	42.	27.75	26.	....	....	40.12	14.	200.		2.5	800	Bronze studs.	1,590	14,023	24.14	19.97
							58 35	15.5	285.	....	2.5	700	Copper bands.	2,002	19,449	36.33	28.21
Elswick.																	
M. L. cannon of coiled wrought-iron, lined with tube of cast-steel. Armstrong's System......	17.72	100.	32.9	30.25	1 in 150 to 1 in 50 at 2".88 from muzzle, remainder uniform.	28	55.12	19.7	463.	Pebble, 1½ inch.	....	2,010	Expanding gas-check.	1,640	37,476	32.11	25.88
M. L. cannon of coiled wrought iron, lined with tube of cast-steel. Armstrong's System.......	8.	11.45	18.21	17.37	From 1 in 85 to 1 in 40.	17	38.3	10.5	85.	Pellet, d. =1.786.	2.5	182	Expanding Gas-check.	1,930	4,700	19.75	13.22
									90.			182		2,030	5,199	21.85	14.35
									95.			182		2,100	5,564	23.39	15.15
M. L. cannon of coiled wrought-iron, lined with tube of cast-steel. Armstrong's System......	6.	3.9	12.	11.5	From 1 in 91 to 1 in 38.	16	22.14	8.08	33.	Pellet, d. =1.820.	2.5	69.9	....do........	1,962	1,863	13.92	7.86
									34.		2.5	69.7	....do........	2,003	1,936	14.47	8.07
GERMAN.	15.75	71.	32.8	28.57	1 in 45.	90	61.5	17.32	440.	Prismatic, d. 1.75 with 1 hole.	2.8	1,709	Copper bands.	1,622	31,168	33.80	29 06
									484.		2.8	1,711	Copper bands.	1,702	34,359	36.26	31.81
	13.976	51	29.13	25.38	1 in 45.	80	42.68	14.37	253.	....do............	2.8	1,155	Copper bands.	1,642	21,587	29.73	24.97
	12.	38.	25.09	22.	1 in 55.	68	37.12	12.24	158.4	Prismatic.	2.8	733	Copper bands.	1,649	13,817	25.81	21.09
Essen. B. L. cannon, steel-hooped. Krupp's System.	12.	36.	25.	18.9	1 in 72.	72	41.8	12.4	132.	Prismatic, 1 inch deep, d. = 175.	2.8	666	Lead coating.	1,501	10,401	19.43	15.87
							41.8	12.4	143.		2.8	664	Lead coating.	1,517	10,593	19.80	16.12
	9.45	17.67	23.41	17.75	1 in 45.	54	50.	11.26	171.6	Prismatic, 1 hole, d. = 1.75.	2.8	353	Copper bands.	1,912	8,946	26.95	20.07
									176.4		2.8	308	Copper bands.	2,086	9,291	27.99	19.49
	5.87	3.8	11.78	12.6	Increasing Final. 1 in 25.	36	28.	6.89	37.4	Prismatic, 7 holes, d. = 175.	2.8	68.9	Copper bands.	2,135	2,177	17.00	9.32
									34.1		3.5	112.2	Copper bands.	1,676	2,184	17.05	12.48
ITALIAN.—Turin.																	
B. L. cannon of cast-iron, hooped with steel. General Rosset's System.................	18.1	87.	28.52	27.5	1 in 60.	60	....	18.6	440.	Prismatic or progressive.	2.6	2,200	....	1,378	28,959	23.77	20·.8
	12.6	38.	22.5	21.	1 in 70.	48	35.66	13.1	132	Dice.	2.7	770	Copper bands.	1,365	9,945	16.85	14.13
									158.	Progressive.				1,492	11,881	20.13	16.63
Elswick.—Navy.																	
M. L. cannon, forged iron, tube of cast-steel. Armstrong's System.......................	17.72	100	32.98	30.5	Increasing from 1 in 250 to 50.	27	64.8	19.75	550.	Progressive.	2.78	2,110	Expanding gas-check.	1,686	41,588	35.63	30.41
	17.	100.	32.98	30.5		27	—	Not enlarged.	375		2.78	2,000		1,542	32,966	30.69	26.63
FRENCH.—Ruelle.																	
B. L. cannon, steel-hooped.....................	18.11	124.	33.39	31.09	....	......	....	... .	575.	Wetteren, 0".6 x0".8.	......	2,645	Copper bands.	1,640	49,316	40.45	35.73
B. L. cannon, cast-iron, hooped and lined with steel....................	12.599	38.	30·	17.	Increasing 1 in 45.	......	....	Not enlarged.	139.		2.5	770	Copper bands.	1,371	10,033	17.00	14.24
RUSSIAN.																	
B. L. cannon, cast-steel, hooped................	12.	39.	20.	17.	....	36	....	12.3	114.	Prismatic.	2.5	650	Lead coating.	1,400	8,764	16.37	13.59
CHINESE GOVERNMENT.																	
Elswick.																	
M. L. cannon of coiled wrought-iron, lined with tube of cast-steel. Armstrong's System......	11.	35.	......	......	....	......	... .	....	235.	Pebble.	....	525	....	1,817	12,295	27.33	20.53
UNITED STATES.																	
M. L. cannon, cast-iron, lined with coiled wrought-iron tube..........................	12.25	40.	21.83	18.74	1 in 70.	21	—	Not enlarged.	115.	Hexagonal, d. = 1.785.	.. ..	700	Expanding gas-check.	1,485	10,701	19.18	15.65
B. L. cannon (proposed model), lined with steel, and coiled wrought-iron tube................	12.	55.	28.3	25.	....	......	57.	15.5	290.	Hexagonal.	3 to 3.5	800		1,886	19,726	36.85	28.83

II.—Table of principal dimensions of European 6-inch rifled howitzers and mortars.

Piece.	Material of piece.	System of mechanism.	Caliber of piece.	Weight.	Length. Nominal exterior.	Length. Of chamber	Length. Of rifling.	Length. Total of bore.	Diameter. Maximum, exterior.	Diameter. At muzzle.	Diameter. Over breech-band.	Diameter. Of trunnions.	Diameter. Of chamber
			Inches.	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
German, 15 c. m. B. L. howitzer (Krupp's System)........	Steel..........	Cylindro-prismatic wedge.........	5.9	2,530	70.87	....	....	62.36	....	....	....	....	....
Russian, 6-inch B. L. mortar.........	Bronze........	Prismatic wedge.	6.0	3,461	53.30	17.	22.97	39.57	17.0	15.0	....	8.75	7.0
Austrian, 17 c. m. B. L. mortar....	Cast-iron.....	Cylindro-prismatic wedge.........	6.57	4,486	67.16	....	31.10	....	....	....	....	....	....
Belgian, 15 c. m. B. L. mortar (proposed)........	Cast-iron.....	French screw.....	5.9	1,320	43.30	11.81	20.05	33.86	13.8	9.84	....	....	....
English 6″ .3 M. L. howitzers.......	Wrought-iron, steel-tubed........	....	6.3	2,010	54.	53.	39.7	45.0	17.25	10.0	....	5.5	....
Krupp, 15 c.m. B. L. mortar........	Steel	Prismatic wedge.	5.9	794	37.4	....	....	29.72	12.59	8.0	....	4.5	6.06

Piece.	Rifling. No. of grooves.	Rifling. Width of grooves.	Rifling. Width of bands.	Rifling. Depth of grooves.	Rifling. Twist.	Preponderance.	Nature of gas check.	Carriage. Nature.	Carriage. Material.	Carriage. Weight.	Carriage. Maximum elevation allowed.
		Inches.	*Inches.*	*Inches.*	*Feet.*	*Pounds.*				*Pounds.*	
German, 15 c. m. B. L. howitzer, (Krupp's System)........	18	0.87	0.17	0.059	9.87	....	Steel ring	Service siege-carriage.	Wrought-iron.	2,574	45°
Russian, 6-inch B. L. mortar.........	24 (parallel.)	0.647	0.13	0.07	20.0	....	A ring of Copper	Top carriage and chassis or director.	Wrought-iron, with wooden director.	2,692	73°
Austrian, 17 c. m. B. L. mortar....	30 (cuneiform.)	0.428	0.326	0.086	33.66	....	....	Wrought-iron, resembling the 8″ mortar carriage.	....	....	....
Belgian 15 c. m. B. L. mortar (proposed)........	....	....	....	....	10 to 13	....	....	....	....	....	....
English, 6″ .3 M. L. howitzers......	20	0.5	0.489	0 1	from 52 to 16	....	....	40-pounder siege.	Wrought-iron.	3,460	35°
Krupp, 15 c. m. B. L. mortar........	18	0.8661	0.1575	0.59	7.375	88	Steel ring	Carriage without chassis.	Wrought-iron.	913	60°

III.—Comparative table of fire of European 6-inch rifled howitzers and mortars.

Piece.	Caliber.	Weight.	Approximate Length.		Twist of Rifling.		Charge.		Projectiles.			
			Of bore.	Of rifling.	Calibers.	Final inclination.	Kind.	Weight.	System.	Length.	Weight loaded.	Bursting charge.
		Tons.	*Calibers.*	*Calibers.*				*Pounds.*		*Calibers.*	*Pounds.*	*Pounds.*
German, 15 c. m. B. L. howitzer (Krupp's System)	5.9	1.1294	10.5	....	20	....	Grs., 0″ .24 to 0″ .40 diameter	5.5	Copper bands....	2.65	66.	....
Russian, 6-inch B. L. mortar.........	6.0	1.5451	6.66	3.83	40	4° 29′	Cannon..........	7.19	Lead coated.......	2½	76.5 81.	5.3 3.3
Austrian, 17 c. m. B. L mortar.....	6.57	2.0027	....	4.7	61	2° 55′	Stein..........	7.39 4.9	Lead coated...... Lead coated.......	2½	84.92 84.92	6.8 6.8
Belgian, 15 c. m. B. L. mortar	5.9	0.5893	5.64	3.34	20 to 26	....	....	1.76	Copper bands....	2½	64.6	....
English, 6″ .3 M. L. howitzer	6.3	0.8973	7.1	6.2	100 to 30	....	R. L. G.	4. 2.	Expanding sabot Expanding sabot	2½	69.3 69.3	7. 7.
Krupp, 15 c. m. B. L. mortar.......	5.9	0.3545	5.04	....	15	....	Grs., 24″ to 39″ D=1.64.........	3.3 1.98	Copper bands....	2¾ 2¾	69.45 69.45	5.14 5.14

Piece.	Ratio of—		Initial velocity.	Elevation.	Pressure per square inch of bore.	Recoil.	Range.	Time of flight.	Mean deviation.		
	Weight of charge to weight of projectile.	Weight of projectile to weight of piece.							Longitudinal.	Lateral.	In direction.
			Feet.		*Pounds.*	*Feet.*	*Yards.*	*Seconds.*	*Yards.*	*Yards.*	
German, 15 c. m. B. L. howitzer (Krupp's System)	1 to 12	1 to 38	979	45°	....	....	6,550	....	97.4	25.3	....
Russian 6-inch B. L. Mortar...........	1 to 11 1 to 11	1 to 45 1 to 52	800	....	....	....		....	....	....	....
Austrian, 17 c. m. B. L. mortar......	....	....	....	45° 70°	....	....	4,339 2,676	....	30.9 31.7	5.79 9.51	....
Belgian, 15 c. m. B. L. mortar.......	1 to 36 1 to 17	1 to 20 1 to 29	620	45° 15°	14,250	....	2,500 3,161	....	....	....	....
English, 6″ .3 M. L. howitzer..........	....	....	....	35°	....	....	2,801	....	....	....	1.32 1.52
Krupp, 15 c. m. B. L. mortar	1 to 21 1 to 35	1 to 11 1 to 11	....	40° 45°	....	....	3,773 2,187	....	18.6 11.26	5.8 6.3	....

The Russian 6″ mortar was employed to test the penetration of mortar shells on an iron-plated deck, 16′×32′, placed at 1,026 yards distance. The angle of fire was 60°. The projectiles fell point foremost, and the results—as regards penetration—were good. Nothing is stated respecting the accuracy of the fire. The Austrian 6″.5 mortar was considered unreliable as to accuracy at the time it was tested. The Belgian 6″ has not been fabricated as yet; the above figures being the details proposed. The English 6″.3 howitzer, as given above, is the latest model, of which a large number have recently been ordered for the siege-train.

IV.—Table of principal dimensions of European 8-inch rifled howitzers and mortars.

Piece.	Material of piece.	System of breech mechanism.	Caliber of piece.	Weight.	Length. Nominal exterior.	Length. Of chamber.	Length. Of rifling.	Length. Total of bore.	Maximum exterior diameter.	Diameter at muzzle	Rifling. No. of grooves.	Rifling. Width of grooves.	Rifling. Width of lands.	Rifling. Depth of grooves.	Rifling. Twist.	Preponderance.
			Inches	*Pounds.*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches.*	*Inches*					*Feet.*	
Prussian, 21, c. m. B. L. mortar.	Bronze	Double prismatic wedge.	8.238	6,655	80.31	17.36	48.70	66.06	21.63	13.38	30	0.5748	0.287	0.1	17.	......
Russian, 8-inch B. L. mortar......	Steel-hooped ..	Cylindro-prismatic wedge.	8.00	7.202	89.98	26.182	44.016	70.198	25.	13.98	30	0.558	0.279	0.09	26.6	0
Austrian, 8 pouces B. L. mortar.	Cast-iron	Cylindro-prismatic wedge.	8.238	10.241	80.89	26.38	33.77	60.15	30.	18.15	30	....	....	....	41.2	......
French, 22 c. m. M. L. howitzer.	Cast-iron, steel-hooped.	....	8.789	8,140	99.50	6.56	86.14	92.60	24.56	15.48	3	2.56	6.844	0.236	....	400
English, 8-inch M. L. howitzer...	Wrought-iron, steel-tubed.	....	8.00	5,164	61.125	12.5	35.50	48.	25.	14.	4	1.5	4.778	0.18	10.6	220
Krupp, 21 c. m. B. L. howitzer.	Steel-hooped...	Cylindro-prismatic wedge.	8.268	6.660	97.05	....	....	80.	21.85	13.	50	0.36024	0.15748	0.059	24.115	0

Piece.	Nature of gas-check.	Carriage. Nature.	Carriage. Material.	Carriage. Weight.	Carriage. Maximum elevation allowed by carriage.
				Pounds.	
Prussian, 21 c. m. B. L. mortar .	Copper ring abutting against a steel bushing.	Is mounted on wheels and connected with a limber for transport. The necessary height of cheek is obtained by wooden trunnion brackets. Rests upon a wooden director or chassis.	Wood	4,457	75°
Russian, 8-inch B. L. mortar	Steel ring..........................	Is mounted on wheels and connected with a limber for transport. Same model as 6-inch mortar carriage, varying only in dimensions.	Wrought-iron .	....	72°
Austrian, 8 pouces B. L. mortar.	Ring of tambac with paste-board bottom.	Is mounted on wheels and connected with a limber for transport	Wrought-iron .	5,140	60°
French, 22 c. m. M. L. howitzer.	....	Old model	Wood	1,650	46°
English, 8-inch M. L. howitzer...	....	Is mounted on wheels and connected with a limber for transport. A bed is proposed mounted on rollers with friction recoil-check, and constructed of wrought-iron. The carriage is similar to that of the 6.3-inch howitzer. (See Treatise on Military Carriages, 1877.)	Wrought-iron .	4,802	40°
Krupp, 21 c. m. B. L. howitzer...	Steel ring..........................	Is mounted on wheels and connected with a limber for transport......... .	Wrought-iron .	4,460	45°

V.—Comparative table of fire of European 8-inch rifled howitzers and mortars.

Piece.	Caliber.	Weight.	Length.		Twist of rifling.		Charge.		Projectile.			
			Of bore.	Of rifling.	Calibers.	Final inclination.	Kind.	Weight.	System.	Length.	Weight loaded.	Bursting charge.
	Inches.	*Tons.*	*Calibers.*	*Calibers.*				*Pounds.*		*Calibers.*	*Pounds.*	*Pounds.*
Prussian, 21 c. m. B. L. mortar	8.238	2.9710	8.01	5.78	25	7	Ordinary cannon	7.7	Lead coated	2.5	176.0	11.0
Russian, 8-inch B. L. mortar	8.00	3.2174	8.76	5.50	40	....	Large grain	11.6	Lead coated	2.5	175.83	6.08
Austrian, 8 pouces B. L. mortar	8.238	4.5719	7.30	4.08	60	3° 1′ 16″	Ordinary cannon	12.32	Lead coated	2.5	191.4	8.8
French 22 c. m. M. L. howitzer	8.789	3.6339	10.53	9.80	....	0° to 6°	Powder, Ripault	13.2	Studs	2.25	175.56	8.8
English, 8-inch M. L. howitzer	8.00	2.3053	6.00	4.438	16	11° 6′ 31″	R. L G.	10.0	Studs	3.	180.0	14.52
Krupp, 21 c. m. B. L.	8.268	3.	9.6	....	35	....	Prismatic, 7 holes. D=1.64	16.	Copper bands.	2.8	200.	10.5
							Large grains. Grs., 0″.24 to 0″.39 D=1.64.	6.6	....	2.8	200.	10.5

Piece.	Ratio of Weight of charge to weight of projectile.	Ratio of Weight of pr'jectile to weight of piece.	Initial velocity.	Elevation.	Pressure per square inch of bore.	Recoil.	Range.	Time of flight.	Deviation.			Remarks.
									Lateral.	Longitudinal.	Derivation.	
			Feet.			*Ft.*	*Yards*	*Seconds.*	*Yards.*	*Yards.*	*Yards.*	
Prussian, 21 c. m. B. L. mortar	1 to 23	1 to 38	704	45°	....	....	4,370	....	9.6	16.3	320.6	Shell 3 cals. long tumbled, and of 2¾ cals. balloted. Larger charges than 7.7 lbs. proved too heavy for the piece. With 15 lbs. prismatic powder the firing was wild.—"Revue D'Art.," July, 1877.
Russian, 8-inch B. L. mortar	1 to 15	1 to 41	751	....	10.657	....	....	....	....	....	....	
Austrian, 8 pouces B. L. mortar	1 to 13	1 to 53	....	45°	....	....	4,940	....	3.83	54.6	142.	This piece, after 1.144 rounds, showed but little diminution of accuracy.—"Revue D'Art.," July, 1877.
French, 22 c. m. M. L. howitzer	1 to 13	1 to 46	843	40°	....	....	5,707	32.1	15.6	86.	174.	
English, 8-inch M. L. howitzer	1 to 18	1 to 29	....	40° 05′	....	....	4,931	30.1	9.6	33.7	265.	
Krupp, 21 c. m. B. L.	{1 to 12.5	1 to 33.3	....	....	....	....	....	....	....	....	....	
	{1 to 30.3	1 to 33.3	....	8° 30′	....	....	2,200	....	2.48	28.76	....	

The French howitzer and the Austrian mortar of 8 pouces permit of the attainment of the greatest ranges, but their weights are very considerable; the Austrian mortar, particularly, appears to have an excessive weight relatively to the effects attainable with it. It is possible by the system of banding to reduce this weight say, at least 1,760 pounds, to give the piece a greater length of bore, which would permit the use of larger charges and of a more progressive powder, by means of which ranges of 5,460 yards should be obtained. The French howitzer has above all a notable inferiority in point of accuracy of range. In the Russian 8-inch mortar, with 17 pounds prismatic powder, the pressure was 17,800 pounds, while in their 8 inch gun (light) with same charge, the pressure was only 15,560 pounds per square inch. The Prussian mortar (so far as we are able to judge from the limited information at our disposal) has a sensible superiority over the Austrian mortar in point of accuracy of range; but in accuracy of direction on the centers the Austrian mortar is very much superior to the Prussian. This latter fact would tend to prove that the Prussians, notwithstanding the improvements made in their shell, have not yet succeeded in giving to it as great a stability in flight as is possessed by the Austrian shell. In respect to this, however, it should be observed that the inclination of the rifling in the Prussian mortar is 7°, while in the Austrian mortar the inclination is only 3°. It is generally admitted in France that the inclination of the rifling for large pieces should but little exceed 4°. As the French 22 c. m. howitzer, on the whole, compares unfavorably with those of other countries, a new model has been prepared, of which the following are principal features: Caliber. 21 c. m.; material, cast-iron, steel-hooped, or bronze; weight, 7,700 pounds; length of rifling, 5 calibers; number of grooves 24; twist, one turn in 30 calibers; system of breech mechanism, cylindro-prismatic wedge; projectile, copper banded; weight, 176 pounds; weight of bursting charge, 11 pounds; gas-check, copper or brass ring; carriage, of plate-iron; kind of powder, medium-sized grain, giving about 5,500 pounds pressure. Weight of carriage, 5,500 pounds. The French are now experimenting with a new rifled howitzer, the details of construction of which are not definitely known; the material is said to be steel.

VI.—Table of principal dimensions of European 10 and 11-inch rifled howitzers and mortars.

Piece.	Material of piece.	System of breech mechanism.	Caliber of piece.	Weight.	Length. Nominal exterior	Length. Of chamber.	Length. Of rifling.	Length. Total of bore.	Diameter. Maximum exterior.	Diameter. At muzzle.	Diameter. Over breech-band	Diameter. Of trunnions.	Diameter. Of chamber.
			Inches	*Pounds.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches*	*Inches*
Krupp, 28 c. m. B. L. howitzer	Steel, hooped.	Cylindro-prismatic wedge.	11.023	22,000	125.98	31.295	67.716	99.012	35.43	18.50	39.37	12.0	11.41
			11.023	....	....	15.5	....	99.012	....	....	....	....	11.26
Russian, 11-inch B. L. mortar	Steel, hooped.	Cylindro-prismatic wedge.	11.00	....	128.20	36.00	64.20	100.20	36.00	19.60	39.20	12.0	13.39
English, 10-inch M.L. howitzer, (experimental)	Wrought-iron, steel-tubed.	....	10.00	13,410	77.50	10.00	50.00	60.00	34.50	18.25	....	10.00	....

Piece.	Rifling. Number of grooves.	Rifling. Width of grooves.	Rifling. Width of lands.	Rifling. Depth of grooves.	Rifling. Twist.	Preponderance.	Nature of gas-check.	Carriage. Nature.	Carriage. Material.	Carriage. Weight.	Carriage. Maximum elevation allowed.
		Inches.	*Inches.*	*Inches.*	*Feet.*	*Pounds.*				*Pounds.*	
Krupp, 28 c. m. B. L. howitzer	72 (parallel) 64	0.303	0.177	0.137	36.736 (uniform)	....	Steel ring.	Top-carriage and chassis, hydraulic buffer.	Wrought-iron.	20,284	75°
Russian, 11-inch B. L. mortar	36 (cuneiform)	0.64	0.32	0.135	....	....	Steel ring.	Top-carriage and chassis, hydraulic buffer.	Wrought-iron.	....	....
English, 10-inch M. L. howitzer (experimental)	7	1.50	2.988	0.2	10.66	....	....	Top-carriage and chassis, hydraulic buffer.	Wrought-iron.	18,900	40°

VII.—Comparative table of fire of European 10 and 11-inch rifled howitzers and mortars.

Piece.	Caliber.	Weight.	Approximate length. Of bore.	Approximate length. Of rifling.	Twist of rifling. Calibers.	Twist of rifling. Final inclination.	Charge. Kind.	Charge. Weight.	Projectile. System.	Projectile. Length.	Projectile. Weight loaded.	Projectile. Bursting charge.	Ratio of— Weight of charge to weight of projectile.
	Inches.	*Tons.*	*Caliber*	*Caliber.*				*Pounds.*		*Caliber.*	*Pounds.*	*Pounds.*	
Krupp, 28 c. m. B. L. howitzer.	11.023	9.82	9.	6.	40	....	Prismatic d = 1.62 to 1.66, 7 holes.	44.	Lead coated....	2½	437	25	1 to 10
Russian, 11-inch B. L. mortar...	{11.023 {11.	10	9. 9.	.... 5.83	35 } ....}	....	....	41.8	Copper bands..	....	....	....	....
English, 10-inch M. L. Howizer..	10.	6	6.	5.	13	....	R.L.G.	20.	Studs............	3	360	24	1 to 18

Piece	Ratio of Weight of projectile to weight of piece.	Initial velocity.	Elevation.	Pressure per square inch of bore.	Recoil.	Range.	Time of flight.	Rectangle containing all the shots. Length.	Rectangle containing all the shots. Width.	Mean difference in— Range.	Mean difference in— Deflection.	Mean reduced deflection.	Derivation.
		Feet.			*Feet.*	*Yards.*	*Seconds.*	*Yards.*	*Yards.*	*Yards.*	*Yards.*	*Yards.*	*Yards.*
Krupp, 28 c. m. B. L. howitzer..	1 to 50	1,030 }	5°30' 22°30' 60°	....	....	2,115 6,349 6,864	....	56. 47. 120.	22. 15. 38.	....	....	....	....
Russian 11-inch B. L. mortar.....	....	{1,016 } {1,050 }	45°	....	....	....	....	145.4	23.5	....	....	....	....
English 10-inch M. L. howitzer..	1 to 37	....	40°06'	....	....	4,816	....	....	....	68.5	350.2	10.26	....

ORDNANCE AND ORDNANCE STORES.—The general denomination "Ordnance and Ordance Stores" comprehends all cannon and artillery carriages and equipments; all apparatus and machines for the service and maneuver of artillery; all small-arms, accouterments and horse equipments; all ammunition and all tools, machinery, and materials for the Ordnance service; and all horse equipments and harness for the artillery; and, in general, all property of whatever nature supplied to the military establishment by the Ordnance Department.

It is a duty of the Chief of Ordnance to furnish estimates, and, under the direction of the Secretary of War, to make contracts and purchases, for procuring the necessary supplies of Ordnance and Ordnance Stores; to direct the inspection and proving of the same, and to direct the construction of all cannon and carriages, ammunition-wagons, traveling forges, artificers' wagons, and of every implement and apparatus for ordnance, and the preparation of all kinds of ammunition and Ordnance Stores constructed or prepared for the service.

ORDNANCE BOARD. In the United States Army, a Board composed of such officers of the Ordnance Department as the Secretary of War may designate, and which is advisory to the Chief of Ordnance and is charged with the investigation of such subjects and the performance of such duties, and at such times and places as the Chief of Ordnance may direct. No changes are made in the established models or patterns of Ordnance and Ordnance Stores for the service of the United States except on the recommendation of the Ordnance Board, approved by the Secretary of War. See *Board of Ordnance*.

ORDNANCE DEPARTMENT.—In the United States Service, the Ordnance Department of the Army consists of one Chief of Ordnance, with the rank of Brigadier-General, three Colonels, four Lieutenant-colonels, ten Majors, twenty Captains, sixteen First Lieutenants, ten Second Lieutenants, and thirteen Ordnance Store-keepers. The Ordnance Store-keeper at Springfield Armory has the rank of Major of Cavalry. All other Ordnance Store-keepers have the rank of Captain of Cavalry. No Officer of the Army is commissioned as an Ordnance Officer until he shall have been examined and approved by a Board of not less than three Ordnance Officers, senior to him in rank. If an Officer of the Army fail on such examination he is suspended from appointment for one year, when he may be re-examined before a like Board. In case of failure on such re-examination he can not be commissioned as an Ordnance Officer. Any number, not exceeding six, of the Ordnance Store-keepers may be authorized to act as Paymasters at armories and arsenals. The Ordnance Department was first established in the United States in 1812. It was not provided for in the reduction of the army in 1815, but continued in the service. In 1821, the Department was merged into the Artillery, attaching to each regiment of Artillery one supernumerary Captain, and giving to each Company four subaltern officers. The Ordnance Corps was re-established April 5, 1832.

In the British service, the Ordnance Department was abolished by an Order in Council of May 25, 1855, after an existence of at least 400 years. Its constitution, its important functions, and the causes which led to its dissolution, will be found under Board of Ordnance. The early history of the Department is lost in the Middle Ages; but it appears to have risen gradually under the Lancastrian kings. A Master of the Ordnance is mentioned in the time of Richard III.; but we read of John Louth being Clerk of the Ordnance as early as 1418. Henry VII. constituted the Board, adding a Lieutenant, a Surveyor, and a Store-keeper, to whom a Clerk of the Cheque, was subsequently joined. With the exception of the last, whose office was abolished in the beginning of the present century, this organization was maintained until the abolition of the whole. In 1604 James I. dignified the Master and Lieutenant with the respective titles of Master-General and Lieutenant-General. The history of the Ordnance Office is of importance in British history, as in all wars it has been responsible not only for the management of the *matériel* of the armies, but also for the direction of the *personnel* of the artillery and engineers. By an Order in Council of June 23, 1870, the Department of Ordnance in a very modified form was revived under the Surveyor-General of the Ordnance, as a section of the War Office, responsible for all supplies and *matériel* of War. See *Board of Ordnance*.

ORDNANCE OFFICE.—Before the invention of guns, this office was supplied by officers under the following names: the Bowyer, the Cross-Bowyer, the Galeater, or Purveyor of Helmets, the Armorer, and the Keeper of the Tents. Henry VIII. placed it under the management of a Master-General, a Lieutenant, Surveyor, etc. The Master-General was chosen from among the first Generals in the service of the Sovereign. The appointment was formerly for life; but since the restoration, was held *durante bene placito*, and not unfrequently by a Cabinet Minister. The letters patent for this office were revoked May 25, 1855, and its duties vested in the Minister of War. The last Master-General was Lord Fitzroy Somerset, afterwards Lord Raglan.

ORDNANCE PROJECTILE.—A projectile having a cast-iron body, with a sabot composed of an alloy of lead and tin, which is cast on the base of the projectile, and held in position by undercuts and dovetails; the action of the charge being to force the sabot on the cast-iron body and to make it take the grooves.

ORDNANCE SELECT COMMITTEE.—A Committee composed of scientific officers, to advise the Secretary of State for War on all inventions in war *matériel*. It had its officers at Woolwich, in the midst of the manufactories of the Royal Arsenal, and near the head-quarters of the Royal Artillery, by whom most of the designs had to be practically tested. The President of the Committee was usually a General Officer of Artillery; and a Captain in the Royal Navy served as Vice-President. Since 1870 these functions have been fulfilled by officers of the Department of the Director of Artillery and Stores, who has his head-quarters at the War office.

ORDNANCE SERGEANTS. — Non-commissioned Staff Officers appointed, by the Secretary of War, from Sergeants who have faithfully served eight years in the Line, four of which shall have been in the grade of Non-commissioned Officers. Sergeants receiving these appointments are dropped from the rolls of the regiment or company in which they have been serving. Captains report to their Colonels such Sergeants as, by their conduct and service, merit appointments as Ordnance Sergeants, setting forth the description and length of service of the Sergeant; the portion of his service he was a Non-commissioned Officer; his general character as to fidelity and sobriety; his qualifications as a clerk, and his fitness for the duties of the position for which he is recommended.

The duties of Ordnance Sergeants relate to the care of the ordnance, arms, ammunition, and other military stores at the post, under the direction of the Commanding Officer. Should the post be evacuated, he remains at the station, under the direction of the Chief of Ordnance, in charge of Ordnance and Ordnance Stores, and of such other public property as is not in charge of some Officer or agent of other Departments; and for this property he accounts to the Chief of the Department to which it belongs. If in charge of stores at a post where there is no Commissioned Officer, he is responsible for the safe keeping of the property, and is governed by the Regulations of the Ordnance Department in issuing and accounting for the same. If the means at his disposal be insufficient for the preservation of such property, he reports the circumstances to the Chief of Ordnance.

ORDNANCE STORE-KEEPER.—An Officer of the Ordnance Department who holds the rank of Captain of Cavalry, excepting the Ordnance Store-keeper at Springfield Armory who, by law, has the rank of Major of Cavalry. There are, at present, five Ordnance Store-keepers in the service; but the grade has been abolished by a recent Act of Congress, and henceforth the duties appertaining to the office will be performed by other officers of the Ordnance Department.

In the British service, the Ordnance Store-keeper is a civil officer in the Artillery who has charge of all the stores, for which he is accountable to the Ordnance Office. See *Ordnance Department.*

ORDNANCE SURVEY.—By this term is understood the various operations undertaken by the Ordnance Department of the British government for preparing maps and plans of the whole kingdom and its parts. The idea of a general map of the country to be executed by the government was first proposed after the Rebellion in 1745, when the want of any reliable map of the northern parts of Scotland was much felt by the officers in command of the Royal troops. A drawing, on a scale of one inch and three-fourths to the mile, was completed in 1755; but in consequence of the war which broke out in that year, was never published. In 1763 it was proposed to extend the survey to the whole kingdom; but the first steps to effect this were taken only in 1784, when Major-General Roy commenced measuring a base-line on Hounslow Heath, near London, This principal triangulation was designed partly for astronomical purposes, and partly as a basis for a map on a small scale. The base-line was remeasured with great care in 1791; and detailed plans were commenced by officers of the Royal Engineers, partly for practicing them in military drawing, and partly for the purpose of forming plans of some portions of Kent for the use of the Ordnance. The principal object was, however, the instruction of a Corps of Military Surveyors and Draughtsmen, the plans themselves being regarded as of secondary importance. In 1794 the survey for the one-inch map was begun, and some sheets were published in 1796. As the series of principal triangles were extended westward towards the Land's End, it was thought right to measure another base, for fortification, on Salisbury plain in 1704; and two other base-lines were subsequently measured—one in 1801 at Misterton Carr, and the other in 1806 on Ruddlan Marsh. Though first intended chiefly as a military map, the publication of the survey soon created a desire on the part of the public for better maps, and surveyors were then hired to hasten its progress. This, however, was very slow, the map being at one time entirely suspended during the war in the beginning of this century, and even the parts which were executed, having been done by contract, were found very inaccurate. In this condition the survey of England continued during the first quarter of the present century, sometimes delayed by the government from motives of economy, at other times urged on by the county gentlemen, who wished the map either as a hunting-map or for local improvements.

In Scotland, the principal triangulation was begun in 1809, but was discontinued in the following year, to enable the persons who had been employed there to carry forward the subordinate triangulation required for constructing the detail maps in England. In 1813 it was resumed, and continued steadily up to 1819; a new base line having been measured on Belhelvie Links, near Aberdeen, in 1817, and the great sector used at various stations, both on the mainland and in the islands. It 1820 it was again suspended, was resumed in 1821 anp 1822, and anew broken off in 1823, the large theodolite being wanted in order to proceed with the principal triangulation in South Britain. In 1824 the survey of Ireland was begun, and nothing more was done in Scotland till 1838, except that some detail surveying for a one-inch map was continued for a few years in the southern Counties. The chief strength of the surveying corps was now transferred to Ireland. A map of that country was required for the purpose of making a valuation which should form the basis of certain fiscal arrangements and other improvements which the social evils and anomalies of Ireland urgently demanded. For this map a scale of 6 inches to the mile was adoped, as best suited for the purposes in view. On this scale the whole map was completed, and published in 1845, though the first portions were in an imperfect form, and needed revision which was proceeded with in 1873.

This great national undertaking has been conducted at different times on different scales and plans, and the system now pursued was only adopted after much discussion both in Parliament and out of doors. The map was originally begun as a military map, and the scale of one inch to the mile chosen, without considering whether some other scale would not offer greater advantages. Many now think that a scale a little larger, and an aliquot part of nature such as 1-50,000, or about $1\frac{1}{4}$ inch to the mile, would have been preferable for the small map; in which case a scale of 1-10,000 of nature, or about $6\frac{1}{3}$ inches, might have been chosen for the intermediate, instead of the six-inch scale selected at first for mere local purposes in Ireland. Be this as it may, the arguments in favor of the one-inch map are that it is the most convenient both as a general and traveling map. For general views of the structure of the country, the distribution and relations of its mountains, plains, valleys, and rivers, the one-inch is admitted to be superior to the six-inch, and thus better adapted in the first instance for laying roads, railways, or other extensive public works, or for the publication of a general geological survey. Such a map, on the other hand, is on too small a scale to admit of correct measurement of small distances; it is in some respects a generalized picture, and not a correct plan. The six-inch maps were at first selected in Ireland as the smallest size on which correct measurements of distances and areas could be made. On them every house and field, and almost every tree and bush might be laid down. Hence they are superior for working out details, as in minute surveys of railways and roads, or the complex geological structure of rich mineral districts. On such sheets, too, a proprietor or farmer may find every field laid down, and the relative heights indicated by contour lines, and may therefore use them for drainage and other improvements. It has also been proposed to use these six-inch maps as a record of sales or encumbrances of land, thus lessening the cost and simplifying the transfer of property. On the other hand, their size unfits them for most of the purposes for which the one-inch map is useful, and the contour lines give a far less vivid and correct impression of the physical features of a country than the hill sketching of the one-inch map. Most of the purposes of the six-inch plans are attained in a still more perfect manner from the 25-inch plans or cadastral survey. The last name is taken from the French *cadastre* (a register of lands), and is defined as a plan from which the area of land may be computed, and from which its revenue may be valued. The purposes to which these large plans may be applied are, as estate plans, for managing, draining, and othewise improving land, for faciliating its transfer by registering sales or encumbrances; and as public maps according to which local or general taxes may be raised, roads, railways, canals, and other public works, laid out and executed.

Nearly all the States of Europe have produced trigonometrical surveys, many of them of great excellence as scientific works. All of these have been published, or are in course of publication, on convenient scales; generally smaller than one inch to a statute mile.

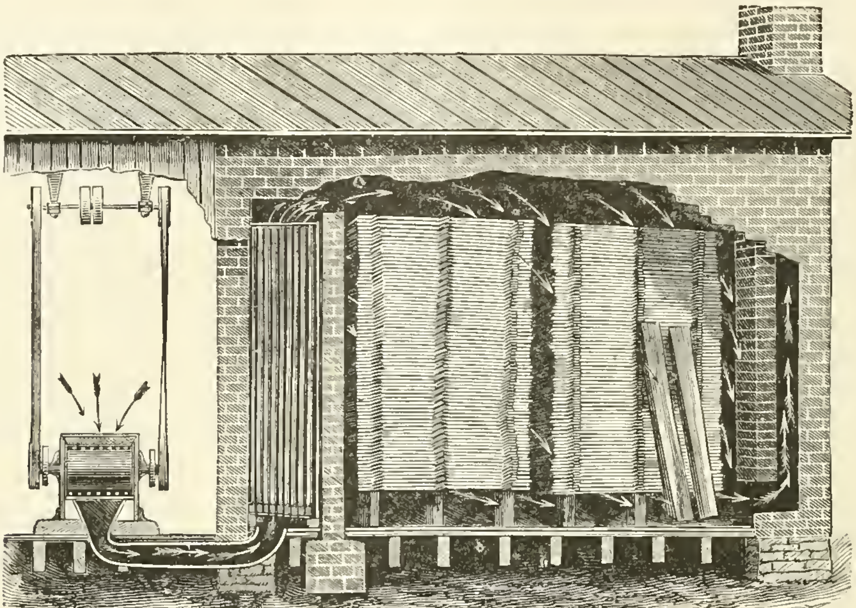
The greatest extra European work of this kind is the Trigonometrical Survey of India, which was begun over seventy years ago, and has been conducted with great ability. The work is drawing to a close, but will still occupy several years. The maps are published on a scale of $\frac{1}{250000}$ or $\frac{1}{4}$ of an inch to the mile. In America, the Coast Survey of the United States, a map of great accuracy and minute detail, has been going on for many years. The general charts are published on a scale of $\frac{1}{80000}$ or $\frac{4}{5}$ of an inch to a mile; the harbors and ports $\frac{1}{20000}$ or $3\frac{1}{5}$ of an inch to a mile. No systematic survey has yet been undertaken for the interior of the country.

ORDNANCE TIMBER.—Timber and wrought iron are the principal materials used in the construction of artillery carriages and machines. Timber for the arsenal is usually purchased in pieces of the size required to make each part. A list of the pieces for a certain kind of carriage, including the contents of each piece, in board-measure, is called a *bill of timber*. None but the best wrought iron should be employed in ordnance constructions. Large and peculiar-shaped pieces, as *axle-trees*, *trunnion-plates*, etc., as well as those requiring great strength, are made from *hammered shapes*, furnished by the iron manufacturer, according to prescribed patterns; other parts are made of rolled iron. The following varieties of timber are briefly noticed as being most frequently required in the various ordnance constructions: *White oak*—The bark of white oak is white, the leaf long, narrow, and deeply indented; the wood is of a straw-color, with a somewhat reddish tinge, tough, and pliable. It is the principal timber used for ordnance purposes, being employed for all kinds of artillery-carriages. *Beech*—The white and red beeches are used for fuzes, mallets, plane-stocks, and other tools. *Ash*—White ash is straight-grained, tough, and elastic, and is therefore suitable for light carriage-shafts; in artillery, it is chiefly used for sponge and rammer staves, sometimes for handspikes, and for sabots and tool-handles. *Elm*—Elm is used for felloes and for small naves. *Hickory*—Hickory is very tough and flexible; the most suitable wood for handspikes, tool-handles, and wooden axle-trees. *Black walnut.*—Black walnut is hard and fine-grained; it is sometimes used for naves, and the sides and ends of ammunition-chests; it is exclusively used for stocks of small arms. *Poplar*—White poplar, or tulip -wood, is a soft, light, fine-grained wood, which grows to a great size; it is used for sabots, cartridge-blocks, etc., and for the lining of ammunition-chests. *Pine.* White pine is used for arm-chests and packing-boxes generally, and for building purposes. *Cypress*—Cypress is a soft, light, straight-grained wood which grows to a very large size. On account of the difficulty of procuring oak wood of a suitable kind in the Southern States, cypress has been used for sea-coast and garrison carriages. It resists better than oak the alternate action of the heat and moisture to which sea-coast carriages are particularly exposed in casemates; but being of inferior strength, a larger scantling of cypress than oak is required for the same purpose; and on account of its softness, it does not resist sufficiently the friction and shocks to which such carriages are liable. *Basswood.*—Basswood is very light, not easily split, and is an excellent material for sabots and cartridge-blocks. *Dogwood.*—Dogwood is hard and fine-grained, suitable for mallets, drifts, etc.

The principal circumstances which affect the quality of growing trees are *soil*, *climate*, and *aspect*. In a moist soil, timber grows to a larger size, but is less firm and decays sooner, than in a dry, sandy soil; the best is that which grows in a dark soil, mixed with stones and gravel; this remark does not apply to the poplar, willow, cypress, and other light woods which grow best in wet situations. In the United States the climate in the Northern and Middle States is most favorable to the growth of timber used for ordnance purposes, except the cypress. Trees growing in the center of a forest, or on a plain, are generally straighter and freer from limbs than those growing on the edge of a forest, in open ground, or on the sides of hills, but the former are, at the same time, less hard. The aspect most sheltered from prevalent winds is generally most favorable to the growth of timber. The vicinity of salt water is favorable to the strength and hardness of white oak. The selection of timber trees should be made before the fall of the leaf. A healthy tree is indicated by the top branches being vigorous and well covered with leaves; the bark is clear and smooth, and of uniform color. If the top has a regular, rounded form; if the bark is dull, scabby, and covered with white and red spots, caused by running water or sap, the tree is unsound. The decay of the topmost branches, and the separation of the bark from the wood, are infallible signs of the decline of the tree.

The most suitable season for felling timber is that in which vegetation is at rest, which is the case in midwinter and midsummer. Recent experiments incline to give preference to the latter season, say the month of July; but the usual practice is to fell trees for timber between the first of December and the middle of March. The tree should be allowed to attain full maturity before being felled; this period, in oak timber, is generally at the age of seventy-five to one hundred years, or upward, according to circumstances. The age of the hard wood is determined by the number of rings which may be counted in a section of a tree. The tree should be cut as near the ground as possible, the lower part being the best timber; the quality of the wood is, in some degree indicated by the color, which should be nearly uniform in the heart-wood, a little deeper toward the center, and without any sudden transitions. Felled timber should, as a rule, be immediately stripped of its bark, and raised from the ground, The white wood next to the bark, which very soon rots, should never be used, except that of hickory. There are sometimes found rings of light-colored wood surrounded by good hard wood; this may be called the *second sap*; it should cause the rejection of the tree in which it occurs. *Brashwood* is a defect generally consequent on the decline of the tree from age; the pores of the wood are open, the wood is reddish-colored, it breaks short, without splinters, and the chips crumble to pieces. This wood is entirely unfit for artillery carriages. Wood which died before felling should, generally, be rejected; so should *knotty trees*, and those which are covered with tubercles and excrescences. Wood in which the grain ascends in a spiral form is unfit for use in large scantlings; but if the defect is not very decided, the wood may be used for naves and for some light pieces. Splits, checks and cracks extending toward the center, if deep and strongly marked, make wood unfit for use, unless it is intended to be split. *Wind-shakes* are cracks separating the concentric layers of wood from each other: if the shake extends through the entire circle, it is a serious defect. The *center-heart* is also to be rejected, except in timber of very large size, which cannot, generally, be procured free from it. As soon as practicable, after the tree is felled, the sapwood should be taken off, and the timber reduced, either by sawing or splitting, nearly to the dimensions required for use. Pieces of thickness, or of peculiar form, such as those for the bodies of gun-carriages and for chassis, are got out with a saw; smaller pieces, as spokes, are split with wedges. Naves should be cut to the right length, and bored out, to facilitate seasoning and to prevent cracking. Timber of large dimensions is improved by *immersion in water* for some weeks, according to size, after which it is less subject to warp and crack in seasoning. To season or dry timber, it should be piled under shelter, in such manner as to allow a free circulation, but not a strong current of air, around each piece. The piles should be taken down and put up again at intervals, varying with the length of time the timber has been cut. The seasoning of timber requires from two to eight years, according to size. Oak timber loses a little more than *one-fifth of its weight* in seasoning, and about one-third of its weight in becoming perfectly dry.

From the fact that certain blowers are used with equal facility either for forcing or exhausting air, or producing a continuous current, which can be reversed at will by simply changing the motion of the blower without any other alteration whatever, they are peculiarly adapted to drying lumber. It is owing to the fact that air has the capacity to take up moisture and hold it in solution, that the process called drying is possible. The water thus taken up is, in this



condition, invisible. At a low temperature, this capacity is very small; at 32° Fahrenheit, a cubic foot of air will only hold in solution two grains of water. This capacity is rapidly increased as the temperature is elevated, in the ratio of about three grains per foot for every ten degrees of heat; so that at 200° Fahrenheit, a cubic foot of air would take up about fifty grains of water. For rapid drying, therefore, it is necessary to have an elevated temperature. But at any temperature, the air can be saturated with moisture, that is so loaded that it can hold no more, even though it be very hot. Hence it is necessary for rapid drying, not only to have heated air, but also to have a constant change, so that as fast as the air becomes saturated with moisture, it may pass off, carrying its load with it, and a fresh supply presented that may, in its turn, carry off its quantum. In simple language, this is the process of drying. The drawing shows Root's Blower as arranged for seasoning timber or lumber. A notice of the drawing will explain the operation. The dry air is taken in at the inlet of the Blower and forced through the heating apparatus, which may be a hot-air furnace, or coils of pipe heated by steam, as shown in the cut, or any other device for heating air. After passing through the heater the rarified air rises to the ceiling of the dry-house, but being positively forced into the room, it displaces an equal quantity of the air already there, which is forced out at the bottom of the flue, as shown by the arrows. By this means a constant and regular change of air in the dry-house is secured, the air passing out being loaded with moisture. By this arrangement a nearly uniform temperature is secured between the air at the ceiling and the floor, seasoning all the lumber alike. Lumber seasoned in this way is not nearly so liable to crack and check as when seasoned with unequal heat.

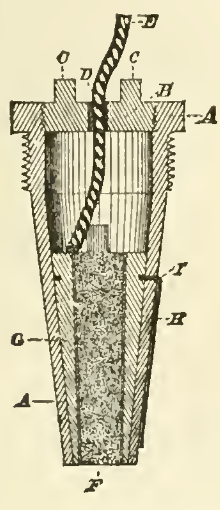
Timber for gun-carriages is now, almost entirely, worked into shape by machinery; the operations are *sawing, planing, turning, mortising and tenoning, dove-tailing*, etc., and are described in detail, under the various machines, in this work. In joining together the different pieces of a carriage, regard should be had to the character of the fiber of the wood, and the effect of drying in changing the form of the piece. If a piece be supported at both ends, as in the cases of carriage-stocks, chassis-rails, etc., the greatest convexity of the fiber should be placed uppermost; if in the middle, as in cases of hounds of limbers, side-rails of caissons, etc., it should be placed downward. When the pieces are to be united in pairs, as cheeks, side-rails, etc., use such pieces as have nearly the same curvature of fiber. In drying a piece of timber, the sapwood shrinks more than the heart, and the effect will be to warp in the direction of the sap; therefore to prevent the joint, formed by the two pieces which constitute a carriage-stock, from opening, the heart-wood should be placed on the outside. To prevent the cheeks from warping inward, place the heart-wood on the inside. In hounds and side-rails, the heart side should be placed on the outside, as this will have a tendency to tighten the joints. When pieces are to be joined, the surfaces of contact and the dowels should be covered with a good coat of white-lead. Bolts and bolt-holes should be well covered with tallow moistened with neat's-foot oil. The surface of holes for elevating screws and pintles should be always well painted. If woodwork is to be painted immediately, it should have a good priming coat of lead before the irons are put on; if not, it should receive a good coat of linseed oil. For service, the woodwork of carriages and machines is painted, in addition to the priming of lead-color, with two coats of olive paint; the iron-work, with one coat of lead, and one coat black paint. Great care should be observed to protect iron fortress-carriages against the corroding influence of the sea-coast atmosphere; the best means remains to be determined by experience; at present they are covered with one coat of hot linseed oil and three coats of a reddish brown paint.

Models, etc.—The models, etc., of all ordnance "*matériel*," are determined by the Ordnance Board, subject to the revision of the Chief of Ordnance, and the final approval of the Secretary of War. When a model has been duly approved, copies, or drawings of it, are sent to the different arsenals of construction, and from these, patterns and gauges are made for the guidance of the workmen. Patterns are generally made of well-seasoned mahogany, and bound with strips of brass; gauges are made of sheet iron or steel. To secure uniformity of work at the different arsenals, it is made a part of the duty of the inspector of arsenals to see that the patterns correspond with the originals; and it is always the duty of the officers stationed at an arsenal, to see that the work, as it progresses, corresponds with the patterns, and that none but suitable materials are used.

OREILLERE.—The ear-piece of an ancient helmet, shaped like an oyster shell, employed to protect the ear and cheek.

OREILLON.—The ear of a sword, languet, or small slip of metal on the hilt, which, when the sword is sheathed, extends along the scabbard.

O'REILLY COMBINATION-FUSE.—This fuse consists of a metal stock, A, open at the rear, but closed



at the front end by a screw-cap, B, from which projects two studs, C C, for screwing and unscrewing the caps. There are also two holes, D D, in the screw-cap through which is passed and secured a strand of quickmatch, E.

The fuse, F, is tightly pressed into a conical shaped, snug-fitting plunger, G, held in place by a wire, H, which passes through a hole, I, in the side of the stock and enters a cannelure on the plunger.

The operation of the fuse is as follows: At the instant of discharge the quick-match is ignited by the flame from the charge of powder; this ignites the fuse, which continues to burn as an ordinary time-fuse; when the flight of the projectile is arrested, the plunger, by its inertia, is driven forward, sheering off the pin which holds it, and, being followed by loose powder in the shell, ignition and explosion follow. See *Fuse.*

ORGAN GUN.—A gun consisting of a number of tubes or barrels placed in arrow like the pipes of an organ. See *Orgue à Serpentin.*

ORGANIZATION.—For the purpose of supply, discipline, rapidity and precision of movement, an army is divided into corps; corps into divisions; divisions into brigades; brigades into regiments; regiments into battalions, and battalions into companies. For the purpose of employing to advantage the different weapons and of providing for that mutual support and aid so essential to success, an army is organized into different arms of service, viz.: Infantry, Cavalry, Artillery and Engineers. These four arms of the service are called *Troops of the Line.* A battalion is the tactical unit of infantry, but the company should undoubtedly be considered the fighting unit, for it is the only organization that will in future wars fulfill all the requirements of a unit, viz: All the men be known to, overlooked by, and within reach of the voice of the officer commanding it. The squadron of two troops is the unit of cavalry. The battery of six guns is the unit of artillery. An army corps usually consists of about thirty thousand men, divided into two or more divisions, depending upon the strength of the corps. Each division is generally composed of the four arms of the service—infantry, cavalry, artillery, and engineers—the artillery being assigned to the corps by battery, and the engineers by company. The corps is, as a rule, provided with a *reserve* of artillery, which, with the artillery assigned to the different divisions, is under the orders of one commander. The organization of an army into corps was introduced by Napoleon about the year 1804, while preparing his army for the contemplated invasion of England. The idea is to make each corps a complete army in itself, in order that it may be detached at any time from the main army when the necessity arises, and be ready to act as an independent force. The division is composed of two or more brigades, and rarely of more than four. Brigades are composed of two or more regiments, and regiments of two or more battalions, each consisting of two or more companies, generally four. The battalion organization is for administrative purposes, and for instruction in the movements prescribed in tactics. As all the duties devolving upon the General in command of an army cannot well be performed by one man, he is assisted in his duties by the officers who compose his Staff. The duties of Staff-officers are: to transmit the General's orders; to procure information, both of the enemy, and of the condition of his own forces; to prepare reports, obtain guides, spies, etc.; to inspect the troops to see that they are properly supplied and in good condition of drill and discipline; to preserve the correspondence and records; in fact, to perform all those duties required of the General in command, which will enable him to have his army at all times prepared in every respect to meet the enemy. The principle of Staff organization is also extended to the divisions, brigades, and regiments, composing the army; the duties being less important and arduous as the body of troops is smaller.

The necessity for a body of officers specially trained in staff duties has been greatly increased in consequence of the fact that wars are now waged by much larger armies than formerly. Therefore every army should be provided with a body of officers who in time of peace should be thoroughly instructed in all duties pertaining to the staff, so when war is declared they will be fully competent to enter upon the active and efficient discharge of their duties. Nearly all European armies have such an organization, which is commonly known as the *General Staff.*

Jomini lays down the following general conditions, as essential to the perfect organization of an army:—1. A good system of recruiting. 2. An efficient formation. 3. A well organized system of national reserves. 4. That officers should be well instructed in drill and maneuvers, and in all the duties of a camp and in the field, and that there should be a good system of interior economy. 5. A discipline strict, but not humiliating; a spirit of subordination as far as possible on a conviction pervading all ranks of its importance, rather than on the mere orders of the service. 6. A well regulated system of rewards and a spirit of emulation. 7. A special corps, engineers and artillery, well instructed. 8. An armament well understood, and, if possible, superior to that of the enemy, comprising arms defensive as well as offensive. 9. A staff capable of applying all these elements to the greatest advantages and with an organization adapted to the theoretical and practical instruction of its members. 10. Well organized commissariat and medical departments. 11. The command of armies and the supreme direction of operations by a sound practical system. 18. The maintenance of a high military spirit.

ORGUE A SERPENTIN.—A machine composed of a great number of guns of small bore loaded either from the muzzle or at the breech. Each separate chamber was encased, as far as the muzzle in wood or metal, and they were fired in succession or all at once. The term *orgue* was applied to several patterns of ordnance, composed of a number of musket barrels, all so joined on the same carriage, and the touch-holes corresponding with each other, that they could be discharged simultaneously. This weapon may be said to have been the origin of the *Mitrailleur.*

ORGUES.—Thick and long wooden beams, pointed and shod with iron, hung vertically by separate ropes in the gateway of and over the entrance to a fortified place. They answer the purpose of a portcullis or door, and are dropped into position by cutting the ropes from which they hang. Their descent is inevitable, in which they possess an advantage over the portcullis, which may be held up by the enemy or blown in by petards, whereas petards have little effect on orgues, for if one beam be destroyed another can be dropped to fill up the gap.

ORIENTAL POWDER.—A variety of gunpowder made at the Oriental Powder Mills at South Windham, Me., on the Presumpscot River, where every facility is at hand for making powder to the best advantage. The following brands are well known and are regarded as excellent:

Falcon Ducking—Especially adapted for breech-loading guns and target practice Its sizes are No. 1 (fine), No. 2, No. 3, and No. 4 (coarse). Packed in kegs of 6¼ lbs., and in canisters of 1 lb. each.

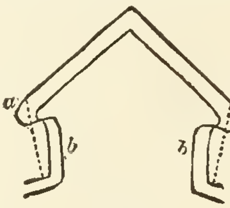
Western Sporting—A clean and moist burning powder, and used for ordinary purposes in the field. Its sizes are FG (coarse), FFG and FFFG (fine). Packed in wood or metal kegs of 25 lbs., 12½ lbs., and 6¼ lbs., and in canisters of 1 lb. each.

Wild Fowl Shooting — Of a coarser grain than "Western Sporting," and especially prepared for use in very damp places, and for muzzle or breech-loading guns. Its sizes are No. 1 (fine), No. 2, No. 3, No. 4. (coarse). Packed in wood or metal kegs of 25 lbs., 12½ lbs., and 6¼ lbs., and in canisters of 5 lbs. and 1 lb. each.

Blasting — A superior grade, and especially adapted for military and mineral mining, also for railroad work. Its sizes are C (coarse), T, TFG, F, FF, FFF (fine). Packed in wood or metal kegs of 25 lbs.

ORIFLAMME.—A banner which originally belonged to the Abbey of St. Denis,and which was borne by the Counts of Vexin, patrons of that church, but which, after the county of Vexin fell into the hands of the French crown, became the principal banner of the Kingdom. It was charged with a saltire wavy or, with rays issuing from the center crossways. In later times the oriflamme became the insignia of the French infantry. The name seems also to have been given to other flags; according to Sir N. H. Nicolas, the oriflamme borne at Agincourt was an oblong red flag split into five parts. Also written *Auriflamme.*

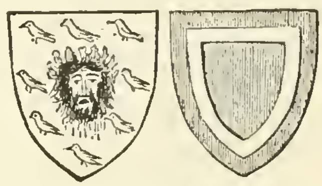
ORILLON.—In fortification, and especially in the earlier systems, the orillon is a semicircular projection at the shoulder of a bastion, intended to cover from the observation of the enemy the guns and defenders on the flank, which, with such a construction, is somewhat retired or thrown back. The flank thus protected is held by many distinguished engineers to be most valuable in the defense of the ditch, when clearing it from an attacking party, or from hostile miners. The retired flank is sometimes



Orillon:
a, a, orillons; *b, b,* retired flanks (the dotted lines show the original bastion).

straight, at others curved. The orillon is as old as the bastion, and is found in the works of Pagan and Speckle.

ORLE.—In Heraldry, one of the charges known under the name of sub-ordinaries, said to be the diminutive of a Bordure, but differing from it in being detached from the sides of the shield. It may be the sole charge in a shield. Or, an orle gules was the



Orle.

coat borne by John Baliol. An orle of heraldric charges of any kind denotes a certain number (generally eight) of these charges placed in orle, as in the coat of the old Scottish family of Gladstanes of that Ilk; argent, a savage's head couped, distilling drops of blood proper, thereon a bonnet composed of bay and holly leaves all proper, within an orle of eight martlets sable.

ORMOLU.—A variety of brass, consisting of zinc 25 parts, and copper 75 parts, which has a nearer resemblance in color to gold than ordinary brass. It is extensively used for castings of ornaments. When the casting is made, its color is brought out by a pickle of dilute sulphuric acid, after which the acid is removed by water, and a liquor varnish is put on to keep it from tarnishing.

ORNAMENTS.—Those parts of the dress of a soldier which are more for appearance or distinction than for absolute use; as belt-plates, shoulder straps, trimmings, etc.

ORPIMENT.—A sulphuret of arsenic. There are many varieties of orpiment, one in fine golden colored scales, another in dense yellow stony lumps, a third in earthy-looking masses, called *King's Yellow*, a familiar paint; but the orpiment required in the laboratory for blue lights, signal-lights, and parachute light-balls, is the *red proto-sulphuret* or *realgar.*

OUTER.—A term applied to a portion of the target. On the regulation targets it is all the space outside of the larger circle, or the space outside the vertical lines. See *Inner*

OUTFIT ALLOWANCE.—In the British army, a sum of £150 for the cavalry and, £100 for the infantry, granted to Non-commissioned Officers promoted to Commissions, to enable them to meet the heavy charges for uniform and equipments. The larger sum is given in the cavalry because the newly Commissioned Officer has to purchase his charger.

OUTFLANK.—To turn the flank or flanks of an enemy. See *Flank Movement.*

OUTGUARDS.—Small bodies of troops stationed at a greater or less distance beyond the limits of a camp or main army, for the purpose of preventing an enemy approaching without notice, and also to offer opposition to his progress, while the main force prepares for resistance. Outguards march off to their position silently, and pay no compliments of any kind to officers or others. As soon as the officer commanding an outguard arrives on his ground, he proceeds to carefully examine the environs, noting all heights within rifle-range, roads and paths by which an enemy may approach, etc. He also takes such impromptu means of strengthening his position as occur to him—felling a tree here, cutting brushwood there, blocking a path in another place, and resorting to any expedient which may serve to delay the foe at point-blank range—an object of importance, as a stoppage at such a point is known to act as a great discouragement to advancing troops. See *Outposts.*

OUTLET.—Outlets, in fortification, are the passages made through a parapet, or an enclosure of a gorge, for the services of the work. They should in all cases be made in the least exposed part of the work. Their width need not be more than six and a half feet, when used only for the service of the work; but when they serve as a common passage for wagons, etc., in the case of the intrenchment crossing a road, they should be at least ten feet wide. When cut through a parapet, the sides receive a slope of three perpendicular to one base, and are revetted with sods, etc. A gate, termed a *barrier*, serves as an enclosure to the outlet. The framework of the barrier is made like an ordinary gate, consisting of two uprights, or *stiles*, a cross-piece, or *rail*, at top and bottom, and a *swinging bar*, or a *diagonal brace*. Upright palisades, about seven feet long and four inches thick, are spiked to the frame about four inches apart; they are finished at top with spikes. A barrier thus constructed will not offer a shelter to the enemy should he attempt to cut it away. The barrier is hung on hinges like an ordinary gate. See *Gorge.*

OUTLINE.—In fortification, the succession of lines that show the figure of the works, and indicate the direction in which the defensive masses are laid out, in order to obtain a proper defense.

OUTLYERS.—A term formerly applied, in the British service, to men who were permitted to work, on condition that the whole of their pay was left in the hands of their Captain for the time they were so employed. This sum the officer appropriated to his own use, to enable him to increase his pay and keep a handsome table when he mounted guard. It was also a common practice to place on the muster-rolls the names of officers' children, and instances have occurred of girls receiving men's pay as outlyers.

OUT-LYING PICKETS.—Detachments of cavalry and infantry, accompanied sometimes with light guns, and posted on the front and flanks of an army in the field, in order to guard against surprise, and to keep reconnoitering parties at a distance. See *Out-posts.*

OUT OF GEAR.—For most heavy guns, the motion of the top carriage to and from battery is regulated by a pair of truck-wheels, one on each side, which work on an eccentric axle placed underneath and a little in front of the axis of the trunnions. The wheels are thrown *out of gear* by means of handspikes inserted into sockets upon the ends of the eccentric axle. See *Into Gear.*

OUT-PENSIONER.—A pensioner attached to a hospital, as Greenwich or Chelsea, England, who has liberty to live where he pleases.

OUT-POSTS.—The detachments of troops and the method of arranging them, by means of which an Army when in bivouac, in camp, or in cantonment, is protected from surprise by an enemy. The duties of the out-posts, and of the grand-guards which form their supports, are strictly those of observation. If attacked, they offer no resistance farther than to enable them to feel the enemy perfectly, and never lose sight of him. The task of holding the enemy in check by a vigorous resistance, so as to procure sufficient time for the main-body to make its dispositions for battle, is consigned to the pickets. The position of the out-posts, with respect to the main-body, will be regulated by the more or less broken character of the country. As a general rule the mean distance may be taken at about two miles. The line occupied by these posts should take in all the approaches to the front and flanks of the main position. When a position is to be held for a considerable time, the out-posts may be thrown farther in advance; to procure greater repose and security for the main-body. The ground on which the line of out-posts is established should be carefully examined; with a view both to observation and defense. As far as practicable, those points should be selected for posts which present some natural advantages for the defense; will screen the troops from the enemy's view; and enable them to watch all his movements. Whenever the features of the ground do not offer natural obstacles to cover the posts, artificial means of a slight character should be resorted to. The flanks of the line should rest upon strong natural obstacles; when such cannot be found, without giving the line too great an extent, these points must be secured by strong pickets of cavalry or infantry, thrown back to form crotchets; from which patroles must be constantly kept up on the flanks in the presumed direction of the enemy.

The strength of each out-post, and the distance from one to the other, will be regulated by the features of the ground, and the number of sentinels, or vedettes that each post must throw out. The posts should, as far as practicable, be within sight of the grand-guards to which they belong; and the sentinels of their respective posts. When the ground does not permit this arrangement, sentinels should be placed at intermediate points, to communicate promptly whatever may happen at the line of posts, or of sentinels to the rear. Posts of infantry should not, as a general rule, be placed farther apart than 600 paces; nor their sentinels more than 300 paces in advance of the posts. Those of cavalry may be some 1,500 paces apart; and their vedettes from 600 to 800 paces in advance. The strength of each post should be calculated at the rate of four men for each sentinel, or vedette. An officer in command of any of the out-posts must be capable of untiring vigilance and activity; to perform the various duties that devolve upon him. He should be provided with a good map of the country, a telescope and writing materials. He will thoroughly reconnoiter the ground upon which he is to dispose his command; and also as far in advance as circumstances admit questioning closely any inhabitant he may find. After taking up his position, he should go forward with the half of his command; and post each sentinel himself. If however, he relieves another in the command, and deems it advisable to make any changes in the dispositions of his predecessors, he should promptly report the facts to the Commanding Officer in his rear. When the officer finds that the enemy is not in his immediate neighborhood, he should endeavor to feel his way cautiously towards him by patrols; and when in immediate presence, he should omit no means to watch the enemy's movements; and from the occurrences of the moment, such as noises, the motion of the clouds of dust, camp fires, conflagrations, etc., endeavor to divine what is passing in his camp, and his probable intentions. Accurate written reports should be promptly sent to the officer in command, in the rear, on all these points. The reports should be *legibly* written, and should clearly but *concisely*, state what has fallen under the officer's eye; what he has learned from others; and the character of the sources from which his information is drawn. See *Advanced Posts.*

OUTRANCE.—To the utmost; to the last extremity. Thus the French say, *Se battre à outrance*, to fight to the last extremity.

OUT-SENTRY.—A sentry posted to guard the entrance or approach to a place. See *Outguards*.

OUTSIDE.—In fencing, that part which is to the right of the line of defense. The *Outside Guard* is used with the broadsword and saber, to defend the outside of the position.

OUTWARD FACE.—A word of command for troops to face to the right and left from their center.

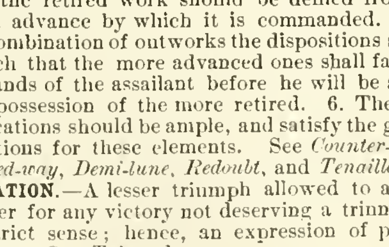
OUTWARD FLANK.—The extreme file on the right or left of a division, subdivision, or section, according to the given front, when the battalion is at close or open column, and which is the farthest wheeling point from line into column, or from column into line. It is likewise called the *reverse* flank.

OUTWORKS.—A work consisting of an enceinte alone is more or less exposed to surprise, as it must have outlets of some description to keep up a communication with the exterior, and a bridge, or other means for crossing the ditch. This is not the only defect of a fortification of this simple character; for having no covers beyond the ditch for its garrison, their action must be restricted to what may be termed a passive resistance alone; in any attempt to operate on the exterior, they are exposed to fire as soon as they emerge from the ditch, and in a retreat towards the work, if closely pursued by the assailant, they will not only run the risk of being cut off, but a retreat under such circumstances may lead to the capture of the work itself, by the assailant being enabled to enter it with the retreating force. To provide against dangers of so grave a character, engineers have devised other defenses beyond the ditch, and which they have placed in immediate defensive relations with the enceinte, being under its fire, and in positions where, if assaulted, they can be readily succored by the garrison. To this class of exterior defenses the term *outworks* has been applied.

The outworks should satisfy the following conditions to render them very effective and secure: 1. They should have revetted scarps of a sufficient height to secure them from any ordinary open assault. 2. As far as practicable their scarps should be flanked by the enceinte and be masked from the positions of the assailant's batteries. 3. Their parapets and covered shelters should be shot-proof. 4. Those which are most retired should command those in advance; and whenever this cannot be done the retired work should be defiled from the one in advance by which it is commanded. 5. In any combination of outworks the dispositions should be such that the more advanced ones shall fall into the hands of the assailant before he will be able to gain possession of the more retired. 6. The communications should be ample, and satisfy the general conditions for these elements. See *Counter-guard*, *Covered-way*, *Demi-lune*, *Redoubt*, and *Tenaille*.

OVATION.—A lesser triumph allowed to a Commander for any victory not deserving a triumph, in the strict sense; hence, an expression of popular homage. See *Triumph*.

OVEN.—A very necessary apparatus in military economy to preserve the health of troops, by enabling them, at a comparatively small expenditure of



OVEN OF GABIONS, DIMENSIONS IN METRES.

fuel, to cook many rations together. In the British army little attention was paid to such subjects, until, in 1858, the inquiries of Mr. Sidney Herbert (afterwards Lord Herbert) brought to light the excessive mortality among soldiers, which was partly—and, as the event has shown, justly—attributed to the bad cookery of their food. Captain Grant has bestowed much attention to army cookery, and has invented ovens for barrack use and for the field. While great improvements on the system—or want of system—which preceded them, these ovens are still admitted to be far from perfect in their arrangements. For boiling meat, etc., in the field, he employs detached cylinders, which, when empty, he proposes to join and floor over for use as pontoons; when in use they are united crosswise, one in the middle serving for a chimney. One or more empty barrels can be attached for steaming potatoes, and the roasting of coffee is performed, though not altogether successfully, in another cylinder made to revolve over the

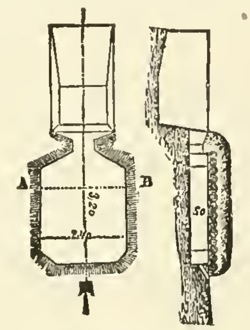


Fig. 2.

chimney. Up to the present time other systema have been partially resorted to; but none has as yet been definitively adopted to the exclusion of others. Cylindrical ovens are preferable for field service, and the want of brick for the arch and fireplace may be supplied by two gabions of semi-circular or semi-elliptical form 1m. 44 in diameter; the basket work is not so close as the ordinary gabion, and is 1m. 32 in height. The two gabions, resting one over the other upon the flat side, make a cradle 2m. 64 long, 1m. 44 broad, and 0m. 72 high. (Fig. 1). The interior and exterior is then plastered with clay, which must penetrate the interstices of the basket work. The front and back part is shut in the same manner, or with sods. The cradle is then covered with earth to retain the heat, and in order that the superincumbent weight may not cause it to give way. Withes are attached to the top of the basket work, and passed vertically through the embankment, and then fastened to the longitudinal beam of a wooden horse straddled against the exterior curve. Eight of these furnaces may be made in 24 hours. The wooden oven (Fig. 2) is made by digging an excavation of 3m. 20 in length by 2m. 40 in breadth, and 0m. 50 in depth, making the fireplace slightly descending towards the mouth. This trench is covered with pieces of wood of 0m. 15 to 0m. 25 square, placed close together; the wood is covered with earth carefully packed, the chimneyplace is sodded. The fireplace is dried by heating for 7 or 8 hours, and subsequent heatings require two hours. Such ovens resist very well five or six bakings.

OVERCHARGED MINE.—A mine whose crater is wider at the top than it is deep. See *Crater*.

OVERCOAT.—A part of the uniform, worn in cold weather and when specially ordered. In the United States army it is prescribed as follows:—

For General Officers.—Of dark blue cloth, closing by means of four frog buttons of black silk and loops of black silk cord; cord down the breast, and at the throat by a long loop "*à l'échelle*," without tassel or plate, on the left side, and a black silk frog button on the right; cord for the loops fifteen hundredths of an inch in diameter; back, a single piece, slit up from the bottom from fifteen to seventeen inches, according to the height of the wearer, and closing at will by buttons, and button-holes cut in a concealed flap; collar of the same color and material as the coat, rounded at the edges, and to stand or fall; when standing to be about five inches high; sleeves loose, of a single piece and round at the bottom, without cuff or slit; lining wooden, and, with the facings, to correspond in color with the trimmings of the uniform; around the front and lower borders, the edges of the pockets, the edges of the sleeves, collar, and slit in the back, a flat braid of black silk one-half an inch wide; and around each frog button on the breast a knot two and one-quarter inches in diameter, of black silk cord, seven hundredths of an inch in diameter. cape of the same color and material as the coat, removable at the pleasure of the wearer, and reaching to the cuff of the coat sleeve when the arm is extended; coat to extend down the leg from six to eight inches below the knee, according to height. To indicate rank, there is on both sleeves, near the lower edge, a knot of flat black silk braid, not exceeding one-eighth of an inch in width, and composed of five braids, double knot.

For all other Officers—Dark blue, close-fitting double-breasted surtout-coat, having a cape, made to detach from the coat and fall to the tips of the fingers when the arm and hand are extended; the skirt of the coat for mounted officers to reach half way between the knee and the sole of the foot; for dismounted officers, three inches below the knee.

The coat has seven buttons on each breast, of the same pattern as those on the uniform coat. The insignia of rank is on the sleeve. as follows, viz: Colonel, five braids, single knot. Lieutenant-colonel, four braids, single knot. Major, three braids, single knot. Captain, two braids, single knot. 1st Lieutenant, one braid, single knot. 2d Lieutenant and Additional 2d Lieutenant, without braid. Military Storekeepers, same as officers of the General Staff of like rank. Chaplains, without braid.

On the frontier and campaign, officers may wear the soldier's great-coat, with the insignia of rank on the sleeve. See *Great-coat*.

OVERHAUL.—A term used in artillery appliances in "overhauling" a tackle, that is, in separating the blocks. This should invariably be done from the standing, and not from the movable block.

OVERLAP.—In marching by echelon for the purpose of forming upon any given point, and particularly in wheeling from column into line, troops may lose their relative distances by not taking ground enough; when this occurs, the rear division, company, or section, unavoidably crowds upon its preceding one, and is then said to *overlap*.

OVERSEER.—An officer in the Ordnance Department, who superintends the artificers in the construction of works, etc. He is called *Superintendent*.

OVERSLAUGH.—To hinder or stop by an unexpected impediment; as to overslaugh a military officer, that is to hinder or stop his promotion or employment by the appointment of another to his rank or duties.

OWN.—A term which has been attached to some British regiments since the Revolution in 1688. Thus the 4th Foot, which landed with William III., was called the 4th Kings Own.

OX.—A ruminant quadruped of the family *bovidæ*, much used as a draught animal in military trains. The ox is more frequently employed as a beast of draught in some parts of the continent of Europe than in Britain. From the earliest historic times the horse has been more generally thus employed, and has now almost entirely superseded the ox. The gait of the ox is slow and plodding, but its strength enables it to perform a great amount of work, and it is not easily exhausted. It needs, however, intervals of rest inconvenient for the marches; and it is not capable of exertion at all equal to that of the horse on any occasion of emergency. See *Bullock*.

OXFORD BLUES.—The third heavy cavalry regiment of the Household Brigade. It was raised in 1661, and took part in Marlborough's campaigns; it also served under Wellington in the Peninsula and at Waterloo. This regiment, like the two regiments of Life Guards, wears a steel cuirass, but over a blue coatee, whereas the coatee of the two latter regiments is red. See *Horse-Guards*.

OXIDES. Metallic oxides are the most important of all the compounds of the metals, and in many cases occur naturally as abundant and valuable ores. They are divided by chemists into three classes viz., (1) basic oxides or bases, (2) saline or indifferent oxides, and (3) acid oxides or metallic acids. The different oxides of the same metal usually afford illustrations of two, and not unfrequently of all three of these classes. Thus (to take the case of manganese) the protoxide (MnO) is a powerful base, the red oxide (Mn_3O_4) is a saline or indifferent oxide, showing little tendency to combine either with acids or alkalies, while permanganic acid (Mn_2O_7) presents all the properties of an acid. As a general rule, the greater the number of atoms of oxygen which an oxide contains, the less is it disposed to unite with the acids; on the contrary, it frequently possesses acid properties, and then unites with bases to form salts. Protoxides generally are strong salifiable bases; they require one equivalent of a monobasic acid to form neutral salts. Sesquioxides are weaker bases; their salts are usually unstable; they require three atoms or equivalents of a monobasic acid to form a salt which is neutral in composition, though it may not be neutral to test-paper; and in general, all oxides require as many equivalents of acid as they contain atoms of oxygen in their composition. Some of the metallic acids, like the stannic and titanic, contain two atoms of oxygen to one atom of metal, but most of them contain three atoms of oxygen—such, for example, as the manganic, ferric, chromic, tungstic, molybdic, and vanadic acids; whilst in a few cases, such as the arsenic, antimonic, and permanganic, the proportion of oxygen is still higher. Of the basic oxides, which form by far the most important class, it may be observed that they are devoid of all metallic appearance, and present the characters of earthy matters, and that six only of them are soluble in water to any considerable extent, viz, the three alkalies and baryta, strontia, and lime. All the oxides are solid at ordinary temperatures, and as a general rule, the addition of oxygen to a metal renders it much less fusible and soluble; the protoxide of iron, the sesquioxide of chromium, and molybdic acid being the only oxides that melt more readily than the metal.

OXYHYDROGEN BLOW PIPE.—An instrument for the purpose of burning oxygen and hydrogen gases in their equivalent proportions, so as to get the greatest heat from the combination. Two volumes of hydrogen and one of oxygen form an exceedingly powerful explosive mixture, in consequence of their instantaneous union upon the application of sufficient heat, as the electric spark or a taper, the result being the formation of water. It was, therefore, early known to be dangerous to experiment with the mixed gases. In some instances, when the gases were contained in separate reservoirs and connected by tubes at their extremities, they have become mingled in one of the reservoirs in consequence of a backward flow of the mixture, and serious accidents have resulted. This led to the early use of concentric tubes for the delivery of the gases, the hydrogen tip usually surrounding the one discharging the oxygen. By properly regulating the pressure in the gas-holders the two gases may be mingled without danger, near the end of the tubes, at the entrance of the burner. Hemming's safety jet is used for burning the gases mixed in the same reservoir; but it is not thought safe to have this of metal, but of a membrane. The ordinary burner, which mingles the two gases for some inches before their exit, is all that is sufficient to produce thorough admixture previous to ignition, and will furnish as "solid" a flame as may be desired. The chief uses of the oxyhydrogen blow-pipe are to readily fuse metals, and to render lime incandescent in the Drummond light. See *Drummond Light.*

P

PACE.—In its modern acceptation, the distance, when the legs are extended in walking, between the heel of one foot and that of the other. Among disciplined men the pace becomes of constant length, and as such is of the utmost value in determining military movements, the relative distances of corps and men being fixed by the number of paces marched, and so on. The pace in the British army is $2\frac{1}{2}$ feet for ordinary marching, and 3 feet for "double quick" or running time. With the Romans the pace had a different signification, and it is important to bear the distinction in mind, when reading of distances in Latin works; the single extension of the legs was not with them a pace *(passus)*, but a step *(gradus)*; their pace (*passus*) being the interval between the mark of a heel and the next mark of the *same* heel, or a double step. This pace was equivalent to 4.84 English feet. The pace was the Roman unit in itinerary measure; the mile being 1,000 paces, or 5,000 Roman feet, equal to .917 of an English mile. Whether measurements were effected by actually counting the paces, or by the time occupied, is not clear; but either method would, with disciplined troops, give a safe result. In the Middle Ages, writers confuse accounts of distances by allusion to a geometrical pace, a measure which varied with different authors.

PACING DRILL.—In the United States Army, before teaching the soldier to estimate distances simply by sight, he is first instructed to measure them by walking over them and carefully counting the number of equal paces thus taken. The Instructor causes a distance of one hundred yards to be measured off on smooth, level ground, and marked by a stake and small flag at each end. The squad is marched to the ground under arms, and formed in single rank, in a line passing through the first stake and at right angles to the measured line. The Instructor directs each man to march straight forward until he comes opposite to the flag planted at the 100-yard stake, and to carefully preserve his natural step without either increasing or diminishing its length, at the same time counting the number of steps taken. This is repeated three times. From the mean of the three trials the Instructor will give to each man a number of steps that he will take in measuring 10 yards and 100 yards, so that if he march with equal paces he can step 100 yards with some degree of accuracy. When the men have learned to measure distances on smooth and level ground, they are next practiced on that which is more or less broken. The Instructor reminds them that in ascending, a shorter step is always taken, and the reverse in descending. Where it is possible, he selects different practice grounds, which will give the men the opportunity of determining the number of steps taken in a given distance in going up or down hill, and also that which is more or less broken by ruts and furrows. The number of steps taken under these circumstances are recorded by each man, giving the inclination of the ground and other irregularities as nearly as possible. The men are then exercised in measuring unknown distances, embracing as great a variety of surface as convenient, and continued until they are able to reduce the error made to within five per cent. of the distance measured. The difficulty of correctly estimating any given distance without the aid of proper instruments for the purpose increases rapidly as the distance becomes greater. The exercises for the instruction of the men are for this reason divided into three parts, and the men are assigned to one of three classes according to their proficiency in the drill. The third section of the course has reference only to distances varying from 100 to 300 yards; the second section to those from 300 to 600 yards, and the first from 600 to 900 yards. Beginners form the third class; those who become expert in estimating the distances of the third section are advanced to the second; and when the drill has been mastered as regards the distances of the second section, the pupil is passed into the first class, and practices estimating all distances up to 900 yards.

PACK-ANIMALS.—Pack-animals may be advantageously employed in sections of country not permitting the use of wheeled carriages. Horses, ponies, mules, oxen, elephants, camels, goats and dogs are more or less used as pack-animals in different countries, and the variety of packing gear is very great. The nature of the country to be traversed and of the load to be transported, will in a great measure determine the form and adjustment of the gear. The *mule* is a favorite pack-animal in many countries, but the ox is far superior, and would be in greater demand, were it only fashionable to use him as a pack and saddle animal. Oxen hold out much better than mules over *long* marches, are much cheaper, are less liable to be stampeded by the enemy, are easily caught when needed, and in case of emergency may be used for beef. In some respects the mule is a superior pack-animal to the horse. His peculiar build gives him, in proportion to his weight, a greater power to transport a load on his back; besides this, the mule eats less than the horse, and is more sure-footed.

The load, gait, journey, forage, intervals of rest, etc., of a pack-animal should be so proportioned that he will be no more fatigued one day than another. It has been determined by experience that a pack-animal, traveling at a walk, over a good road, can carry from 220 to 300 lbs., 30 miles in 10 hours; or if he moves at a trot, 175 lbs. over the same distance; and the daily work of a pack-animal is equal to that of five men, under the same circumstances. If the road be hilly the advantage will be in favor of the men. The above data supposes that the animal is regularly fed on the service-ration. If he be fed on grass alone, an allowance must be made for its quality and abundance. Over difficult and long-continued journeys, with pastures seldom good, the net weight of the packs should not exceed the half of those readily transported over a level country, furnishing a sufficiency of grain and camps at regular intervals. The question *how must the animal be loaded and urged to obtain the maximum work or useful effect*, is an important one. If he transports a light weight, he may make a long day's journey; if he transports an excessive weight, he may soon come to a standstill, and in either case the "useful effect" is little or nothing. Let D=the distance an animal could travel daily if unloaded. W=the weight under which he could not travel at all. W′=some weight less than W, under which he could travel D′ miles per day. Then, there obtains $W'D^2 = W(D-D)'^2$. Now the work or 'useful effect" will be a maximum when W′D′ is a maximum, or when $W'^1 = \frac{4}{9}W$, and $D' = \frac{1}{3}D$, or in other words, the animal will accomplish the most work when he transports $\frac{4}{9}$ths of the load under which he would stagger, and he will travel just $\frac{1}{3}$ the distance he could if he carried no load at all. For example: Suppose an animal is able to travel 20 miles per day, bearing a load of 200 lbs., and 45 miles per day, when he carries nothing; then, from the equation $W'D^2 = W(D-D')^2$, we find $W = \frac{200 \times 2025}{625} = 648$ lbs., the load under which he would be brought to a standstill, and from $W' = \frac{4}{9}W$ and $D' = \frac{1}{3}D$, we find the best load to be 288 lbs., carried 15 miles per day.

An army requires to be accompanied by several thousand pack-animals, sometimes horses, but preferably mules; and in Asia, commonly camels, or even elephants. Pack-saddles are variously fitted, according to the objects to be carried; some for provisions or ammunition; others for carrying wounded men, tents, and, in mountain warfare, even small cannon. In battle, the immediate reserves of small-arm ammunition are borne in the rear of divisions by pack animals; the heavy reserves being in wagons between the army and its base of operations. See *Buffalo*, *Camel*, *Elephant*, *Llama*, *Mule*, *Packing*, and *Pack-saddle*.

PACKFONG.—A Chinese alloy or white metal, consisting of arsenic and copper. It is formed by putting two parts of arsenic in a crucible with five parts of copper turnings, or finely divided copper; the arsenic and copper require to be placed in alternate layers, and the whole is covered with a layer of common salt, and pressed down. When melted, the alloy contains nearly the whole of the arsenic, and is yellowish-white in color when in the rough state, but takes a fine white polish resembling silver. It is not very ductile, and cannot be fused without decomposition, as the arsenic is easily dissipated. It is seldom imported now, the nickel alloys of Europe having quite superseded its use; in China, however, it is extensively employed in the laboratory. Also written *Petong*.

PACKING.—The art of making up and adjusting the load of a pack-animal. The mode of packing varies with the pack-saddle and gear. With the aparejo, used in the United States Army, the packing process is very simple. It requires two men to properly pack the animal. Designating the packers as No. 1 and No. 2, their duties are as follows:

No. 1 is habitually on the near or left side, and No. 2 on the off or right side of the animal. To teach the art, the Instructor commands:

1. *Prepare*. 2. To Pack.

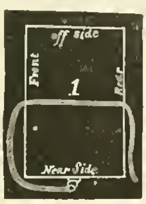
At this command, No. 2 places the hackamore upon the animal, leads him on the off side of and near the rigging, places the blind and assumes his position on the off side. No. 1, assisted by No. 2, on the off side, then places and carefully adjusts the saddle blanket and corona. (Two). No. 1 seizes the aparejo, the left hand near the center of its front, the right hand near the off and rear corner, and places it well to the rear on the back of the animal, when No. 2 immediately adjusts the crupper, and assists No. 1 in moving the aparejo as far forward as possible. (Three). No. 1 passes the aparejo cinch to the off side, till the slider end reaches directly under the animal, and assisted by No. 2, passes the latigo strap downwards over the slider and inwards through the ring, and again over the slider. While No. 1 is drawing the latigo strap moderately tight, No. 2 reaches over the animal, in front of the aparejo, seizes its front corners and draws them upward and forward, placing the aparejo squarely over the animal. This being done and the aparejo *set*, No. 1 places his left knee against the aparejo, and seizes the latigo strap as far down as possible, the left hand in advance. (Four). The latigo strap is drawn until the cinch is sufficiently tight, when No. 1 doubles it, and passes it through the loop on the cinch, drawing it tight. No. 2 removes the blind, and ties the animal at or near his cargo. If No. 1 is not sufficiently strong, No. 2 passes around to the near side, faces No. 1 and assists him in drawing the latigo strap.

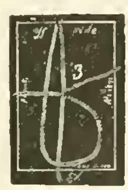
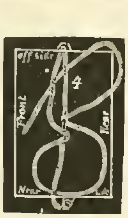
1. *Sling*. 2. The Pack.

At this command, No. 2 unties the animal, places the blind, and takes his position near the cargo. No. 1 seizes the sling rope, doubles it and throws the loop well over on the off side. (Two). No. 2 quietly raises his side of the pack high up on the aparejo, and holding it there with his left hand passes, with his right hand, the loop of the sling-rope over the cargo to No. 1, who passes the ends of the sling-rope through the loop, drawing them tight. (Three). No. 1 quickly places his side of the pack on the aparejo against that of No. 2, holds it there with his left hand, and passes one end of the sling-rope to No. 2, who passes it under a branch of the sling rope already on his side, and back to No. 1. No 1, resting his left arm against the pack, quickly brings the ends of the sling-rope together and ties them in a square knot, after drawing tight. (Four). Nos. 1 and 2 seize the pack at the lower and inner edges, settle it to the full extent of the sling-rope, and carefully balance it, No. 2 removing the blind, and gently leading the mule a few steps forward, while No. 1 observes the pack from the rear. No. 1 then places the pack cover, and is assisted by No. 2 in adjusting it. When the mantas are not in use, they are folded and carried on the aparejos under the cinches.

1. *Lash*. 2. The Pack.

At this command, No. 1 takes the lash-rope, and holding it coiled in his right, seizes it with his left hand near the cinch, and throws it to its full extent to the right; whereupon he passes the cinch hook from him, under the mule, and holding it steady, he places the rope lengthwise on the center of the pack (Fig. 1.)



(Two.) No. 1 now moves forward to the animal's shoulder, draws the lash rope forwards two-thirds of its length, seizes it 5 or 6 feet from the cinch, and passes it doubled to No. 2 (Fig. 2), who takes the double in his right hand, and the hook of the cinch in his left. No. 2 then moves his hands, until he feels the rope tight, when he passes the rear branch of the rope from above into the hook and the slack back to No. 1, who draws it tight with his left hand. He then passes his right hand under his left, seizes the rope in front of the pack and passes it to the rear (Fig. 3). (Three.) No. 1 passes the rope in his left hand under the standing branch from rear to front, pulls it well up on the pack (Fig. 4) and forces the bight thus formed below the aparejo. In the meanwhile, No. 2 grasps the end of the rope, passes it under the front standing branch on his side (from front to rear or from rear to front), pushes it to the top of the pack, and throws the end in front of the pack on the side of No. 1; No. 2 then seizes the front standing branch with both hands, well down, and places his left knee against the aparejo. No. 1 seizes the front branch on his side, placing his left shoulder against the pack. No. 2 pulls while No. 1 takes in the slack. When all is sufficiently tight, No. 1 says "good," and seeing the pack well balanced passes to the rear and tightly pulls the branch under the aparejo. (Fig. 5). (Four.) No. 2 goes to the rear, pulls the branch on his right and passes it forward under the points of the aparejo. No. 1 moves forward, on his own side, takes the end of the rope, tightens it, passes it down under the points of the aparejo, back to the center of the pack and there fastens it by drawing it under the standing branches (Fig. 6). If the lash rope is very long, No. 1 passes the end to No. 2, who makes it fast as stated. All set, No. 2 removes the blind, ties up the hackamore strap and drives off the animal.

1. *Unsling*. 2. THE PACK.

At this command, No. 2 loosens the end of the lash rope, goes to the animal's shoulder and pulls out the branch on his side. (Two.) No. 1 slackens the rear and front branches on his side in succession, passes the front branch under the standing branch from front to rear, withdraws it and passes the slack to No. 2, who unhooks it, whereupon Nos. 1 and 2 throw the lash rope to the rear. (Three.) No. 1 unties the sling rope quickly. (Four.) Nos. 1 and 2 take down the portions of the pack on their sides.

The aparejo is taken off in the inverse order in which it is put on. This being done, No. 1 arranges the cargoes while No. 2 collects and assorts the rigging, placing the aparejos in line, resting on the lower ends of the pads. As the train moves out, each animal should be carefully noticed. Raising the hips and twiching the mouth or nose indicates *galling*, and should lead to immediate examination. The hackamores should fit very closely. Nothing is so liable to irritate an animal and give him "fits of fury" as sore ears. If possible, the cargo should be made into two packages of equal weight and bulk, of about 100 or 125 pounds, and the highest loads should be the bulkiest and most valuable stores. All rattling pans, camp kettles, buckets, etc., should be closely packed in sacks and securely lashed on top between the side packs. If carelessly packed and allowed to rattle, the animals will frequently become alarmed and as frequently succeed in dropping their packs.

PACKING-BOX.—A box used for keeping fixed shot or shell in store, or in transit from place to place, or on the march with siege trains. The name is given to any box or case containing military stores.

PACKING OF POWDER.—Government powder is packed in barrels of 100 pounds each. Powder barrels are made of well seasoned white oak, and hooped with hickory or cedar hoops, which should be deprived of their bark; the cedar is not so liable as hickory or white oak to be attacked by worms, and it should therefore be used in preference; or the hoops may be prepared by immersion in a solution of corrosive sublimate. The hoops should cover two-thirds of the barrel. The grain powders may be packed in canvas bags before being barreled. Instead of a bung on the side, a screw-hole 1.5 inches in diameter is made in the head of the barrel, for mortar and musket powder; it is closed by a wood-screw with an octagonal head, which must not project beyond the ends of the staves; under the head of the screw is a washer of thin leather, steeped in a solution of beeswax in spirits of turpentine. This screw-plug renders it unnecessary to take out the head of the barrel, and the hoops may therefore be secured with copper nails; for transportation, a piece of cloth should be glued over the head of the plug. Some barrels have been made with six copper hoops, and others with four copper and eight or ten cedar hoops; the copper hoops are one inch wide and one-eighth of an inch thick, fastened with two rivets and nailed each with three copper nails 0.625 inch long. Average weight of a hoop $2\frac{1}{4}$ pounds. Powder boxes lined with galvanized iron and copper with large screw lids are now on trial, holding 100 pounds. It has been found that lining powder barrels with India-rubber cloth has an injurious effect on the powder in consequence of the affinity of the caoutchouc for sulphur. The heads of powder barrels are painted *black* in order to show the *marks* more plainly in dark magazines. The following are the dimensions of powder barrels:—

Whole length	20.5 inches.
Length, interior, in the clear	18 inches.
Interior diameter of head	14 inches.
Interior diameter of bilge	16 inches.
Thickness of the staves and heads	0.5 inch.
Weight of the barrel	25 pounds.

The barrels have generally 12 hoops, 14 to 16 staves, and two or three pieces in each head. The dimensions are such that with 100 pounds of powder there shall be a vacant space on the barrel to allow for shaking to prevent caking. The barrel will hold 120 pounds settled by shaking. See *Gunpowder*.

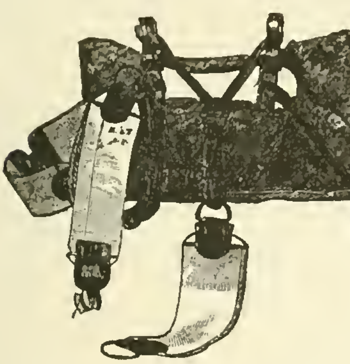
PACKING SMALL ARMS.—When small-arms are to be sent on a long sea voyage the arm-chests are provided with tin linings, securely soldered, so as to exclude all dampness. The clamps for the bayonets are screwed down precisely as in the unlined chest. The tenons of the packings (muzzle, butt, top, and middle) are cut off, as the tin does not extend in the grooves ordinarily filled by them. In a chest intended to be lined the grooves are omitted. A leather strip is placed under each bottom muzzle-clamp to prevent the butt-plate rubbing on the lining. Two strips of wood $\frac{1}{8}$ inch wide and 1 inch thick are placed lengthwise with the box, one on each side, their ends resting in notches cut in the ends of the top clamps. The edges of the lining are about one inch above the level of the chest. They are bent inward, and hammered down on the strips of wood before mentioned. The edges are then carefully soldered to the cover. To open the box a soldering-iron and thin knife are required to open the soldered joint.

In the field, or under other circumstances, when the proper arm-chests are not on hand, it may sometimes be necessary to pack arms with straw. The interior dimensions of a box for twenty muskets may be the same as for the regular packing-box. The straw should be long, perfectly dry, and free from dust; *rye straw* is the best; *hay* should not be used; about twenty-five pounds of straw are required to a box. *To prepare the musket for packing*—Oil it; let down the hammer, pass the bayonet up to the socket into the guard-bow, on the right side, in front of the trigger. Make a rope of about forty straws, slightly twisted, and forty inches long; wrap it about the musket, commencing on top of the hammer going round the bayonet below, again over the hammer and round the piece in front of the guard, then over the socket of the bayonet near the neck, and wrapping the rest around the handle of the stock.

Lay a bed of straw 2 inches thick in the bottom of the box; in the middle and at 6 inches from the ends, place three cushions of straw 6 inches thick and 12 inches wide. Put in a tier of 10 muskets, crossing each other, the butts resting alternately against the ends of the box, the guards uppermost and the hammers bearing on the cushions. Put small trusses of straw under the upper and middle bands by raising the muskets at one end and then pressing them down between the others. Pack between the butts wads of straw 8 inches long, made of a handful of straws folded in three; cover the guards and guard-bows with the ends of the straw that form these wads, which will be still about 12 inches long. Put in another tier of 10 muskets in the same manner, making the cushions 4 inches thick. Pack the implements in straw in the vacant spaces. Fill the box with straw, so that the cover shall require strong pressure to keep it down. Put two hoops round the box, at 18 inches from the ends. Other arms, swords, etc., are packed in a similar manner. Arms should not be wrapped in paper, unless it be oiled, as it attracts moisture more readily than straw does. See *Small-arms*.

PACK SADDLE.—Pack-saddles are variously fitted, according to the nature of the loads to be carried: some for provisions or ammunition; others for carrying wounded men, tents, and, in mountain warfare, even small cannon. *The cross-tree saddle and gear*, represented in the drawing, is used to a great extent by the Indians and traders in Northwestern America. This description of saddle is very well adapted for smooth roads and evenly formed packs. but for scouting trains or the professional packer, where objects of every imaginable shape and various weights are to be transported, nothing has yet been invented so suitable as the *aparejo*, composed entirely of hide.

In very early times the saddle to which the bundles were fastened consisted of two pieces of wood,

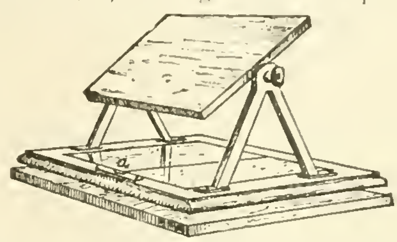


curved so as to fit the horse's back, and joined together at the ends by two other straight pieces. This frame was well padded underneath, to prevent injury to the horse's back, and was firmly fastened by a girth. To each side of the saddle a strong hook was attached, for the purpose of carrying packages, panniers, etc. Panniers were sometimes simply slung across the horse's back with a pad under the band. The panniers were wicker baskets, and of various shapes, according to the nature of their usual contents, being sometimes long and narrow, but most generally having a length of three feet or upwards, a depth of about two-thirds of the length, and a width of from one to two feet. The pack-horse with panniers was at one time in general use for carrying merchandise, and for those agricultural operations for which the horse and cart are now employed; and in the mountainous regions of Spain and Austria, and in other parts of the world, it still forms the sole medium for transport; though the mule has, especially in Europe and America, been substituted for the horse. See *Aparejo* and *Packing*.

PACK TRAIN.—A troop of pack-animals. When fitting out a train, as few different kinds of animals should be taken as possible, as they will run in different herds and require much more attention.

PADDLING. The removal, by means of a copper spud, of such lumps of gunpowder as adhere to the faces of the rollers during the incorporating process in the manufacture of gunpowder. The operation requires great care, and should only be resorted to under exceptional circumstances. Generally water poured on the face of a roller will, to some extent, loosen the powder.

PADDOCK INTERPOLATER. When, owing to the interposition of an intermediate obstacle, the object to be fired at cannot be seen from the mortar, a point must be interpolated on the required line in such position that it can be seen from the mortar. This is most readily effected by this most simple and convenient instrument, consisting of two small mirrors attached to a metallic frame. One of these, termed the upper mirror, revolves on a horizontal axis; the other is called the lower mirror, and to it is attached a small spirit level, *a*. Hair-lines are marked on these mirrors, representing the trace of a plane nor-



mal to the axis of the level at its center, and also to the axis of the upper mirror. To use the instrument, the observer places himself approximately on the line from the mortar to the object to be fired at. Keeping the bubble in the center of the level, he turns the instrument so that the mortar will be reflected from the upper mirror onto the hair-line of the lower mirror. He then revolves the upper mirror, and, catching the reflection of the object, observes on which side of the hair-line of the lower mirror it falls. He moves in that direction until both images—that of the mortar and of the object—fall upon the lower hair-line, the two hair-lines being coincident. A pin or plummet is placed in prolongation of this line to mark the required point. To make the last part of the observation with accuracy, the instrument should be rested on some convenient object.

When the foregoing instrument is not to be had, a point may be interpolated by two persons, each using a light, slender stake. They place themselves as near as practicable on the required line, one facing towards the mortar, where he can see it, and the other towards the object, where he can see it, and both within view of each other. Holding their stakes vertical, they sight and move them alternately, until finally they have them in such position that they range both upon the mortar and the object. The stakes or, better, plummets are then adjusted at these points, and sighting by them back to the mortar, a plummet is suspended in the usual manner behind the platform. The plummets thus established mark the desired plane of sight. This operation is more conveniently performed by using a strip of board, ten or twelve feet long, in which is set at each end a priming-wire. The board is placed at the intermediate point in a position approximately in the plane of sight, and where the mortar can be seen by sighting past both wires back upon it, and the object can be seen by sighting forward in the same manner. Two persons, one at each end, by alternately sighting and moving the board, readily establish the wires in the required line. A plummet is then suspended, at some convenient point in front of the mortar, in line with the two wires on the board. The plummet in rear of the mortar is suspended on the same line. The two plummets thus established determine the plane of sight.—See *Plummet.*

PADS.—In the artillery and cavalry service, pads are used to protect saddle and draught horses from galls. The pad recommended is in the form of a folded blanket, or pad made of sheep or kid's skin, stuffed with hair, 6 inches by 4 inches. When placed above and below the gall considerable relief will be afforded. If a piece of harness is seen to be commencing to rub a horse, besides altering the fitting, friction may be prevented by rubbing in any lubricant (tallow will do on an emergency). To cure a gall or sore while the horse continues his work, pads must be judiciously applied. Sheep skin is the favorite specific of many collar-makers; it sometimes effects more than would be expected; it enables the harness and skin side of the sheep skin to move, while the ends of the hair remain without motion on the tender part of the horse. The rubbing of a trace is sometimes difficult to prevent; we have seen the pressure completely removed by attaching a short, flat piece of wood along a hip or bearing strap, with the ends extending 2 inches past the trace, small pads being fixed on it above and below the trace. It looks ugly, but it works well. Elastic pads constructed of a certain number of tubes of vulcanized caoutchouc united together, and invented, some years ago, by General Angelini, of the Italian army, are stated to have been very successful in the Italian cavalry in preventing galls.

PAGAN SYSTEM OF FORTIFICATION.—This system paved the way for Vauban. It included three kinds of Fortification, the great, the mean, and the small, with fronts of 390 yards, 350 yards, and 312 yards respectively; and was the first to employ the perpendicular (which equaled 58 yards) to draw the line of defense. The faces of the bastion were equal to $\frac{3}{10}$ of the front. The flanks were perpendicular to the lines of defense, the ditch 30 yards wide at the salient, and its counterscarp directed on the shoulder-angle of the bastion. Inside the bastions were constructed interior retrenchments, with magistrals parallel to, and 32 yards from the enceinte. The flank was triple; the first retired and level with the ground, the third level with the inner bastion, and the second of intermediate command. The ravelin had a 90 yards' face, and occasionally received a reduit, while a counterguard sometimes covered the bastions. In another method, called "re-inforced," the enceinte was preceded by a continuous envelope. The weak point of this system was the possibility of breaching the curtain from the re-entering place of arms, thereby turning the interior bastion. The triple flanks were also defective, the defenders being too much exposed to the splinters of the upper scarps

PAGEANT.—In ancient military history, a triumphal car, chariot, or arch, variously, adorned with colors, flags, etc., carried about in public shows, processions, etc. Also a gorgeous show or spectacle.

PAGEANT SHIELDS.—Richly embossed shields of the 16th century. Although they were pieces of defensive armor, they were rather intended to be worn on gala days, when the Nobles rivalled one another in the magnificence and artistic richness of their equipments.

PAH The name of the stockaded intrenchments of the New Zealanders.

PAILLER.— An ancient body of French Militia. The soldiers belonging to it were probably so called either from the circumstance of their wearing straw in their helmets, in order to know one another in action, or because they were accustomed to set fire to the habitations of their enemies with bundles of straw, which they always carried with them for that purpose.

PAINTS.—Prepared or unprepared compositions by which wood, iron and other materials are coated with a preservative surface of oil, mixed with an earthy matter to give it color and consistency The art of painting in its primitive state consisted merely in applying such natural, mineral, and vegetable colors as were spontaneously yielded, without any vehicle to render them permanent, consequently they had to be renewed as often as they were rubbed or washed off from the surfaces to which they were applied. The paints now in use are nearly all mixed with a liquid vehicle, and are applied in the liquid state. The mixing materials are varied according to the requirements of the work. Thus for some kinds of decorative work, and for water-color drawings, gum, glue, size, or other adhesive materials dissolved in water, are employed; whilst for the painting of buildings, etc., oils of various kinds are used for mixing and thinning the colors. Thus, for painted work exposed to the weather, it is found that linseed oil boiled with the sulphates of lead (litharge) or zinc, or with acetate of lead (sugar of lead), is the best. The preparation of boiled oil is one requiring particular care, as it is desirable to have it bright and clear. Hence the proportions of the metallic salts are much varied by different manufacturers, and by some various other ingredients are added. The time of boiling and the method of filtering are also much varied. For indoor work, plain linseed oil and oil (spirit) of turpentine are used; if a *glossy surface* is wished, the linseed oil must be in excess; if a *dull*, or *flattened surface*, then the quantity of turpentine, or *turps*, as it is often technically called, must be increased; and it is usual to add a small quantity of ground litharge and sugar of lead, which are prepared for this purpose, and sold under the name of *driers*. For artists' colors, very fine linseed or nut oil is used, unboiled, and in small quantity, and turpentine is employed to dilute them. Paints for very rough purposes, such as ordnance work, stone walls, etc., are often mixed with whale oil boiled with white vitriol (acetate of zinc), litharge, and vinegar, and they are diluted with common linseed oil and turpentine.

Most of the paints used for ordinary purposes are composed first of the coloring matter, then of a quantity of white-lead, with which and the oil they are worked into a paste of the shade required, and afterward thinned down with oil and turpentine when used. The white-lead which thus forms the basis of most paints, and by itself a color, is a carbonate and oxide of the metal, produced by exposing pieces of lead to the action of the steam of acetic acid in beds of fermenting tan. It is the principal white paint used, but is liable to discoloration from the gases contained in impure atmospheres. Other white pigments are prepared from the oxide of zinc, and the carbonate and sulphate of barytes. *Olives*, for carriages, are produced by mixtures of yellow ochre, boiled oil, litharge, lamp black, spirits of turpentine, and Japan varnish. *Reds* are either purely mineral, or they are *lakes*, i. e., organic colors precipitated on alumina bases. Of the latter there are madder-lakes, prepared from madder-roots, and carmine-lakes, prepared from cochineal; of the former, vermilion (bisulphuret of mercury), Indian red (a native oxide of iron), Venetian red (an oxide of iron), red lead (red oxide of lead or *minium*). *Blues* consist of the artificial ultramarine, and for artists' purposes of the real ultramarine, also the silicate of cobalt, and for water-colors, indigo and Prussian blue. *Greens* are either produced by mixtures of *yellows* and *blues*, or they are made directly from the phosphates, carbonates, acetates, and arsenites of copper, also from the sesquioxide of chromium and from *terre verte*, a native mineral, consisting of iron, silica, potassa, and magnesia. *Browns* are numerous, and various in their composition. Decomposed peat, burned madder, burned Prussian blue, burned terre verte, asphalt, manganese brown, catechu, umber (which is an oxide of iron with maganese), and mummy, or the asphalt mixed with other matters taken from Egyptian mummies, are amongst the best known and most used. *Blacks* are made of lampblack and bone-black, peroxide of manganese, and blue-black, which is made of the charcoal of burned vine twigs. In all cases the coloring materials of paints require to be very finely ground, and as very many are poisonous, great care is required in their preparation, and several forms of mill have been invented for the purpose. The principle upon which all are made is to secure the operator from the poisonous dust and exhalations, and to reduce the coloring material, if ground dry, to an impalpable powder, or, if mixed with the oil, to a perfectly smooth paste.

The following table shows the quantity of paints required for carriages:

Kind of carriage.	Lead color.	Olive.	Black.	Metallic.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Field gun-carriage and limber with implements..	6	10	0.75	.....
Caisson with limber and implements...	8	15	0.80	.....
Forge with limber.......	6	10	1.00	.....
Battery-wagon with limber.......	7	13	0.90	.....
Siege-carriage, limber, and implements....	7	11	1.00	.....
Mortar-wagon.......	5	8	0.75	.....
Carriages and chassis, iron.				
8-inch casemate.	.....	.....	.....	About 10
8-inch barbette......	.....	.....	.....	About 11
10-inch casemate.........	.....	.....	.....	About 10
10-inch barbette....	.....	.....	.....	About 11
15-inch barbette.	.....	.....	.....	About 14
20-inch barbette....	.....	.....	.....	About 20

A priming of lead color and two coats of olive color are applied to new wood-work, and one coat of lead color and one of black, to the iron-work of field-carriages. Two coats of metallic paint are required for the iron carriages. Add 60 per cent. for 10″ and 40 per cent. for 15″ carriages with pneumatic buffers, and 30 and 20 per cent. for these carriages with hydraulic buffers. One coat will last a year. *Oriental red* is the best for iron-work, most durable, and retains its full, rich, red color better than other metallic paints. For use mix 100 pounds of oriental red paint (in a dry state) with 5 gallons of raw linseed-oil to prepare it for grinding; for use, add 10 gallons boiled linseed-oil, 1 gallon spirits of turpentine, ½ gallon Japan dryer; mix thoroughly. This mixture will make about 230 pounds. Brown metallic paint requires about the same quantity of oils, etc. The oriental red has a good body, spreads, and adheres well to iron. Vermilion red and red ochre are good substitutes when the oriental is not available; their color may be moderated by yellow ochre. Spanish brown is also a good substitute for oriental red. Mix as follows: 100 pounds of Spanish brown, with 25 pounds of red lead; grind each in raw linseed-oil before mixing. Mix as for oriental red; the red lead makes this paint dry harder and firmer, and stands exposure well. It requires about 2 gallons more oil than the oriental red.

Before painting, all blisters, rust, or accumulation of old paint should be removed with a scraper. The top of the chassis rails should neither be painted nor oiled, but kept clean by dry scraping. All iron handspikes, elevating-bars, and similar implements, are painted black, using for this purpose common black paint. Heads of bolts and edges of rails may likewise be painted black. The damp location of most artillery posts is particularly favorable to the rapid decay of material. Rust gradually eats away iron parts of carriages and machines. These defects are frequently hidden by repeated coats of paint or lacquer, making them extremely liable to lead to accident or disaster. Such parts should be carefully examined by means of punches and hammers, and no such material be suffered to remain where it is dangerous. See *Lackers*.

PAIRING. When the web of a gabion is made with two rods at a time, the process is called *pairing*.

PAIXHANS GUN. This gun, intended for ships of war or coast fortresses, and adapted to throwing shells and hollow shot, was adopted in France about 1824, and afterwards in England. It was used by the Russian fleet which destroyed the Turkish forts and ships in the harbor of Sinope. Paixhans recommended cylindro-conical projectiles as going more directly and striking more powerfully than round balls, and exposed to less resistance from the air. He believed in small ships carrying heavier guns for firing shell and hollow shot. The original Paixhans gun was $9\frac{1}{3}$ feet long, with a bore of $8\frac{2}{3}$ inches, and a weight of about 7,400 pounds. The charge was between $10\frac{1}{2}$ and 18 pounds of powder. It would bear hollow shot of 60 pounds, or solid shot of 86 to 88 pounds. The shell was mostly employed for incendiary purposes, and was either charged with gun powder alone, or, as in the French service, with gun powder and carcass composition. See *Ordnance*.

PALADIN.—A term originally derived from the Counts Palatine or of the Palace, who were the highest dignitaries in the Byzantine Court, and thence used generally for a Lord or Chieftain, and by the Italian romantic poets for a Knight-Errant.

PALAESTRA.—In Grecian antiquity, a public building where the youth exercised themselves in the military art, wrestling, running, etc.

PALANKA.—A species of permanent intrenched camp attached to Turkish frontier fortresses, in which the ramparts are revetted with large beams, rising 7 or 8 feet above the earthwork, so as to form a strong palisade above.

PALANQUIN—PALKI.—A vehicle commonly used in Hindustan by travelers, and for the transport of sick and wounded. It is usually a wooden box, about 8 ft. long 4 ft. wide, and 4 ft. high, with wooden shutters which can be opened or shut at pleasure, and constructed like Venetian blinds for the purpose of admitting fresh air, while at the same time they exclude the scorching rays of the sun, and the heavy showers of rain so common in that country. The furniture of the interior consists of a cocoa mattress well stuffed and covered with morocco leather, on which the traveler reclines; two small bolsters are placed under his head, and one under his thighs, to render his position as comfortable as possible. At the upper end is a shelf and drawer, and at the sides are nettings of larger dimensions than the ordinary pockets in carriages, for containing those articles which may be necessary during the journey. At each end of the palanquin, on the outside, two iron rings are fixed, and the *hammals*, or palanquin-bearers, of whom there are four, two at each end, support the palanquin by a pole passing through these rings. Traveling in this mode is continued both by day and night. The palanquin is also used at the present day in Brazil, with the prominent exception of Rio Janeiro.

Similar modes of traveling have been at various times in use in western Europe, but only for short distances. The Roman "litter," the French "chaise à porteurs," and the "sedan-chair" were the forms of vehicle most in use, and the two latter were in general use till they were superseded by hackney coaches. The Roman "litter" was one of the criteria of its owner's wealth, the rich man generally exhibiting the prosperous condition of his affairs by the mulitude of the bearers and other attendants accompanying him. See *Stretcher* and *Two-horse Litter*.

PALE. 1. In Heraldry, one of the figures known as ordinaries, consisting of a perpendicular band in

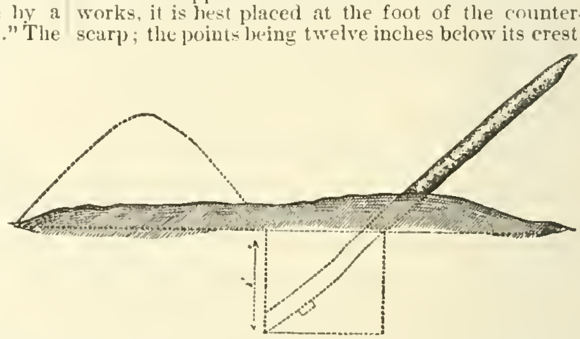
the middle of the shield, of which it is said to occupy one-third (No. 1). Several charges of any kind are said to be "in pale" when they stand over each other perpendicularly, as do the three lions of England. A shield divided through the middle by a perpendicular line is said to be "parted per pale." The Pallet is the diminutive of the pale, and is most generally not borne singly. Three pallets gules (No. 2), were the arms of Raymond, Count of Provence. When the field is divided into an even number of parts by perpendicular lines, it is called "paly of" so many pieces as the (No. 3), Paly of six argent and gules, the arms of the family of Ruthven. When divided by lines perpendicular and bendways crossing, it is called pal bendy (No. 4). An Endorse is a further diminutive of the pallet, and a pale placed between two endorses is said to be endorsed (No. 5). 2. In Irish history, pale means that portion of the Kingdom over which the English rule and English law was acknowledged. There is so much vagueness in the meaning of the term that a few words of explanation appear necessary. The vagueness arises from the great fluctuations which the English authority underwent in Ireland at various periods, and from the consequent fluctuation of the actual territorial limits of the pale. The designation dates from the reign of John, who distributed the portion of Ireland then nominally subject to England into twelve counties palatine, Dublin, Meath, Kildare, Louth, Carlow, Kilkenny, Wexford, Waterford, Cork, Kerry, Tipperary and Limerick. To this entire district, in a general way, was afterwards given the designation of the Pale. But, as it may be said that the term is commonly applied by the writers of each age to the actual English territory of the period, and as this varied very much, care must be taken to allude to the age of which the name Pale is used. Thus, very soon after the important date of the statute of Kilkenny, at the close of the reign of Edward III., the English law extended only to the four counties of Dublin, Carlow, Meath, and Louth. In the reign of Henry VI. the limits were still further restricted. In a general way, however, the Pale may be considered as comprising the Counties of Dublin, Meath, Carlow, Kilkenny, and Louth. This, although not quite exact, will be sufficient for most purposes.

PALEAGAS.—Chiefs of mountainous and woody districts in the peninsula if India, who pay only a temporary homage. Also written *Polygars*.

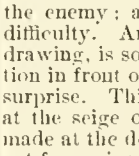
PALETTES.—The part of the armor protecting the arm-pits. *Palettes* date back to the middle of the fifteenth century, and disappear at the end of the sixteenth.

PALINTONE.—An ancient machine of war, described by Heron, Philon and Vitruvius. It was a variety of the catapult.

PALISADES.—A palisade is a stake about ten feet long, and of triangular form, each side of the triangle being eight inches. The trunks of straight trees should be selected for palisades. The diameter of the trunk should be from sixteen to twenty inches. The trunk is sawed into lengths of ten and a half feet, and is split up into rails, each length furnishing from five to seven rails. The palisade is pointed at top; the other extremity may be charred if the wood is seasoned, otherwise the charring will be of no service. A *palisading* is a row of palisades set in the ground, either vertically, or slightly inclined towards the enemy. To plant the palisades, a trench is dug three feet deep; they are then placed about three inches asunder, with an edge towards the enemy. Each palisade is nailed to a strip of thick plank, termed a *riband*, placed horizontally about one foot below the ground; another riband is placed eighteen inches below the top. The earth is firmly packed in the trench. A palisading is sometimes used as a primary means of defence, particularly for low works. A banquette is thrown up for this purpose against it; the tread of the banquette being six feet below the top of the palisading, and four feet three inches below the upper riband. As an obstacle in flanked works, it is best placed at the foot of the counterscarp; the points being twelve inches below its crest,



or else covered by a small glacis. In this position the palisading fulfills all the conditions of an efficient obstacle; it is under the fire of the work; covered from the enemy's fire; will not afford a shelter to the enemy; and cannot be cut down without great difficulty. An inclined palisading, as shown in the drawing, is sometimes placed in an advanced position in front of an ordinary trench to secure it from surprise. This was done to secure a line of trench at the seige of Fort *Wagner*. The palisading was made at the depôt in panels of four or five palisades, cut from pine saplings varying from four to eight inches in diameter, those above five inches being split in two, and placed with the bark side upwards. The spaces between the palisades were left only small enough to prevent a man forcing his body through them. See *Accessory Means of Defence*, and *Stockade*.

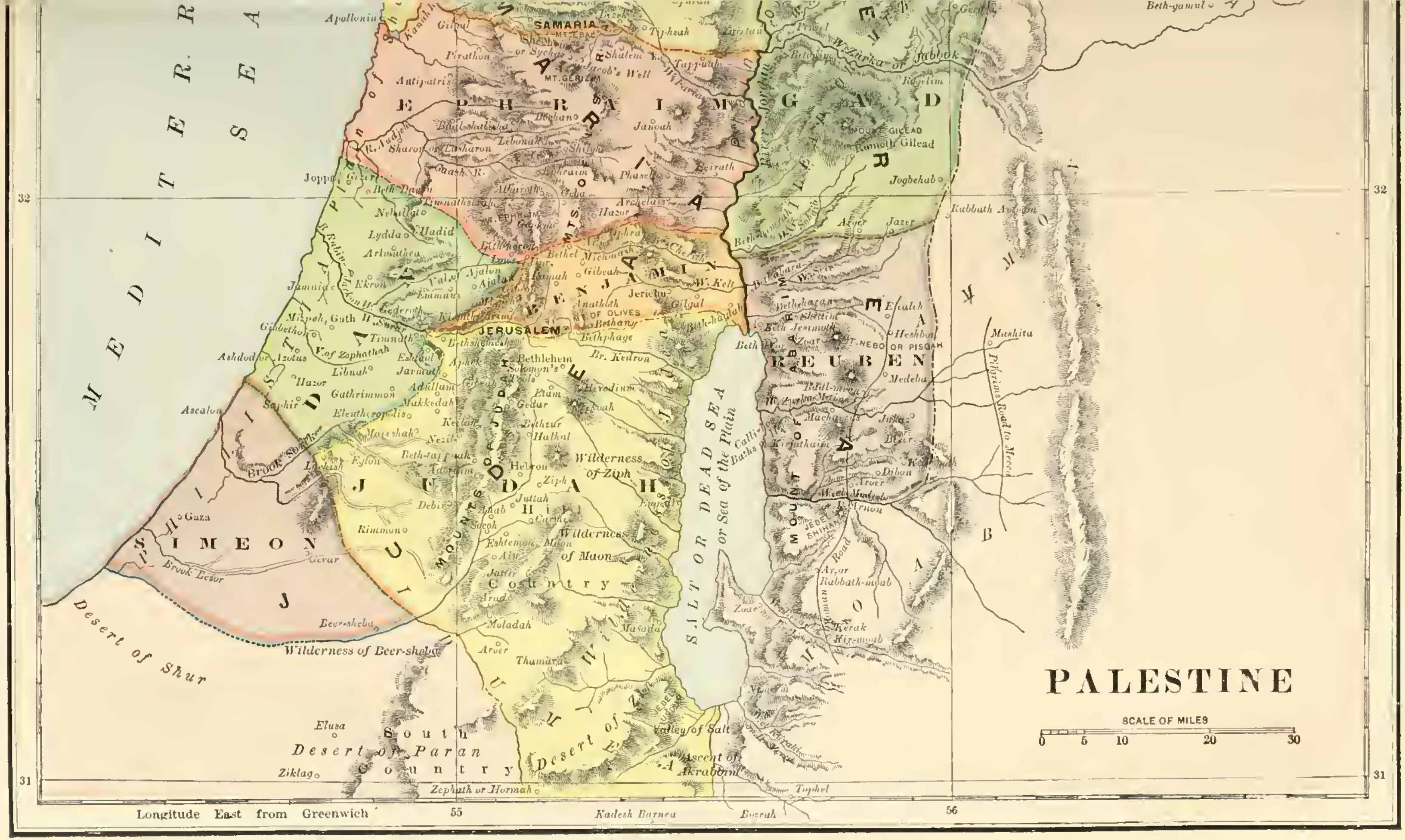


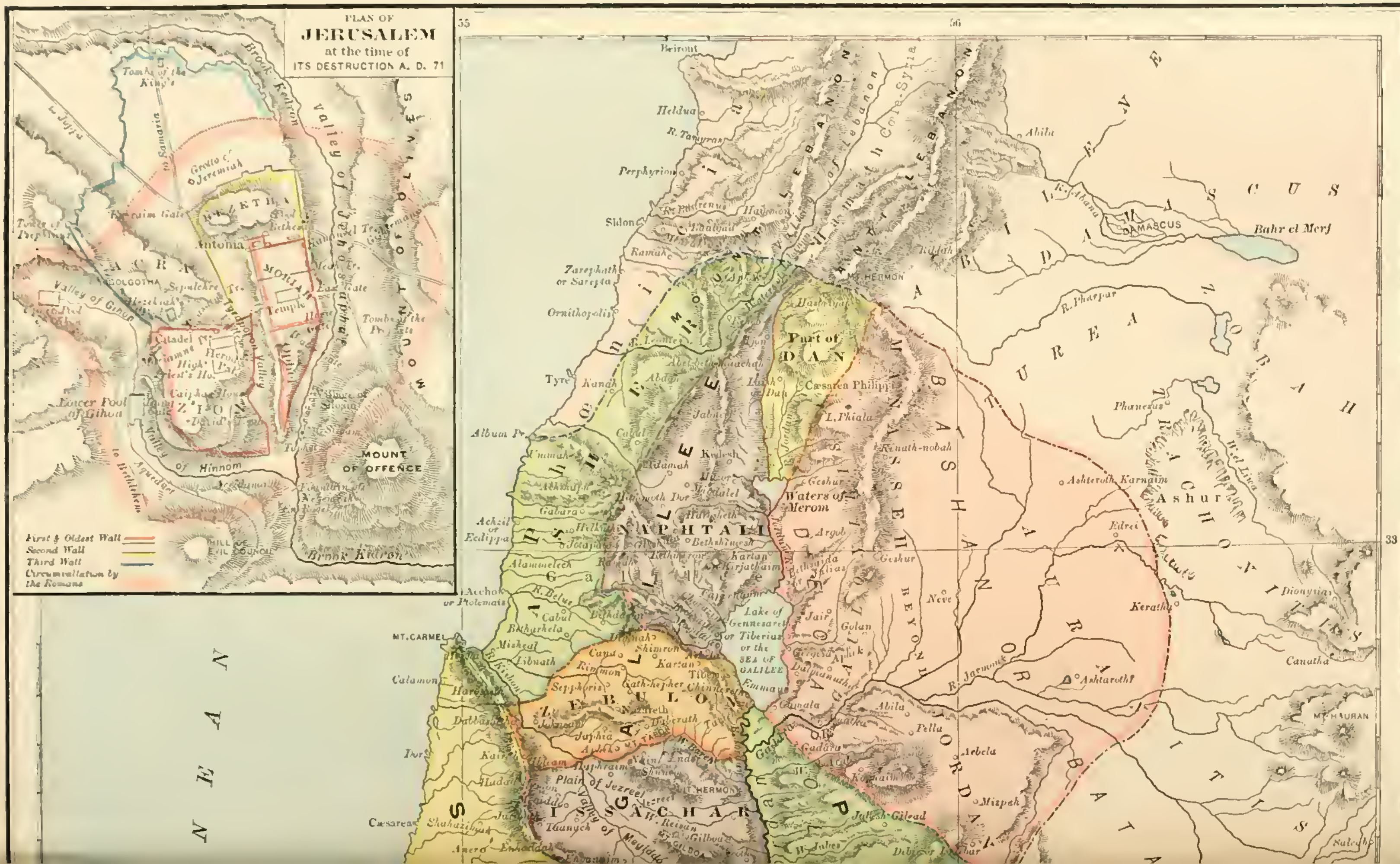
Pall.

PALL.—In Heraldry, the upper part of a saltire conjoined to the lower part of a pale. It appears much in the arms of ecclesiastical sees.

PALLISER BOLT.—A screw bolt for securing armor-plates. The end upon which the screw-thread is cut is larger than the shank. See *Bolts*.

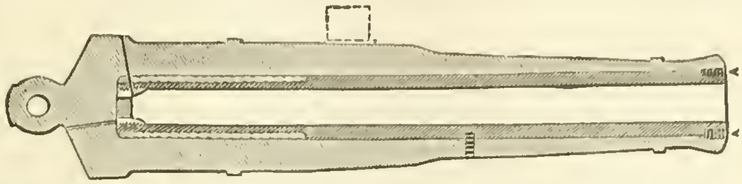
PALLISER GUN.—Major Palliser, of the British Service, describes his manner of making a gun to consist in introducing into a cast-iron gun a barrel or hollow cylinder of coiled wrought-iron, of such thickness in proportion to its caliber, that the residual strain borne by the tube shall have a relation


PALESTINE
SCALE OF MILES
0 5 10 20 30
Longitude East from Greenwich
MEDITERRANEAN SEA
SALT OR DEAD SEA
or Sea of the Plain
JERUSALEM
SAMARIA
EPHRAIM
BENJAMIN
JUDAH
SIMEON
DAN
GAD
REUBEN
MOAB
AMMON
Wilderness of Beer-sheba
Desert of Shur
Desert of Paran
South Country
Wilderness of Ziph
Wilderness of Maon
MOUNTS OF JUDAH
Bethlehem
Hebron
Gaza
Ascalon
Joppa
Lydda
Jericho
Beer-sheba
MT. NEBO OR PISGAH
MOUNT GILEAD
Pilgrims Road to Mecca
River Jordan


PLAN OF
JERUSALEM
at the time of
ITS DESTRUCTION A. D. 71
MOUNT OF OLIVES
MOUNT OF OFFENCE
Valley of Jehoshaphat
Brook Kedron
Valley of Hinnom
Valley of Gihon
Lower Pool of Gihon
Antonia
MORIAH
Temple
ZION
ACRA
BEZETHA
GOLGOTHA
to Samaria
to Joppa
to Bethlehem
Grotto of Jeremiah
Tombs of the Kings
Citadel
First & Oldest Wall
Second Wall
Third Wall
Circumvallation by the Romans
GALILEE
NAPHTALI
ZEBULON
ISSACHAR
Part of DAN
BASHAN
TRACHONITIS
AURANITIS
ITUREA
ABILENE
DAMASCUS
LEBANON
ANTI LEBANON
PHOENICIA
Tyre
Sidon
Beirout
Heldua
Sarepta
Ornithopolis
Album Pr.
Acco or Ptolemais
Achzib or Ecdippa
MT. CARMEL
Calamon
Dor
Cæsarea
Plain of Jezreel
Lake of Gennesaret or Tiberias or the SEA OF GALILEE
Waters of Merom
Cæsarea Philippi
L. Phiala
MT. HERMON
MT. HAURAN
Bahr el Merj
R. Pharpar
Ashtaroth
Ashteroth Karnaim
Edrei
Kerath
Canatha
Golan
Gadara
Pella
Arbela
Mizpah
Jabesh Gilead
R. Jarmuk
BEYOND JORDAN
55
56
33

to the strain it transmits to the surrounding cast-iron, which shall be most suitably proportioned to their respective elasticities. The precise proportions will depend on various circumstances, viz: the excessive expansion of wrought-iron due to heat, also the greater range between the limits of elasticity and rupture of this metal, and that the cast-iron will have to do nearly all the longitudinal work. By varying the thickness of the tube, the transmitted strains can be regulated with the greatest nicety.

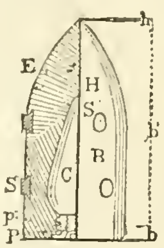
The method of construction is very simple. The gun having been bored, a coiled wrought-iron tube is inserted, as shown in the drawing. The tube consists of two thin wrought-iron barrels, the outer one being much shorter than the inner one, and shrunk to it at the breech-end. Two are used for the purpose of obtaining the benefit of the tension, and also to break the continuity of any internal fracture. The



tube is made to slightly taper, and the bore of the gun is tapered correspondingly; the tube is placed in the bore, and as soon as it comes in contact throughout its length, a screw-locking ring, A, which takes against a shoulder on the tube, is screwed into the muzzle, and sets the tube home; and since in practice it has been found that the elasticity of the wrought-iron inner tube is not proportioned to its greater elongation, the deficiency is supplied by putting the tube under slight compression, which is effected by permanently stretching the wrought-iron in the gun by heavy proof-charges. The tube is further secured in the gun by means of a screw which passes through the cast-iron shell a short distance before the trunnions at right angles to the bore, and screws into the tube.

In the larger guns Captain Palliser proposes to use two or more concentric tubes. In the very largest guns he proposes three tubes, the inner one to be of the softest and most ductile wrought-iron; the next may be of a stronger and harsher nature; the third of steel for some distance in front of the chamber. The system is being applied in the United States, and with most promising results, in the conversion of 10″ Rodman guns into 8″ rifles. In these guns the rifling consists of fifteen grooves and lands of equal width, with a uniform twist of one turn in forty feet. The shape of the groove is flat. The center of gravity is, by this alteration, thrown in front of the axis of the trunnions. This renders a special elevating apparatus necessary. The rifle thus obtained, though giving to a projectile a less muzzle velocity than does the 10″ smooth-bore, has, on account of the increased weight of shot, greater penetrating power at all ranges, being doubled at some and trebled at others. Its accuracy is three times greater and the capacity of its shell twice that of the original gun. See *Built-up Guns*, *Converted Guns*, and *Ordnance*.

PALLISER PROJECTILES.—The French and Woolwich systems differ only in the form and position of the studs, and the material of which they are made; in each system, the number of buttons varies with the size of the gun, there being, however, always one set for each groove in the piece. The body of these projectiles is made of cast-iron; the form is cylindro-ogival. The studs, of an alloy of copper and tin, are secured to the projectile by being pressed into undercut holes; their shape differs with the kind of rifling employed. Two studs to each groove are used for all guns smaller than 12 inches in caliber, and, except for cored shot, are at equal distances from the center of gravity, and the same distance apart on all projectiles for the same gun. The bearing of the projectile is on the studs alone. The solid shot are constructed on the plan of Major Palliser, formerly of the Royal Artillery, and are designed especially for the penetration of armor. They consist, as shown in the drawing, of the *body* B, from *(b)* to *(b′)*; of the *head* H, from *(b′)* to *(h)*; the *cavity* C; the *studs* S; the *screw-plug* P, with its *bushing (p)*; and two *extractor-holes*, one shown at E. The essential feature of this projectile is that the body is cast in a sand mold and the head in one of metal. By this means, the head is chilled white nearly to the center, and acquires the properties of intense hardness, crushing strength, brittleness, and high density. Hardness here relates to the rigidity of actual particles, and crushing strength to the rigid connection or building up of particles so as to resist their being forced in upon each other. The deficiency of the head in tenacity is met by the form given to it. The body of the projectile, being cast in sand, has greater tenacity than the head; a sounder casting is ensured; and the metal is rendered much less subject to the action of the molecular forces which may either split it in store, or crack it so as to cause rupture in the bore of the gun; the presence of the cavity



also reduces this liability, and adds to the strength of the projectile, as it is very difficult to obtain a solid casting from such a metal, and any defect in this respect would be a source of weakness. The shape of the cavity is especially adapted to the work required. The iron is cast about the bushing in the base, which is of wrought-iron, as the metal employed, even when cast in sand, is too hard to admit of tool work. The Palliser Shell also is designed for the penetration of armor, and differs from the shot in construction only, having a larger cavity in order that a bursting-charge may be used. No fuse is employed, the charge being ignited by the heat produced in the metal on impact. To prevent the explosion from taking place before penetration is accomplished, the interior of the shell is covered with a lacker, and the charge is placed in a woolen bag. The Boxer shrapnel, named from its inventor, embodies all the features essential to such a projectile. The charge being at the base, the tendency is, on explosion, to increase the forward velocity of the bullets instead of their lateral spread. See *Studded Projectiles*.

PALM.—That measure of length, originally taken from the width of the hand, measured across the joints of the four fingers. In Greece it was known as *palaiste*, and was reckoned at 3 in., or $\frac{1}{8}$ of a cubit, which was their standard unit. The Romans adopted two measures of this name—the one was the Greek *palaiste*, and was called *palmus minor*; the other, which was not introduced till later times, was called *palmus major*, or *palma*, and was taken from the *length* of the hand, being therefore usually estimated at three times the length of the other. At the present day, this measure varies in a most arbitrary manner, being different in each country, and occasionally varying in the same. The English palm, when used at all, which is seldom, is considered to be the fourth part of an English foot or 3 inches.

The following is a list of the most common measures to which the name palm is given :

	Value in Eng. inches.
Greek *palaiste* . . . . . . =	3.03375
Roman *palmus*, or lesser palm . =	2.9124
" *palma*, or greater palm . =	8.7372
English palm (¼ of a foot) . . =	3.0000
Hamburg palm (⅓ of a foot) . . =	3.7633
Amsterdam "round" palm . . =	4.1200
" "diameter" palm . . =	11.9687
Belgian palm / Lombard palm } properly the *decimeter* =	3.9371
Spanish Palm, or *palmo major* . . =	8.3450
" " or *palmo minor* . =	2.7817
Portuguese palm, or *palmo de Craveira* =	8.6616

In Germany and in the low countries the palm is generally confined to wood-measurement, while in Portugal it used to be the standard of linear measure.

PALMER EQUIPMENT.—The Equipment, invented by Lieutenant George H. Palmer, of the U. S. Army, consists of carrying-braces, coat-straps, knapsack, and haversack—the whole weighing 3½ pounds. The haversack, which is a little smaller than the knapsack, is carried on the right side, the knapsack on the left side The carrying-braces consist of a back-pad and double shoulder-straps—two straps for each shoulder. The shoulder-straps are attached to the back-pad by rivets, so as to be movable on their fastenings. The back-pad gives additional bearing-surface for the weight carried. Its shape enables the shoulder-straps to be attached in such a manner as to separate them on the back and shoulders. The back-pad, in connection with the shoulder-straps, prevents the weight carried from pulling directly downward on the shoulders, instead of which it tends to pull toward the center of the back by means of a pad supporting a portion of the weight. Two straps are attached to the front ends of each shoulder-strap, for supporting the front corners of the bags, the waist-belt, and cartridge-boxes. To the back-pads are fastened rings which hold the blanket-straps. Two straps are attached to the pad for supporting the rear corners of the bags. On these straps is a double loop, which may be moved down or up, for the purpose of drawing the bags together at the back, or to permit them to hang at the sides. A strap looped at each end is on the blanket-straps and passes underneath the straps supporting the bags, for the purpose of holding the blanket more firmly in place when marching at double time. At the bottom of the bags are straps with buckles for drawing the bags together at the back and to retain them more firmly in place.

PALUDAMENTUM.—A military mantle, worn by the ancient Romans, differing little, if at all, from the Chlamys. It was worn by the officers and principal men in the time of war, who were therefore called *Paludati*, and this distinguished them from the common soldiers, who, because they wore the *Sagum*, were called the *Sagati*. The Paludamentum, which was generally white or red, came down to the knees or lower, was open in front, hung loosely over the shoulders, and was fastened across the chest by a clasp. Also written *Paludimentum*.

PALY.—A term used in Heraldry, to signify division into four or more equal parts by perpendicular lines, and of two different tinctures disposed alternately. See *Pale*.

PAN.—1. That part of the lock of a musket, pistol, etc., which holds the priming powder, the necessity of which is superseded by the use of percussion-caps. 2. The distance which is comprised between the angle of the epaule and the flanked angle in a fortification. 3. In military history, one who was Lieutenant General to *Bacchus* and his Indian expedition. He is recorded to have been the first author of a general shout, which the Grecians practiced in the beginning of their onsets in battle.

PANACHE.—A plume worn upon the crest of an ancient helmet. The term is now commonly applied to any military plume or feather.

PANCARTE.—An ancient exercise or tournament, which was performed in the Roman Amphitheater, when strong, athletic men were opposed to all sorts of enraged animals.

PAN COUPE.—The short length of parapet by which the salient angle of a work is sometimes cut off.

PANDOURS.—A people of Servian origin who lived scattered among the mountains of Hungary, near the village of Pandour in the county of Sohl. The name used to be applied to that portion of the light-armed infantry in the Austrian service which is raised in the Slavonian districts on the Turkish frontier. The Pandours originally fought under the orders of their own proper chief, who was known as Harun-Basha, and rendered essential service to the Austrians during the Spanish war of succession, and afterward in the Seven Years War. They originally fought after the fashion of the "free lances," and were a terror to the enemy whom they annoyed incessantly. Their appearance was exceedingly picturesque, being somewhat oriental in character, and their arms consisted of a musket, pistols, a Hungarian saber, and two Turkish poniards. Their habits of brigandage and cruelty rendered them, however, as much a terror to the people they defended as to the enemy. Since 1750 they have been gradually put under a stricter discipline and are now incorporated with the Austrian frontier regiments.

PANIC.—A term employed where fear, whether arising from an adequate or inadequate cause, obtains the mastery over every other consideration and motive, and urges to dastard extravagance, or hurries into danger or even unto death. An inexplicable sound causes a rush from a church, a vague report in the market-place causes a run on a bank, and precipitate the very events that are dreaded. This emotion either differs from natural apprehension, or presents so intense and uncontrollable a form of the feeling, that it is propagable from one person to another, and involves alike the educated and ignorant —those who act from judgment as well as those who act from impulse. There are, besides this feature, several grounds for believing that such manifestations of involuntary terror are of morbid origin, and should be regarded as moral epidemics. They have generally arisen during, or have followed, seasons of scarcity and of physical want and disease, the ravages of war or periods of great religious fervor and superstition. The dancing mania, the retreat of the French Army from Moscow, and recent and familiar commercial panics afford illustrations of certain of these relations. The most notable instance of universal panic, and that which demonstrates most aptly the connection here indicated, is the dread of the approaching end of the world which pervaded all minds, and almost broke up human society, in the 10th century. The Empire of Charlemagne had fallen to pieces ; public misfortune and civil discord merged into misery and famine so extreme that cannibalism prevailed even in Paris ; superstitions and vague predictions became formalized into a prophecy of the end of all things and universal doom in the year 1000. This expectation suspended even vengeance and war. The "Truce of God" was proclaimed. Enormous riches were placed upon the altars. Worship and praise never ceased. The fields were left uncultivated ; serfs were set free ; four Kings and thousands of Nobles retired to the cloister ; and all men, according to their tendencies, prepared to die. It is worthy of note that during all pestilences there have arisen epidemic terrors, not so much of the devastations of disease, as of plots and poisonings directed by the rich against the poor. Even where these epidemic terrors are legitimately traceable to local and physical causes, as in the case of the singular affection timoria, which occurs in the marshy and unhealthy districts in Sardinia, the tremor and trepidation, and other phenomena, are ascribed to the magical influence of enemies.

PANNELS.—In artillery, the carriages upon which mortars and their beds are conveyed on a march.

PANNIERS.—1. Shields of basket work formerly used by archers, who set them up in front during battle. 2. Wicker baskets of various shapes, usually slung in pairs over the back of a pack-animal to carry a load. Also leather bags used in the same way; and especially the cases used for carrying medicines. See *Pack-saddle.*

PANONCEAU.—An ancient name for an ensign or banner.

PANOPLY.—Complete armor or defense; a full suit of defensive armor.

PANTAGRAPH — PANTOGRAPH.—An instrument for copying maps and other drawings. Its invention is ascribed to Christopher Scheiner, a Jesuit, in 1603. It has since undergone various modifications and improvements. It usually consists (Fig. 1) of four metallic rules, jointed two and two, and perforated with holes, a tracer, a pencil or picker; and a screw or point which is forced into the drawing-board or table to hold the instrument in position. For use, the rules are secured to each other by inserting thumb-screws through the holes corresponding with the scale to which the drawing is to be reduced or enlarged. The micropantagraph, used for copying *microscopic dispatches*, may be described as a system of connected pantagraphic levers, the least of which carries a piece of glass on which the original is reduced in a proportion determined by the relation between the lengths of the longer and shorter arms of the series. The glass rests and moves upon a diamond-point while the point remains stationary. The diamond may be raised or lowered by appropriate mechanism, to regulate the width and depth of the cut, or entirely remove it from the glass. With an instrument of this kind the Lord's Prayer has been written within the space of $\frac{1}{356000}$ of a square inch. In the same ratio the whole of the Old and New Testament would be contained within $\frac{1}{27}$ of

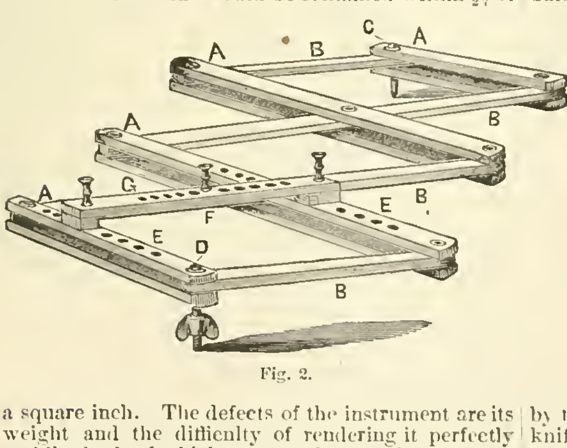


Fig. 2.

a square inch. The defects of the instrument are its weight and the difficulty of rendering it perfectly mobile, both of which prevent that steady motion of the tracer which is necessary for making an accurate copy. To remedy these defects, the pantagraph has been constructed in a variety of forms, all of which, however, like the one described, depend upon the principle that the two triangles which have, for their angular points, the fulcrum the pencil-point and a joint, and the fulcrum, the tracer-point, and a joint, must always preserve their similarity.

Fig. 2 shows the instrument arranged for use as an accessory to the indicator, to reduce the motion between the cross-head, or any other part of the engine, and the indicator.—See *Lazy Tongs.*

PANTHER.—A term in Heraldry. The *panther* is borne gardant and incensed, *i.e.*, with fire issuing from his mouth and ears.

PANZERBRECKER.—An ancient small, three-sided poniard. It figured conspicuously at the battle of Bouvines, in 1214.

PAPEGAI. A popinjay; a bird made of wood or pasteboard, stuck upon a lance, and used as a mark when practicing with the bow, cross-bow, musket, etc.

PAPER AMMUNITION FOR SMALL ARMS. There are two kinds of paper cartridges used in the United States Service, the ball-cartridge, made with a single elongated ball, and the blank cartridge.

Lead balls are made by compression, by means of machines for that purpose. Balls thus made are more uniform in size and weight, smoother, more solid, and give more accurate results than cast balls.

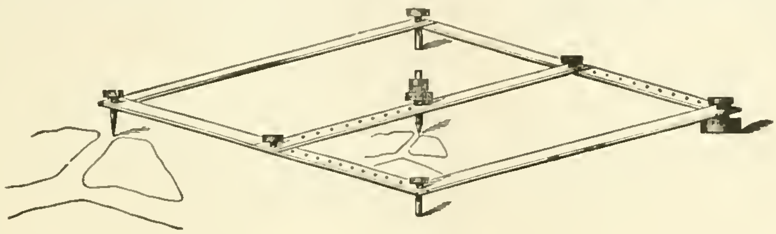


Fig. 1.

The lead is first cast into round cylindrical bars, .58 inch in diameter for the calber .58, and 21 inches long, and then rolled to .46 inch in diameter; length, 25 inenes. These bars are fed to the machine, which cuts off a part sufficient for one ball and transfers it to a die, in which the ball is formed, with cavity and rings, the surplus metal being forced out in a thin belt around the ball in the direction of its axis. The balls are trimmed by hand, with a knife, and are then passed through a cylinder-gauge of the proper size. One man can make with the machine 30,000 balls in ten hours, the bars of lead being prepared for him. One man can cast 1,500 bars in ten hours, and can trim and roll 2,000 bars in ten hours. A boy can trim and gauge 5,000 in 10 hours. Bullet-molds are provided to cast balls where the pressed balls cannot be had. The mold is so constructed as to trim the balls by a single operation before they are taken from the mold. To grease the balls, place them on their bases on a tin frame capable of holding 50 balls, and immerse it in a melted mixture of one part of tallow and eight of beeswax, kept warm, until the cylindrical part of the ball is covered. Remove the frame and let it stand till the grease hardens. Three frames are required for each boy.

The paper is first cut into strips of a width equal to the length of a trapezoid, using the pattern as a guide. The paper and ruler are kept from moving by means of a lever, one end of which is fixed and the other is moved by the foot by means of a cord and treadle. The knife is held in both hands. From six to eight reams may be cut at a time in this way. A cutting-machine like that used by book-binders facilitates the operation when many hands are employed. When only a knife and ruler are used, about 12 sheets are cut at a time.

The following implements are required by each workman when making the cartridges:

Two *boxes* to hold cylinders, 20 inches long, 8 inches wide, and 4 inches high, in the clear, made of ½-inch boards, without a cover; they are placed on their sides, their backs inclined against the partition in the middle of the cartridge-table, the front resting on cleats nailed to the table; 1 *former*, cylindrical, of hard wood, of the same diameter as the ball, 6 to 7 inches long, one end pointed almost as much as the ball, and marked with a shallow groove 4 inches from the end; 1 *sabot* or *frame*, tacked to the table, to hold balls, placed at the left hand of the boy; 1 *spool of thread*, turning on a vertical spindle fixed in the table near the balls; 1 *choking-string*, made of four or five cartridge-threads twisted together, about 9 inches long, with a wooden toggle at the end, fastened to the edge of the table at the right hand of the boy; 1 *knife blade*, 1½ inch long, hooked, driven into the front of the table below and near the choke-string.

To form the cylinder, lay the trapezoids on the table with the sides perpendicular to the bases, toward the workman, the broad end to the left. Take the former in the right hand and lay it on a trapezoid, the groove in the former against the right edge of the paper, bringing the pointed end ⅓ inch from the broad end of the paper; envelop the former with the paper; then, with the fingers of the left hand laid flat upon the paper, turn the former and roll all the paper upon it; hold it firmly with the left hand and, with the choking-string in the right, take one turn around the cylinder at about ⅜ inch from the end; hold the former firmly in the left hand and draw gently upon the choking-string, pressing at the same time with the left forefinger upon the projecting end of the cylinder, thus folding it neatly inder on it, on a second trapezoid; put a ball over the end of the former; roll the paper on the former and the ball; hold the cylinder in the left hand and choke and tie it as thus described for the inner cylinder; withdraw the former, pressing the cylinder with the left hand, and place it in the box.

The following implements are required to fill the cylinder:

One *charger*, made of a cylinder of wood or brass pierced with two holes through its length, holding the exact charge of powder; a funnel attached to one end of the cylinder, and a discharge pipe to the other. The holes in the cylinder are made to communicate and shut off, alternately, from the funnel holding the powder, and the discharge-pipe at the lower end, by a reciprocating motion given to the cylinder by the hands. Fill the funnel with powder, insert the discharge-pipe in a cartridge, holding the charger in both hands, and turn the cylinder; the charge of powder is deposited in the cartridge; insert the pipe in the next, and turn the cylinder in the opposite direction, and continue in the same way for all the rest. Cartridges may be filled with a copper charger made to hold the exact charge, pouring the powder by means of a small funnel, which is inserted in the cartridge.

To pinch the cartridge, take it in the right hand, strike it lightly on the table to settle the powder; flatten the empty part of the cylinder and bend it flush with the top of the powder at right angles to the cartridge, the oblique side of the trapezoid on top, the cartridge standing vertical on the table; fold the flattened part in the direction of its length, with two folds from the exterior, meeting in the middle; bend this folded end back on itself and strike it on the table to set the folds.

The following utensils are required to bundle the cartridges:—1 *box* without ends or top, width equal to five times the diameter of the ball, height equal to twice that diameter, and length that of the cartridge.

CARTRIDGES FOR SMALL-ARMS.

Kind of cartridge	Expanding-ball.		Blank.	Elongated ball.			
Kind of arm	Musket and rifle (1855).	Cadet musket (1857).	Musket and rifle (1855).	Pistol, carbine.	Revolver, Army.	Revolver, Navy.	Sharp's carbine.
Caliber ... inches	.58	.58	.58	.58	.44	.38	.54
Ball — Diameter ... inches	.5775	.5775	....	.5775	.46	.39	.56
Ball — Weight ... grains	500	450	....	450	216	145	475
Charge of powder ... do	60	50	60	40	30	17	50
Trapezoid — Height ... inches	4.12	4.12	3.75	4.1	2.75	2.4	3
Trapezoid — Long base ... do	4.0	4.0	4.16	4.0	3.25	2.5	3.25
Trapezoid — Short base ... do	2.5	2.5	2.2	2.5	1.6	1.6	2.25
Number of trapezoids in one sheet	16	16	24	16	30	40	24
Wrapper — Length ... inches	9	9	....	9	8	7.5	10
Wrapper — Width ... do	6.5	6.5	....	6.5	6.5	4.9	6.8
Wrapper — Number in one sheet	6	6	....	6	6	12	4
Wrapper — Color	Ordinary. color.	Red.....	Ordinary.	Blue	Ordinary.	Blue	Ordinary.
Thread for 1,000 ... ounces	.5	.5	....	.5	.5	.5	.5
Weight of 10 cartridges ... do	13.5	13	....	12.5	6	5	13.5
Bundles of 10 — Length ... inches	2.6	2.5	....	2.4	2.3	2.20	2.6
Bundles of 10 — Width ... do	2.9	2.9	....	2.9	2.0	1.9	2.5
Bundles of 10 — Depth ... do	1.15	1 15	....	1.15	.85	.85	1.1
Size of packing-boxes for 1,000 cartridges — Length ... do	14.75	....	15.5	....	13.1	10.5	14.75
Size of packing-boxes for 1,000 cartridges — Width ... do	10.75	....	11.0	....	4.6	3.8	8.9
Size of packing-boxes for 1,000 cartridges — Depth ... do	6.38	....	6.25	....	3.5	3.25	5.2
Weight of box packed ... pounds	98	....	....	....	28.5	16.5	78
Color of box	Olive	Gray.....	Olive.....	Yellow...	Olive	Blue.....	Olive.....
Packing-box for 1,000 balls — Length ... inches	8.25	8.25	....	5.25	....	....	....
Packing-box for 1,000 balls — Width ... do	8.25	8.25	....	5	....	....	....
Packing-box for 1,000 balls — Depth ... do	5	4.25	....	4.25	....	....	....
Packing-box for 1,000 balls — Weight ... pounds	73	59.5	....	59.5	....	....	....

down upon the end of the former. Having choked the cylinder close, carry it to the right side, and with the thread in the right hand, take two half-hitches firmly around the part that has been choked; cut the thread on the knife-blade and press the choke in a cavity in the table; place the former with a cyl- It is tacked to the table, the sides parallel to and near the edge of the table.

Put a wrapper in the box, the long side perpendicular to the edge of the table, the middle of the paper in the middle of the box; parallel to the sides of the box, two tiers of cartridges of 5 each, the balls alternating; bring the short ends of the paper together and fold them twice close down on the cartridges; insert a package of caps in the end of the bundle next to the ends of the lower tier; fold the wrapper on the ends and tie the bundle, first in the direction of the length, then its breadth, with the twine fastened in a single-bow knot.

When making blank cartridges, cut the paper into trapezoids, as for the ball-cartridges; roll the trapezoid on the former one turn, fold down this much of the paper on the head of the former with the left hand; roll the rest of the paper; fold down the rest of the paper; touch the fold with a little paste on the finger; press the end of the informer on a ball imbedded in the table for the purpose; remove the cylinder from the former; place it in a box to dry. Fill the cylinders, as described, for ball-cartridges.

Balls are packed in boxes with tow or saw-dust, to prevent their bruising. The boxes are made of 1-inch boards, and contain 1,000 balls. They are marked on both ends with the number and kind of balls, and on the inside of the cover with the place and date of fabrication. The cover is fastened with six 2-inch screws, and the boxes must be hooped with iron for transportation. They are not painted.

The cap for small-arms is made of copper. It is very slightly conical, with a rim or flange at the open end; it has four slits, extending about half the height of the cap. The cap is charged with *fulminate of mercury*, mixed with half its weight of niter, the object of the *niter* being to render the fulminate less explosive and to give body to the flame. To protect the percussion-powder from moisture, and also to secure it from falling out, it is covered over, in each cap, with a drop of pure shellac varnish. *The copper for making the caps* is obtained in sheets 48 inches long and 14 inches wide, weighing 3 pounds; a variation of 4 ounces, more or less, is allowed. The copper should be pure, free from seams, holes, or blisters, well annealed, and as evenly rolled as possible, with straight and smooth edges. The copper is cleaned by immersion in a pickle made of one part (by measure) of sulphuric acid and forty parts water; it is scoured with fine sand and a hand-brush, and washed in running water; after which it is well dried in clean saw-dust and rubbed over with a cloth slightly oiled; it is then ready for the machine. See *Ammunition*.

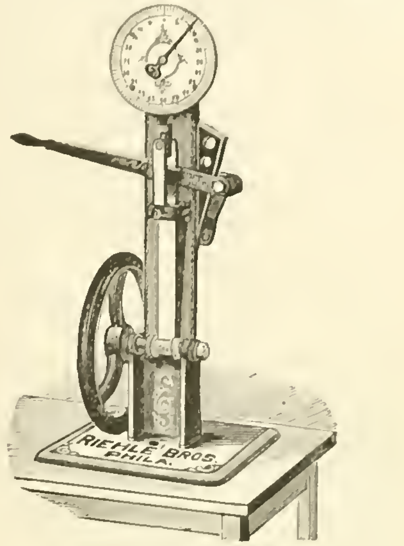
PAPERSHELL.—A species of fireworks, in the shape of an ordinary shell made of paper, filled with decorative pieces, and fired from a mortar. It contains a small bursting charge of powder, and has a fuse regulated to ignite it when the shell reaches the summit of its trajectory.

PAPER-TESTER.—A machine for ascertaining the strength of various papers. The drawing shows such a contrivance with the following:

DIMENSIONS.		ADAPTATION.
Extreme height.......	2 ft.	Tensile specimens 12 in. long
Extreme length........	1 ft.	by 1 in wide or less.
Extreme width.........	1 ft.	Capacity.............. 100 lbs.
Weight	45 lbs.	

A weight balance indicates the strain. There are no loose weights. A weighing beam can be substituted for a spring balance if desired. When the specimen is secured, the wheel at the end of the machine being turned, causes the mandrel to turn and apply the strain to specimens. The indicator, on the face of the dial, remains stationary at the breaking point. A test can be made with speed and accuracy. The machine is quite valuable in testing the qualities, etc., of papers for the laboratory. See *Testing Machine*.

PAPER TIME FUSE.—A fuse consisting of a cylindrical column of burning composition packed in a paper case, gradually increasing in thickness from its lower to its upper or outer extremity: to insure ignition, it is primed with rifle-powder at the larger end. It is inserted at the time of loading the piece into a brass or wooden plug previously driven into the fuse-hole of the shell. The composition has the same ingredients as gunpowder, the proportions being varied to suit the required rate of combustion; pure *meal powder* gives the quickest composition; by adding certain proportions of sulphur and niter, the composition burns more slowly. The rate of burning also depends upon the density of the composition



Paper tester.

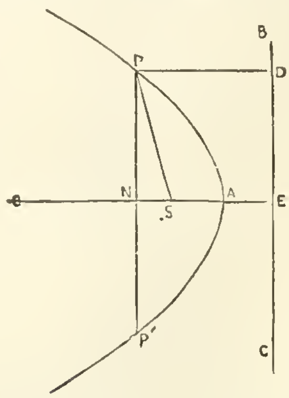
and the purity and thorough mixture of the ingredients. These fuses vary in length, burning from 4 to 40 seconds; they are graduated in seconds on the outside of the case, and can be cut to a length corresponding to any time of flight. See *Fuse*.

PAPIER-MACHE.—From the extension of the applications of papier-maché in the laboratory, modifications have taken place in its composition, and it is now of three kinds—1st, the true kind, made of paper pulp; 2d, sheets of paper pasted together after the manner of pasteboard, but submitted to far greater pressure; and 3d, sheets of thick millboard cast from the pulp are also heavily pressed. The term papier-maché is in trade held to apply rather to the articles made of the pulp than to the pulp itself; and a vast manufacture has sprung up during the present century, particularly in Birmingham, in which a great variety of articles of use and ornament are made of this material. They are coated with successive layers of asphalt varnish, which is acted upon by heat in ovens until its volatile parts are dissipated, and it becomes hard, and capable of receiving a high polish. The fine surface which can be given to the asphalt varnish also permits of burnished gilding and other decorative applications with excellent effect.

PAPILIO.—A square Roman tent for eight men.

PAPYROGRAPHY.—A term applied to a modified process of photolithography for enlarging copies of maps, which is considered to possess certain advantages for use in the field. The process is carried out by means of an ink invented by Captain Abney, which is not greasy, and drawings made with which upon ordinary paper might be transferred to stone or zinc, for the reproduction of topographical maps and military sketches. This invention has been introduced into the British Army.

PARABOLA.—One of the conic sections, produced by a plane not passing through the vertex, which cuts the cone in a direction parallel to that of a plane touching the convex surface of the cone. A little consideration will show that a section so produced cannot be a closed curve, but its two branches, though continually widening out from each other, do not diverge so rapidly as in the hyperbola. The nearer the cutting plane is to that touching the cone, the less the two branches diverge; and when the two planes coincide, the branches also coincide, forming a straight line, which is therefore the limit of the parabola. It may otherwise be considered as a curve, every point of which is equally distant from a fixed straight line and given point; the fixed straight line is called the *directrix*, and the given



point the *focus*. Thus PAP′, is a parabola, any point P in which is equally distant from the focus S and the directrix CB, or $PS = PD$. If, from S, a perpendicular, SE, be drawn to the directrix, and produced backward, this line, AO, is the *axis* or *principal diameter* of the parabola, and the curve is symmetrical on both sides of it. As A is a point in the parabola, $AS = AE$, or the *vertex* of a parabola bisects the perpendicular from the focus to the directrix. All lines in a parabola which are parallel to the axis cut the curve in only one point and are called *diameters*. All lines, such as PP′, which cut the curve in two points, are ordinates, and the diameter to which they are ordinates, is that one which bisects them; the portion of this diameter which is intercepted between the ordinate and the curve, is the corresponding abscissa. From the property of the parabola that $PS = PD$, the equation to the curve may be at once deduced for $PS = PD = EN$, therefore PS^2 (which $= PN^2 + NS^2$) $= EN^2$; hence $PN^2 = EN^2 - NS^2 = (ES + SN)^2 - NS^2 = ES^2 + 2\ ES.SN =$ (since $ES = 2AS$) $4AS^2 + 4AS.SN = 4AS (AS + SN) = 4AS.AN$; and calling PN, the semi-ordinate, y; AN, the abscissa, x; and AS, a; the equation to the parabola becomes $y^2 = 4ax$, where a (the distance of the vertex from the focus) remains the same for all points in the same curve. It is evident from the equation, as well as from the geometrical derivation of the parabola, that it must have two, and only two branches, and that the further it is extended the nearer its branches approach to the condition of straight lines parallel to the axis, though they never actually become so. The parabola has no asymptotes, like the hyperbola, but it possesses many properties which are common to it with that curve and the ellipse. In fact, the parabola is nothing more than an ellipse, whose major axis is infinitely long. If parallel rays of light or heat fall upon the concave surface of a paraboloidal mirror, they are reflected to the focus, and conversely, if a light be placed in the focus of a paraboloidal reflector, its rays will be reflected in parallel directions, and would appear equally bright at all distances did light move without deviation, and unabsorbed. Also, if a body be projected in a direction not vertical, but inclined to the direction of gravity, it would, if undisturbed by the resisting force of the atmosphere, describe accurately a parabola whose axis is vertical, and whose vertex is the highest point reached by the body. The term parabola is used in analysis in a general sense, to denote that class of curves in which some power of the ordinate is proportional to a lower power of the abscissa. Thus the curve we have just described, and which is distinguished as the *common* or Apollonian parabola, has the square of its ordinate proportional to its abscissa; the *cubical* parabola, has the cube of its ordinate proportional to its abscissa; and the *semicubical* parabola has the cube of its ordinate proportional to the square of its abscissa.—See *Projectiles* and *Trajectory*.

PARACHUTE.—A machine invented for the purpose of retarding the velocity of descent of any body through the air, and employed by aëronauts as a means of descending from balloons. It is a gigantic umbrella, strongly made, and having the outer extremities of the rods on which the canvas is stretched, firmly connected by ropes or stays to the lower part of the handle. The handle of the parachute is a hollow iron tube, through which passes a rope connecting the balloon above with the car (in which are the aëronauts and their apparatus) beneath, but so fastened, that when the balloon is cut loose, the car and parachute still remain connected. When the balloon ascends, the parachute collapses like an umbrella; but when the balloon rope is severed, and the car begins to descend, the parachute is extended by the action of the air, and prevents the car from acquiring a dangerous velocity of descent; the final velocity in those cases where the machine is of a size proportioned to the weight it has to support, being no more than would be acquired by a person leaping from a height of between two and three feet. But the slightest derangement of the parachute's equilibrium, such as might be caused by a breath of wind, or the smallest deviation from perfect symmetry in the parachute itself, immediately produces an oscillatory motion of the car, having the apex of the parachute as a center, and the oscillations becoming gradually greater and more rapid, the occupants of the car are in most cases either pitched out or are along with it dashed on the ground with frightful force. This defect in the parachute has been attempted to be remedied in various ways, but hitherto without success. The first successful experiment with the parachute was made by Blanchard at Strasburg in 1787, and the experiment has been often repeated by Garnerin and others; very frequently, however, with fatal results. The parachute was employed by Captain Boxer, R.N., as an essential part of his patent light-ball, for discovering the movements of an enemy at night, and was so arranged as to open up when the lighted ball had attained its greatest elevation, so as to keep it for a considerable period almost suspended in the air.

PARACHUTE LIGHT.—A suspended light invented by General Boxer, R.A., and which is used for the same purposes as *ground light-balls*, viz.: to light up the enemy's works and working parties. It is preferred to light-balls, as they can be extinguished or their lights hid with a few shovels full of earth, whereas the parachute has the advantage of being out of reach, so it cannot be interfered with.

The *parachute light* consists of two outer and two inner tinned iron hemispheres; the two outer are lightly riveted together, the two upper hemispheres are connected by a chain; the inner upper hemisphere has a depression at the top, to admit the bursting charge and fuse. A quick-match leader conducts the flash from the bursting charge to the fuse composition in the lower inner hemisphere. The inner upper hemisphere contains the parachute tightly folded up. To insure its opening, a cord is passed between its folds, and through a hole in the top of the parachute, and is fastened to the upper inner hemisphere, so that, when the hemisphere is blown away, the cord is pulled and the parachute expanded. The lower inner hemisphere contains the composition. A hole is bored, and driven with fuse composition, and matched as usual: this hemisphere is connected with the parachute by cords and chains;

The bursting charge is issued in the parachute, the fuse is bored to the required length and well hammered in; the parachute placed in the mortar, and fired.

The action is further described as follows: The fuse ignites the bursting charge, the outer hemispheres are blown away, and the inner upper hemisphere, which is chained to the outer one, is blown away with it; the parachute is opened by the cord and expands, the composition in the lower hemisphere being ignited by the quick-match leader, which ignites the fuse composition, the composition burning about three minutes when fired from the 10-inch mortar.

PARACHUTE LIGHT-BALL.—A thin shell, the upper half of which is blown off by the charge at a certain height. The lower half, filled with composition, which is kindled by the explosion, is kept floating in the air by means of a small parachute, which is set free when the upper half of the shell flies off.

PARADE. This word signified in its original sense a prepared ground, and was applied to the court-yard of a castle, or to any inclosed and level plain. From the practice of reviewing troops at such a spot, the Review itself has acquired the name of Parade. In its modern military acceptation, a *Parade* is the turning out of the garrison or of a regiment in full equipment, for inspection or evolutions before some superior officer. It is the boast of British troops that their line and discipline are as perfect under an enemy's fire as on the parade-ground. Parades are General, Regimental, or Private (Troop, Battery, or Company), according to the strength of the force assembled. See *Dress Parade*, and *Undress Parade*.

PARADE OFFICER.—An officer who attends to the minutiæ of regimental duty, but who is not remarkable for military science.

PARADE ORDER.—When a regiment of horse or foot, a troop or company, is drawn up with the ranks open and the officers in front, it is said to be in *Parade Order*.

PARADE REST.—A position of rest for soldiers, in which, however, they are required to be silent and motionless; used specially at parade. Also, the command for the position. When without arms, to give the men rest, imposing both steadiness of position and silence, the Instructor commands: 1. *Parade*, 2. REST.

Carry the right foot three inches directly to the rear, the left knee slightly bent; clasp the hands in front of the center of the body, the left hand uppermost, the left thumb clasped by the thumb and fore-finger of the right hand.

When under arms, and at an order arms, the Instructor commands:

1. *Parade*, 2. REST.

At last the command *rest*, carry the muzzle in front of the center of the body, the barrel to the left; grasp the piece with the left hand just above, and with the right hand at the upper band; carry the right foot three inches straight to the rear, the left knee slightly bent.

To resume order arms the Instructor commands: 1. *Squad*, 2. ATTENTION.

1. *Carry*, 2. ARMS. Raise the piece vertically with the right hand, grasping it at the same time with the left above the right, resume the carry with the right hand, (Two.) Drop the left hand by the side. See *Manual of Arms, Fig. 5.*

PARADOS.—Another name for a traverse. It is an intercepting mound, erected in various parts of a fortification for the purpose of protecting the defenders from a rear or ricochet-fire.

PARALLEL.—In siege operations, parallels are trenches cut in the ground before a fortress, roughly parallel to its defenses, for the purpose of giving cover to the besiegers from the guns of the place. The parallels are usually three, with zigzag trenches leading from one to another. The old rule used to be to dig the first at 600 yards distance, but the improvements in artillery have rendered a greater distance necessary; and at Sebastopol, the Allies made their first trench 2,000 yards from the walls. The third trench is very near to the besieged works, and from it saps and zigzag approaches are directed to the covered-way. The trenches of the parallels receive a width at bottom of 10 feet; their depth in front is 3 feet, and in rear, 3 feet 6 inches. Two steps, each 18 inches high and 18 wide, lead from the bottom of the trench, on the front side, to the natural ground. The reverse of the trench receives a slope of 45°; or else, is also cut into steps. The steps in front are alone revetted with fascines. Vauban, in his maxims, prescribes that there shall be at least three parallels, or places-of-arms to be occupied by the troops of the besieging force immediately on duty, with a view to meet any sorties of the garrison on the besieger's works; and further, that these parallels should embrace so wide a front as to control all the defenses which bear in any manner upon the ground over which the besiegers will have to run their trenches.

In Vauban's time, and to within quite a recent day, it was considered that when the site was completely exposed to the fire of the besieged, the first parallel might be laid out at about 600 yards from the most advanced points of the defenses to be embraced within it, and concentric with a line joining these points, and extended so far each way as to guard all the batteries thrown up along its front to silence the fire of the defenses, from assaults in front and on either flank of the parallel. The position of the 1st parallel, Vauban makes dependent on the site, as affording more or less of shelter from the fire of the defenses; and, at the celebrated siege of Sebastopol, the French established their 1st parallels at two separate points, the one at nearly 1000 yards, the other at nearly 1800 yards from the defenses; and the English, in their attack, also placed their 1st parallel at nearly 1800 yards from the defenses in their front. This departure from usage was owing to the great caliber of the guns and the large quantity of fire of the Russian defenses. Instead of three parallels, the French found it quite necessary to throw up as many as seven, the nearest of which to the Russian defenses was about 30 yards, when the final open assault was made from it upon the key point of the Russian position.

The greater range and accuracy of fire of rifled guns will necessarily lead to establishing the first batteries against the defenses at much greater distances than formerly, when smooth bores were alone used; and assuming the 30-pounder, as the probable largest ordinary caliber of siege guns for the attack, the first batteries will probably, in futute sieges, occupy positions at from 2,000 to 3,000 yards from the defenses. These distances will secure for these batteries, what is essential for all those of the attack, a good range for destroying the artillery of the defenses, and security, if properly guarded, either by placing them within strong inclosed works, with sufficient troops to defend the works, or by troops occupying trenches so disposed as to meet a front or flank attack on the battery. Anything like a continuous line of parallel would seldom be requisite at this distance, as the garrison would hardly venture sorties so far from their defenses. Besides which, considering the great extent of front that the batteries would have to embrace at this distance, to control all the fire of the defenses, it would require too great a length of continuous entrenchment.

Tactical considerations require that, in the establishment of the successive parallels, the one most advanced should be laid out nearer to the one in its rear, by which the workmen completing the former are protected, than to the defenses; so that it can receive timely succor against an assault upon it by the besieged. Considering the first line of batteries and trenches as a 1st parallel, the position of the 2d parallel may be safely placed at 1,000 yards in advance of it; that is, nearer to it by 100 yards or more than to the defenses. As it is usual to place the 3d parallel so near to the defenses as to bring the covered ways, or other most advanced defenses, which may be assaulted openly, within range of stone mortars, placed in batteries either within or in front of this parallel; its position, for this object, should be some 60 yards from the salient points of the most advanced portions of the defenses, or as to bring their interior within the range of the stones and other missiles thrown from the mortars.

In giving the 3d parallel this position, there will be a wide zone of ground between it and the 2d parallel, over which the approaches connecting these two parallels must be run, which would be very much exposed to the sorties of the besieged, as well as the 3d parallel, were its protection left to troops stationed as a guard in the 2d parallel. To provide protection for these approaches and for the 3d parallel, whilst in process of construction, ends of trenches, termed *demi-parallels*, are run out, on the right and left of the lines of the approaches, far enough to contain sufficient bodies of troops to protect all the men working on the trenches in advance of them from sorties. The positions of the demi-parallels will be regulated by the same tactical considerations as those which regulate the positions of the parallels. The length to which they should be extended on the flanks of the approach, will be regulated by the number of troops that it may be deemed necessary to post within them, and also from the considerations that they shall not obstruct or be endangered by the fire of any batteries to their rear. See *Approaches* and *Siege*.

PARALLEL FORCES.—Those forces which act upon a body in directions parallel to each other. Every body, being an assemblage of separate particles, each of which is acted upon by gravity, may thus be considered as impressed upon by a system of parallel forces. The following demonstration will exhibit

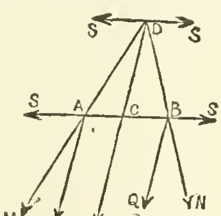


Fig. 1

the mode in which the amount and the position of the resultant forces are found: Let P and Q be two parallel forces acting at the points A and B respectively, either in the same (Fig. 1) or in opposite (Fig. 2) directions: join AB, and in this line, at the points A and B, apply the equal and opposite forces S and S, which counterbalance each other, and therefore do not affect the system. Find M and N, the resultants of P and S, and Q and S respectively, and produce their directions till they meet in D, at which point let the resultants be resolved parallel to their original directions; then there are two equal forces, S and S, acting parallel to AB, but in opposite directions, and thus, as they counterbalance each other, they may be removed. Then there remain two forces, P and Q, acting at D, in the line DC, parallel to their original directions, and their sum (Fig. 1) or difference (Fig. 2) represented by R, is accordingly the resultant of the original forces at A and B. To find the position of C, the point in AB, or AB produced, through which the resultant passes, it is necessary to make use of the well-known property denominated the *triangle of forces*, according to which the three forces S, M, and P are proportional to the lengths of AC, AD, DC, the sides of the triangle ADC; then S : P :: AC : CD, similarly Q : S :: DC : CB, therefore Q : P :: AC : BC, and Q P or R : P :: AC BC or AB : BC, from which proportions we derive the principle of the lever, $P \times AC = Q \times BC$, and also that $R \times BC = P \times AB$, whence $BC = \frac{P}{R} \times AB$, and the point C is found. The failing case of this proposition is when P and Q acting in opposite parallel directions at different points are equal, in which case the resultant $R = Q - P = Q - Q = 0$. In all other cases there is a progressive motion, such as would be caused by the action of a single force R ($= Q \pm P$) acting at the point C in the direction of CR; but in the failing case, since $R = 0$, there is

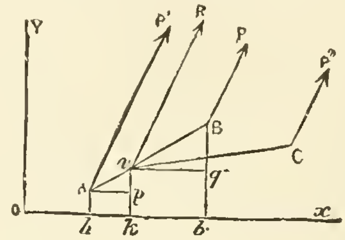


Fig. 2.

no progressive motion but a rotatory movement round the center of AB. It is of no consequence whether A and B be the true points of application of the forces P and Q, provided their directions when produced pass through these points, and the point of application of the resultant need not be in the line joining the points of application of the component forces, but its direction must, when produced, pass through C. If there be more than two parallel forces, the resultant of the whole is found by compounding the resultant of the first two with the third in the way given above, thus obtaining a new resultant, which is similarly combined with the fourth force; and so on till the final resultant is found. The center of gravity is only a special name for the point of application of the final resultant of a number of parallel forces. See *Couple*

PARALLELOGRAM OF FORCES.—The fundamental problem in statics is to find the magnitude and direction of the resultant of two forces; in other words, to compound them into a single force, which shall be in every respect their equivalent. Intensity and direction being the only elements necessary to entirely describe a force, forces in statics are represented by lines, which are obviously capable of being made to represent them both in magnitude and direction. When two forces act along the same straight line on a particle, it is sufficiently obvious that if they act in the same direction, the resultant will be their algebraical sum; if in opposite directions, their algebraical difference. This being premised, the relation between two forces acting at the same point, but not in the same line, and their resultant, is set forth in the following theorem, which is known as the Parallelogram of Forces. If two forces, P,

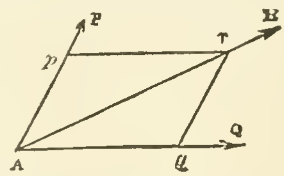


Fig. 1.

Q, acting on a particle A, be represented in direction and magnitude by the lines A*p*, A*q*, then the resultant will be represented in direction and magnitude by the diagonal A*r* of the parallelogram described upon A*p*, A*q*. The proof of this depends upon the simple principles, that a force may be supposed to act at any point of its direction, that point being conceived to be rigidly attached to the particle on which the force acts; and what may be accepted as an axiom of universal experience, that when any number of forces are impressed on a particle or body, each exerts itself, as if the others were not acting, to produce its full effect. The doctrine of the parallelogram of forces has given rise to much controversy, not as to its truth, but as to its derivation, some appearing to contend that it is directly deducible from the axiom above stated, without the necessity of further reasoning. Knowing how to compound two forces acting at a point, we are able to compound or determine the resultant of any number. If the forces, though in the same plane, do not act at the same point of a body, those of them whose directions meet may be compounded by the preceding rule; if they are parallel, their resultant is a force parallel to them and equal to their algebraical sum, counting those acting in one direction as positive, and in the opposite direction as negative. The singular case is that of equal parallel forces acting in opposite directions. These constitute a couple, and cannot be represented by any single force.

The resolution of forces is the converse problem. To resolve a given force R, whose direction and magnitude is Ar, into two forces acting in any directions that may be chosen, as AP, AQ, we have only to draw

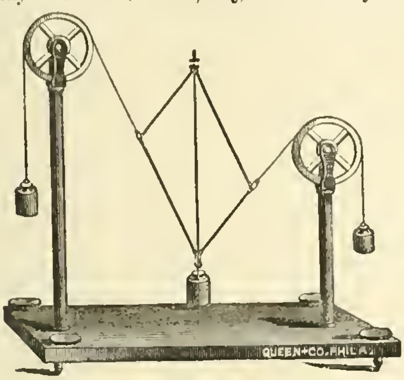


Fig. 2.

parallels through r, which determine the lines Ap, Aq, representing the magnitude of the forces required. It is evident that there is an indefinite number of pairs of forces into which Ar might be resolved, according to the direction in which the new forces are to act. It is usual, however, to resolve a force into forces that are at right angles to each other.

The composition of motions is analogous in every way to that of forces; motions are the results of forces, and the analogy might be expected. If a body be actuated simultaneously by two velocities having different directions, it will evidently move in a direction intermediate to the two, and with a velocity which will in some way depend on each of them, and which is called their resultant. The proposition which sets forth how to find the resultant, is called the Parallelogram of Velocities. It is: If two velocities, with which a particle is simultaneously impressed, be represented in direction and magnitude by two straight lines drawn from the particle, the resultant velocity of the particle will be represented in direction and magnitude by the diagonal of the parallelogram described on those two straight lines. The proof is very simple. There is no reason why the full effect of both velocities should not be produced, as if the body moved first with one of them, and then with the other, in their respective directions. If in one second the body moving with the one velocity would reach p, and if we suppose it then to move on pr for another second, parallel with the other velocity, it would at the end of the second second be at r. Hence, under their joint influence, it will be at r at the end of one second. The resolution of motions is altogether analogous to that of forces. All the principles of the Parallelogram of Forces may be readily illustrated by the apparatus shown in Figure 2. See *Falling Bodies*.

PARALLEL ORDER OF BATTLE.—In tactics, the natural order of battle is when troops coming upon ordinary ground are ranged in line of battle by the prescribed tactical means, and when they are formed in column right in front.

The parallel order operates on the contrary against the whole front of the enemy. Turenne and Condé fought habitually in parallel order, although they sometimes made a skillful use of oblique attacks. *Guibert* well says that a contiguous and regular parallel order can be of no use in war.

The *oblique* order is contradistinguished from the parallel, and in general means every tactical combination the aim of which is to produce an effect upon two points of an enemy's line by bringing a superior force to bear down on those two points. Such combinations constitute the oblique order, whatever maneuvers may be used to accomplish the object.

PARALLEL RETREAT.—Great advantages sometimes arise in conducting a retreat parallel to our frontier, when the topography lends itself to this operation; as, the enemy, in following up, really gains but little ground in advance. If a retreat of this kind, termed a *parallel retreat*, is made in the enemy's country, the army subsists at the enemy's expense; the evils of war fall on him; and he is almost as badly off as if he had not the upper hand. If this retreat takes place within our own frontier we draw after us the victorious army; we force him to move onwards without gaining a foot of ground towards the interior; we abandon to him only our borders, whilst we force him to offer his flank to any force we may have in the interior. But, with all these obvious advantages, we must look out how we attempt anything of the kind in a territory which is open, and would give the enemy an easy means of cutting us off from our base. Such a retreat, therefore, requires to be covered by a river, a mountain chain, or some other obstacle that an enemy cannot cross with safety, to interrupt our communications to the interior. If the parallel retreat is covered by a river, all bridges by which the enemy might intercept our communications, or attack in flank, should be timely destroyed, the fords obstructed and guarded. Like precautions are to be taken, when covered by a mountain chain, in occupying the main defiles, and obstructing other less important passes. Our troops should be so disposed as to fall in mass upon any corps of the enemy that attempts to force its way through; and we should not show too much anxiety respecting any weak body of troops that may have risked a raid upon our rear, as the peril is for it and not for our troops. It will be readily seen that a parallel retreat can only be resorted to with effect along a frontier of some considerable extent. Although a frontier of this character is more difficult to guard than one more limited, it presents, on the other hand, the advantages above pointed out, and lends itself well to the *defensive—offensive* on our side, which of itself, in the hands of an able General, is the surest means of success in a defensive war.

PARALLEL RULER.—A draughtsman's instrument consisting of two wooden or metallic blades, so joined together by jointed cross-pieces as to open to different intervals and yet retain their parallelism, Fig. 1. A still simpler form is a rolling cylinder. Fig. 2, represents a rolling parallel ruler, consisting of a flat ruler, and a roller rotating in bearing-posts fastened to the ruler. This instrument is very useful for constructing the plans and elevations of fortifications and numerous other military subjects. The illustrations are on page 482. See *Drawing*.

PARAMETER.—This term, used in conic sections, denotes, in the case of parabola, a third proportional to the abscissa of any diameter and its corresponding ordinate; in the ellipse and hyperbola, a third proportional to a diameter and its conjugate. The parameter of any diameter is, in the case of the parabola, the same as the double ordinate of that diameter which passes through the focus, and is four times as long as the distance between the diameter's vertex

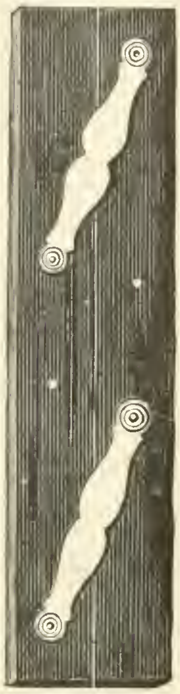


Fig. 1.

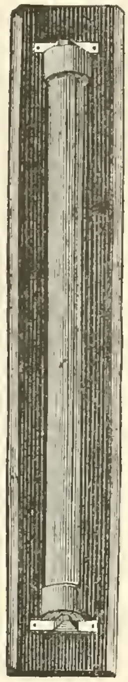
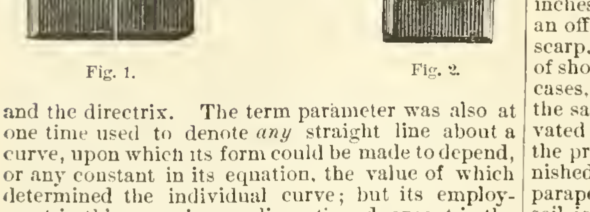


Fig. 2.

and the directrix. The term parameter was also at one time used to denote *any* straight line about a curve, upon which its form could be made to depend, or any constant in its equation, the value of which determined the individual curve; but its employment in this sense is now discontinued, except in the theory of homogeneous differential equations, where the constants, for the purpose of aiding the solution, are supposed to vary, and the method is consequently denominated the "variation of the parameters."

PARAPET.—1. A wall raised higher than the gutter of a roof for protection; in domestic buildings, churches, etc., to prevent accident by falling from the roof. Parapets are of very ancient date. The Israelites were commanded to build "a battlement" round their flat roofs. In classic architecture balustrades were used as parapets. In Gothic architecture parapets of all kinds are used. In early work they are generally plain, but in later buildings they are pierced and ornamented with tracery, which is frequently of elaborate design, especially in French flamboyant work. Shields and little arcades are also



used as ornaments to parapets; and the battlements of castles are imitated in the parapets of religious and domestic buildings. 2. In field fortifications the main features are the covering masses of earth of which they are constructed, and which are intended to shelter the assailed from the view and fire of the assailant. When the covering mass is so constructed as to afford the assailed a view and fire over the assailant's line of approach, it is termed a *parapet.* The rifle trench is the simplest form of work. In this, the parapet is formed by throwing the earth from a trench within to the front. The earth thus thrown up, together with the depth of the trench, affords the desired shelter. The troops stand or squat in the trench and deliver their fire over the bank of earth in front. The method of intrenching affords the speediest means of obtaining cover, and is the one resorted to when troops are under fire, or when they intrench their camp or position for a temporary stay. Rails, logs, in fact, almost anything at hand may be used as a rough interior revetment for sustaining the earth. For artillery, the trench is made somewhat wider than is necessary for infantry. In the more elaborate class of field fortifications, such as the inclosed works of various descriptions, the earth to form the parapet is taken from the exterior, thus forming in front of the parapet a ditch which makes a formidable obstacle in the way of an assailant attempting to enter the work by escalade.

Having fixed upon the profile, the pick commences the construction of the parapet by breaking ground so far from the counterscarp crest that, by digging vertically three feet, he will arrive at the position of the counterscarp. The excavation is carried on at the same depth of three feet, advancing toward the scarp, where the same caution is observed as at the counterscarp. The earth is thrown forward, and evenly spread and rammed, in layers of about twelve inches, from the banquette slope to the exterior slope. For the facility of entering the ditch, whilst working, the offsets at the scarp and counterscarp may be formed into steps with a rise of eighteen inches each; and if the ditch is deeper than six feet, an offset, about four feet broad, should be left at the scarp, about mid-depth of the ditch, to place a relay of shovels to throw the earth on the berm. In some cases, a scaffold of plank is raised in the ditch for the same purpose. When the ditch has been excavated to the bottom, the offsets are cut away, and the proper slope given to the sides. The earth furnished by the offsets, if not required to complete the parapet, may be formed into a small glacis. If the soil is stony, the vegetable mold on the surface should be scraped off, and reserved to form the top of the parapet, which should be made of earth of this kind, to the depth of at least eighteen inches, to prevent injury to the troops from the effect of a shot striking the top, and scattering the pebbles in their faces. In making the parapet, care should be taken to form a drain, at some suitable point, to carry off the water from the interior into the ditch. The water from the drain should not be suffered to run down the scarp, as it would soon destroy it. A gutter formed of boards, should be made to prevent this. See *Field Fortifications* and *Normal Profile.*

PARASANG.—A Persian military measure, sometimes assumed as a league, but equal to about four English miles.

PARAZONIUM.—A name given by the early Greeks, to a short sword or dagger worn in the belt at the right side.

PARBUCKLES.—Four-inch ropes, 12 feet long, with a hook at one end and a loop at the other. To parbuckle a gun, is to roll it in either direction from the spot in which it rests. To do this, place the gun on skids, and if it is to be moved up or down a slope, two $4\frac{1}{2}$-inch ropes are made fast to some place on the upper part of the slope, the ends are carried under the chase and breech of the gun respectively round it, and up the slope. If the running ends of these ropes are hauled upon, the gun ascends; if cased off, it descends. If the ground is horizontal, handspikes only are necessary to move the gun.

PARBUCKLING.—A mode of drawing up or lowering down an inclined plane any cylindrical object, as a barrel or a heavy gun, without the aid of a crane or tackle. It consists in passing a stout rope round a post or some suitable object at the top of the incline, and then doubling the ends under and over the object to be moved. This converts the cask or gun into a pulley in its own behalf, and limits the pressure at each end of the rope to one-fourth the weight of the object moved, as felt on the incline. By hauling in the ends equally, the gun ascends, or *vice versâ*. See *Mechanical Maneuvers*.

PARCEL.—A term, meaning in the artillery service, as applied to a rope, to put around it canvas well daubed with tar and bound with spun yarn to protect it from chafing.

PARCHMENT.—There are several kinds of parchment, prepared from the skins of different animals, according to their intended uses. The ordinary writing parchment is made from those of the sheep and of the she-goat; the finer kind, known as *vellum*, is made from those of very young calves, kids, and lambs; the thick, common kinds, for drums, tambourines, battledores, etc., from those of old he-goats and she-goats, and in northern Europe from wolves; and a peculiar kind is made from asses' skins, the surface of which is enameled. It is used for tablets, as black-lead writing can be readily removed from it by moisture. The method of making parchment is at first the same as in dressing skins for leather. The skins are limed in the lime-pit until the hair is easily removed. They are then stretched tightly and equally, and the flesh side is dressed as in currying, until a perfectly smooth surface is obtained. It is next *ground* by rubbing over it a flat piece of pumice-stone, previously dressing the flesh side only with powdered chalk, and slaked lime sprinkled over it. It is next allowed to dry, still tightly stretched on the frame. The drying process is an important one and must be rather slowly carried on, for which purpose it must be done in the shade. Sometimes these operations have to be repeated several times, in order to insure an excellent quality, and much depends upon the skill with which the pumice-stone is used, and also upon the fineness of the pumice itself. When quite dried, the lime and chalk are removed by rubbing with a soft lambskin with the wool on.

PARCOURIR.—A term expressive of those movements which are made by General Officers, Officers Commanding Brigades, etc., for the purpose of encouraging their soldiers in the heat of an engagement.

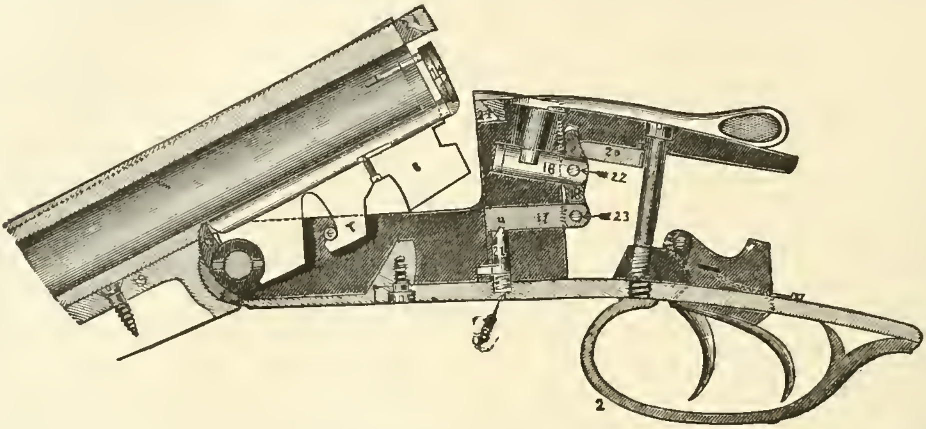
PARDON.—An act of grace emanating from that power in the State intrusted with the execution of the laws, and exempting the individual on whom it is bestowed from the punishment to which he has been legally sentenced after conviction of crime, or to which he is by law liable for an offence on which he has not been tried and convicted. Every officer authorized to appoint a General Court-Martial, has the power to pardon or mitigate the sentence of death; or of cashiering an officer, which, in cases where he has no authority to carry them into execution, he may suspend, until the pleasure of the President of the United States can be known, which suspension, together with copies of the proceedings of the Court-Martial, the said officer immediately transmits to the President for his determination. And the Colonel or Commanding Officer of the regiment or garrison where any Regimental or Garrison Court-Martial is held, may pardon or mitigate any punishment to be inflicted.

PARK.—An enclosure, or any place, where guns, wagons, animals, etc., can be placed in safety. A *Park of Artillery* is the whole train of great guns with equipment, ammunition, horses, and gunners for an army in the field. It is placed in a situation whence rapid access can be had to the line of the army in any part; and at the same time where the divisions of the force can easily mass for its protection. The horses of the park are picketed in lines in its rear. The term is also applied to the ground on which all guns stand or are parked. During a siege the park must be sheltered and screened as much as possible from the view and fire of the enemy; but, in a position to communicate freely with the besieger's trenches. If possible, its locality should also be chosen close to some good line of communication, either a road or river. Great care should be given to the position of the laboratories; they should be as far away from the enemy as the park will permit. The officer in charge of the park should be assisted by well trained men of the Ordnance Department and a sufficient number of artificers. An *Engineer Park* comprehends all the materials, tools, etc., attached to that branch of the service. A *Siege Park* comprises the guns collected together at the commencement of the investment of a fortress, taken from the artillery park, and manned by artillery, aided by the men of the Ordnance Department. The carriages of a battery are parked in two ranks, all the pieces limbered and in the front rank, the caissons covering their pieces; the interval is such as is most convenient; the distance from the rear part of the pieces to the end of the poles of the caissons is about eight yards. The carriages of each section are arranged from right to left in the order of their permanent numbers, the 1st section on the right. In *horse batteries*, the distance is seventeen yards, but may be decreased to eight yards if the nature of the ground requires it.

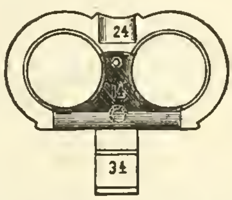
To form the park, the Captain directs the column of sections toward either flank, or in rear, of the position to be occupied by the park, and establishes the Guidon near the point where the lead-driver of the leading carriage is to halt. He then directs the column forty-seven yards in rear of, and parallel to, the line to be occupied by the lead-drivers of the front-rank carriages, and commands:

1. *Right* (or *left*) *into park*, 2. *At* (so many) *yards' interval*, 3. MARCH, 4. FRONT. The Chief of the leading section commands: *Right wheel*, at the first command, and repeats the third. At the command *march*, given when the leading section is three and one-quarter yards from the point opposite the position which it is to occupy, the leading section wheels to the right moves forward and is halted by its Chief when the leading driver arrives in line with the Guidon. Each of the other sections continues the march until three and one-quarter yards from the point opposite its place in park, then wheels to the right at the command of its Chief, and moves forward; on arriving at three yards from the line, the Chief commands: 1. *Section*, 2 HALT, 3. *Left*, 4. DRESS. The Chiefs of platoon superintend the movements of their sections, but do not repeat the commands. The Captain and Chief of caissons go to the left and superintend the alignment as previously explained. The Captain commands *right into park*, or *left into park*, according as the column is left, or right, in front. See *Train*.

PARKER GUN.—This gun is a distinctively American production, and has all the advantages of the American system of manufacturing. The different parts are made by special machinery, and by workmen who make a speciality of one thing only, and are subjected to rigid inspection so that no defective or imperfect part can find its way into the finished gun. The number of parts is reduced to a minimum, and the construction is so simple that anyone with no tool but a screw-driver can take the gun apart for cleaning or repairs. No breech-loader has less to get out of order, and none will stand better the ordeal to which a breech-loader is subjected. The drawing shows the top action. Pressing the thumb against the lever, throws it to the right, and acting through the piece, 16, forces the piece, 18, to the rear. This piece being pivoted at the top withdraws the bolt, 17, from the mortise which is cut in the lug, 6, and releases the barrels. When the gun is closed the sides of the extension rib, 24, being upon the arc of a circle, with the hinge joint, 13, as a center, have a bearing along their entire surface, and the extension rib fits securely into its seat, 24, in the frame. When the barrels are brought to place for firing, the bottom of the lug, 6, strikes the trip, 21, withdrawing it from the bolt, 17, which then enters the mortise in the lug, 6, and securely locks the gun. The taper-

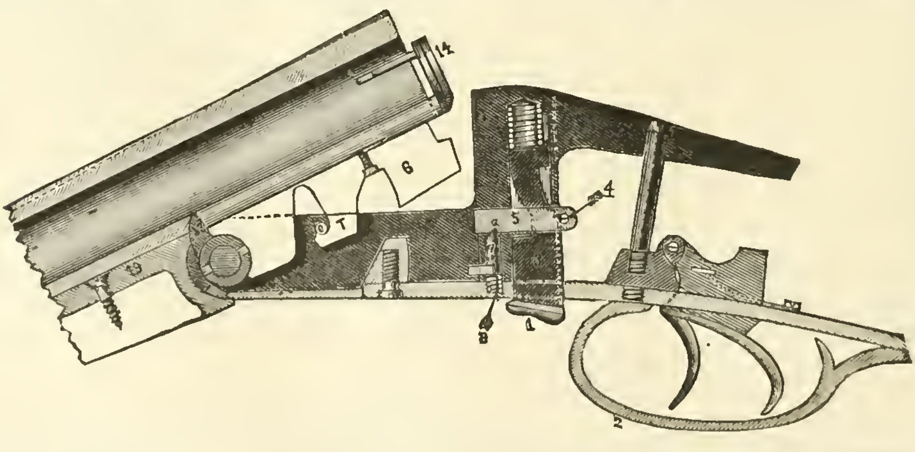


bolt, 17, locks the barrels positively firm, and the use of a taper-bolt for fastening the gun gives it a decided advantage, as it does not allow a little dirt (which is very liable to get under barrels when open) to prevent the gun from locking. Many times when shooting, marksmen are balked in this way, but this gun closes with the same ease and locks as securely even if there is a little dirt in the way. When the gun is opened, the check-hook, T, comes in contact



with the pin, E, which avoids any strain on the joint, 13, and thus prevents the gun becoming shaky by constant use.

This gun has an automatic extractor which draws the shells or cartridges from the barrels during the



operation of opening the gun. The extractor, 14, is inserted in a hole drilled in the lug, 34, with its rear end enlarged and extending into and around a portion of the chambers of the barrels, as shown in the drawing (which represents an end view of the breech of the barrels). When the gun is closed, the extractor, 14, extends from the rear end of the barrels to the projection on the joint, 13, and as the barrels swing on this joint, 13, which remains stationary, this projection forces the extractor, 14, from the rear end of the barrels, so that when they arrive at the position as shown above, the cartridges are withdrawn from them quite far enough to be entirely removed by hand. In connection with the lock, which is *rebounding*, attention should be called to the direct blow of the firing-pin exactly in the center of the cap and at right angles with the head of the shell. By this arrangement the chance of a miss-fire is very much lessened, and the efficiency of the arm is increased. The locking-bolt is held back while the gun is open, doing away with the wear on the hinge joint which all breech-loaders are subjected to when the barrels are forced down against a strong spring in the rear of the bolt.

The following drawing explains the *lifter action* peculiar to this gun: Pressing up on the finger-piece, 1, in front of the guard, 2, raises the lifter, 3, and its beveled side—coming in contact with the screw, 4—acts as a wedge to draw the bolt, 5, from the mortise which is cut in the lug 6, and releases the barrels ready for the insertion of the cartridges. It will be observed that when the bolt, 5, is back to the position as shown, the small hole which is drilled in the under side of said bolt comes directly over the trip, 7, which, by the assistance of the small spiral spring, 8, is made to enter this hole in the bolt, 5, and thereby holds it in position. The finger-piece, 1, is solid and a part of lifter, 3. The action of *the lifter*, 3, *is positive*, not only to withdraw the bolt *from*, but to force it forward *into* the mortise in the lug, 6. For the purpose of cleaning, it can be very easily removed by taking off the locks and removing the small screw, 4, from the end of bolt, 5, then press down on trip, 7, which will allow the lifter to be withdrawn without removing either stock, guard, or trigger-plate. The improved roll, 13, gives great strength to the joint. This gun has been issued by the United States Government for arming Paymasters' escorts, etc., when light shooting and rough usage were anticipated.

PARKHURST MACHINE GUN.—In machine-guns the heating of the barrels has limited the number of charges that could be rapidly fired before they become too hot for use, so that after a period of rapid firing the gun would become dangerous if not allowed to cool. The Parkhurst gun has a device for keeping the barrels cool by surrounding them with water under atmospheric pressure, thus preventing the temperature from rising above the boiling point of water. A temperature not exceeding 212° Fahrenheit does not impair the action of the gun. The barrels are inclosed in a metallic water-tight casing having a vent for the escape of steam. The casing is filled from time to time during the firing, as may be required. The mechanism for rapidly loading and firing is also improved.

PARKINSONIA.— A shrub found commonly in Bengal. It has been stated to yield a very fair charcoal for gunpowder purposes; but from trials made of it, of late years, at the Government Powder Works at Ishapore, it was not found to be equal to that made from *urhur* or *dhall stalk*. Nevertheless it might be used if the latter crop failed.

PARK PALING.—A very inferior gun-material, from which vast numbers of very inferior guns were made during the existence of the slave-trade.

PARK PICKETS.—Small wooden posts which support the rope line round the artillery park. They are carried either on carts or camels in India when on the march. Dimensions—length 53 inches, and diameter 3 inches.

PARLEY.—In military language, an oral conference with the enemy. It takes place under a flag of truce, and usually at some spot—for the time neutral—between the lines of the two armies. *To beat a parley*, is to give a signal for such conference by beat of drum or sound of trumpet.

PARMA.—A kind of round buckler used by the Velites in the Roman Army. It was 3 feet in diameter, made of wood, and covered with leather. Its form was round, and its substance strong; but Servius on the Aeneid, and even Virgil, say that it was a light piece of armor in comparison with the clypcus, though larger than the pelta.

PAROI.—A stout wooden frame having long, sharp-pointed stakes driven into it horizontally. It is placed upon the parapet to oppose scaling parties.

PAROLE.—1. A watch-word differing from the countersign in that it is only communicated to Officers of Guards, while the countersign is given to all the members. The *parole* is usually the name of a person, generally a distinguished officer, while the countersign is the name of a place, as of a battle-field. 2. A declaration made on honor by an officer, in a case in which there is no more than his sense of honor to restrain him from breaking his word. Thus a prisoner of war may be released from actual prison on his *parole* that he will not go beyond certain designated limits; or he may even be allowed to return to his own country on his *parole* not to fight again, during the existing war, against his captors. To break *parole* is accounted infamous in all civilized nations, and an officer who has so far forgotten his position as a gentleman, ceases to have any claim to the treatment of an honorable man, nor can he expect quarter should he again fall into the hands of the enemy he has deceived. The following rules in regard to *paroles* are established by the common law and usages of war: An officer who gives a *parole* for himself or his command on the battle-field is deemed a deserter, and will be punished accordingly. For the officer, the pledging of his *parole* is an individual act, and no wholesale paroling by an officer, for a number of inferiors in rank, is permitted or valid. No prisoner of war can be forced by the hostile Government to pledge his *parole*; and any threat or ill treatment to force the giving of the *parole* is contrary to the law of war, and not binding.

No prisoner of war can enter into engagements inconsistent with his character and duties as a citizen and a subject of his State. He can only bind himself not to bear arms against his captor for a limited period, or until he is exchanged, and this only with the stipulated or implied consent of his own Government. If the engagement which he makes is not approved by his Government, he is bound to return and surrender himself as a prisoner of war. His own Government cannot at the same time disown his engagement and refuse his return as a prisoner.

No one can pledge his *parole* that he will never bear arms against the Government of his captors, nor that he will not bear arms against any other enemy of his Government, not at the time the ally of his captors. Such agreements have reference only to the existing enemy and his existing allies, and to the existing war, and not to future belligerents.

While the pledging of the military *parole* is a voluntary act of the individual, the capturing power is not obliged to grant it, nor is the Government of the individual paroled bound to approve or ratify it.

Paroles not authorized by the common law of war are not valid till approved by the Government of the individual so pledging his parole.

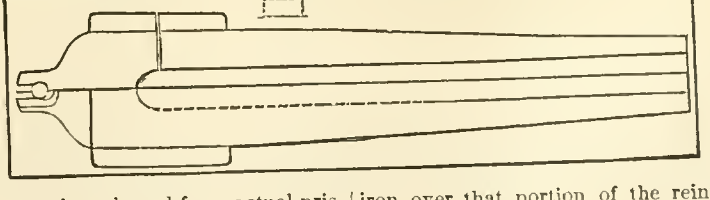
The pledging of any unauthorized military *parole* is a military offense, punishable under the common law of war.

PAROLE EVIDENCE.—In law, it is such evidence as is given by witnesses by word of mouth at a trial or hearing of a cause. Parole agreement, in English law, means any agreement made either by word of mouth or by writing not under seal. If the agreement is made by writing under seal, it is called a deed, or indenture, or covenant, according to the nature of its contents.

PARRAIN.—In military orders, the person who introduces or presents a newly-elected Knight. The term is also used to signify the comrade who is selected by a soldier who is condemned to be shot to bind the handkerchief over his eyes.

PARROT-BEAKED.—A term applied to a battle-axe and the like when very short in the handle and resembling a parrot's beak.

PARROTT GUN.—The Parrott rifle-gun is a cast-iron piece of about the usual dimensions, strengthened by shrinking a coiled band or barrel of wrought-iron over that portion of the reinforce which surrounds the charge. The bodies of the larger Parrott



guns are cast hollow, and cooled from the interior on the Rodman plan. The barrel is formed by bending a rectangular bar of wrought-iron spirally around a mandrel and then welding the mass together by hammering it in a strong cast-iron cylinder, or tube. In bending the bar, the outer side being more elongated than the inner one, is diminished in thickness, giving the cross section of the bar a wedge shape, which possesses the advantage of allowing the cinder to escape through the opening, thereby securing a more perfect weld. The barrel is shrunk on by the aid of heat, and for this purpose the reinforce of the gun is carefully turned to a cylindrical shape, and about one-sixteenth of an inch to the foot larger than the interior diameter of the barrel in a cold state. To prevent the cast-iron from expanding when the barrel is slipped on to its place a stream of cold water is allowed to run through the bore. At the same time and while the bands hang loosely upon it, the body of the gun is rotated around its axis to render the cooling uniform over the whole surface of the barrel. A large number of these guns were used in the late war, both on sea and land; and the amount of work done by them, especially in breaching masonry, is probably not exceeded by the rifle-guns of any other system. While a few of them have failed in the service, others have shown very great endurance. The cause of this failure has been attributed to the bursting of shells in the bore, the presence of sand in the bore, etc., but late investigations show that the Parrott projectiles were frequently broken at the bottom by the force of the powder in such manner as to wedge the body against the bore. It is quite probable that this cause had much to do with the bursting of the guns. The inventor thinks he has corrected this evil.

The following table gives the more important dimensions, etc., of Parrott guns; ranging from the 10-pounder to the 10-inch.

Gun.	Length of Bore.	Diam. of Bore.	Diam. of Barrel	Weight.	Number of Grooves.	Depth of Grooves.	Twist Increasing.	Charge.	Weight of Projectile.
	Inches.	Inches.	Inches.	Lbs.		Inches.	1 turn in ft. at Muzzle.	Lbs.	Lbs.
10-pounder............	70	3.	11.3	890	3	0.1	10	1	10
20-pounder............	79	3.67	14.5	1,750	5	0.1	10	2	19
30-pounder............	120	4.20	18.3	4,200	7	0.1	12	3	28
100-pounder............	130	6.4	25.9	9,700	9	0.1	18	10	86
8-inch..................	136	8.	32.	16,300	11	0.1	23	16	150
10-inch..................	144	10.	40.	23,500	15	0.1	30	25	250

The proof of these guns consists in firing each piece *ten* rounds with service charges. The table given below shows the ranges of the 100-pounder Parrott gun; charge, 10 pounds of cannon powder; projectile, Parrott shell, filled, 100 pounds; initial velocity being 1,080 feet. See *Cast-iron Guns* and *Ordnance*.

Range.	Elevation.	Time of Flight.	Angle of Fall.	Remaining Velocity.	Range.	Elevation.	Time of Flight.	Angle of Fall.	Remaining Velocity.
Yards.	° ′	Seconds.	° ′	Ft.-secs.	Yards.	° ′	Seconds.	° ′	Ft.-secs.
100	0 14	0.28	0 14	1066	1700	4 36	5.15	5 09	923
200	0 29	0.56	0 29	1053	1800	4 54	5.48	5 24	916
300	0 44	0.85	0 44	1041	1835	5 00	5.59	5 33	914
400	0 59	1.14	1 00	1029	1900	5 12	5.81	5 47	910
405	1 00	1.16	1 01	1029	2000	5 31	6.14	6 10	903
500	1 14	1.44	1 16	1019	2100	5 50	6.47	6 33	897
600	1 30	1.73	1 33	1009	2158	6 00	6.67	6 45	893
700	1 46	2.03	1 50	1000	2200	6 09	6.81	6 56	891
788	2 00	2.29	2 06	992	2300	6 28	7.15	7 19	885
800	2 02	2.33	2 08	991	2400	6 47	7.49	7 42	879
900	2 18	2.63	2 26	983	2470	7 00	7.73	7 59	875
1000	2 34	2.94	2 44	974	2500	7 07	7.83	8 08	873
1100	2 51	3.25	3 03	966	2600	7 27	8.18	8 34	867
1151	3 00	3.41	3 13	962	2700	7 47	8.53	9 00	861
1200	3 08	3.56	3 22	959	2767	8 00	8.76	9 13	857
1300	3 25	3.87	3 41	951	2800	8 07	8.88	9 26	855
1400	3 42	4.19	4 00	944	2900	8 27	9.23	9 52	850
1500	4 00	4.51	4 21	937	3000	8 48	9.58	10 18	844
1500	4 00	4.51	4 21	937	3056	9 00	9.78	10 32	841
1600	4 18	4.83	4 42	930	3100	9 09	9.94	10 47	839

PARROTT LIFE-SAVING MONSTER.— A mortar made of cast-iron and lined with a steel tube. The piece is cylindrical about the seat of the charge, gradually tapering to the face of the muzzle. The breech is hemispherical. The trunnions are placed near the breech; their projection upon a plane through the vent and axis of the bore, being in front of and tangent to a plane perpendicular to that axis and containing the front end of the chamber. The chamber has the form of the frustum of a cone. The projectile is of cast-iron, cylindrical, with the ends rounded. An eye-bolt is screwed into the base for the attachment of the line. The eye of this bolt is close to the base of the shot. The cylindrical portion is turned in a lathe so as to be almost a perfect fit for the bore.

This apparatus is provided with a safety attachment, consisting of a piece of rubber, rectangular in cross-section, about 1′ long, 0″.75 wide, and 0″.5 thick, and of three or four galvanized-iron wires about 6′ long, laid parallel to each other, loosely twisted and coiled into a helix of from 18 to 19 turns. The rubber strap is sometimes placed inside the coil, and at others outside of it. This combined strap and spring is interposed between the shot and line in firing. The object of the combination is to absorb the shock of the discharge and thus prevent the breakage of the line, by letting the first jerk come upon the rubber, which will generally break, and then upon the coiled wire spring. The wires will be straightened out before the full strain falls upon the line. See *Life-saving Rockets*.

PARROTT PROJECTILES.—These projectiles are composed of a cast-iron body and a brass ring cast

into a rabbet formed around the base. The flame presses against the bottom of the ring and underneath it, so as to expand it into the grooves of the gun. To prevent the ring from turning in the rabbet the latter is recessed at several points of its circumference.

Parrott's incendiary shell has two compartments formed by a partition at right angles to its length. The lower and larger space is filled with a burning composition; the upper one is filled with a bursting charge of powder, which is fired by a time or concussion fuse. The burning composition is introduced through a hole in the bottom of the shell, which is stopped up with a screw-plug.

A more recent form of the Parrott Projectile for large calibers shown in the drawing. The sabot is cast on to the projectile, and is provided with a lip and cannelure. It is prevented from turning on the projectile and from stripping by means of recesses and undercuts upon the base of the projectile, into which the metal when liquid enters. See *Expanding Projectiles* and *Projectiles*.

PARRY.—A defensive movement in bayonet and saber exercises, executed as follows: *With the bayonet*—The Instructor commands: 1. *Tierce*, 2. PARRY. Move the point of the bayonet five or six inches to the right. 1. *Quarte*, 2. PARRY. Move the piece quickly to the left, the small of the stock passing under the left elbow, the piece covering the left shoulder; the barrel to the left, bayonet in front of, and higher than the shoulder, the left forearm on the right of the piece, the elbow touching the right wrist, the fingers on the stock. 1. *Seconde*, 2. PARRY. Move the point of the bayonet quickly to the left, describing a semi-circle from left to right, the point of the bayonet at the height of and in front of the right knee, barrel to the left; the left elbow in front of the body, the flat of the butt under the right forearm, the elbow two or three inches higher than the right shoulder. 1. *Butt*, 2. PARRY. Move the piece quickly to the left, covering the left knee and shoulder; the barrel to the right, the butt three inches above, and to the left of the left knee; the left hand and arm as in quarte parry. 1. *Prime*, 2. PARRY. Lower the point of the bayonet and describe a semicircle to the left, carry the piece to the left, covering the left shoulder; the barrel downward, the left fore-

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6

Fig. 7.

Fig. 8

Fig. 9.

Fig. 10.

arm behind the piece, the bayonet at the height of and to the left of the left knee; the butt higher than the head, the right forearm above the eyes and six inches in front of the forehead. The double parries are combinations of the simple parries, and are executed by the following commands: 1. Tierce, 2, Quarte. 1. Prime, 2. Seconde. 1. Quarte, 2. Tierce. 1. Seconde, 2. Prime. 1. Tierce, 2. Seconde. 1. Tierce, 2. Butt. 1. Seconde, 2. Tierce. 1. Butt, 2. Tierce. The *tierce* and *quarte parries* are used against blows aimed above the arms; *seconde* and *butt parries*, below the arms; *prime parry*, for blows either above or below the arms. In all parries, care must be taken not to uncover the body, by moving the piece farther than necessary to parry the blow. These positions are shown in Figures 1, 2, 3, 4, and 5. *With the Saber*—The Instructor commands: 1. *Tierce*, 2. PARRY. Carry the hand quickly a little to the right, point of the saber as high as the eyes, and opposite the right shoulder, edge to the right. (Two.) Resume the guard. 1. *Quarte*, 2. PARRY. Turn the hand in quarte, and carry it opposite the left breast, edge of the blade to the left, point to the


Fig. 11.

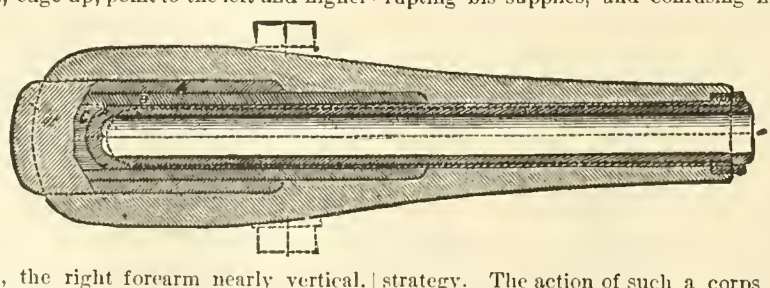

Fig. 12.

front, as high as the eyes, and a little to the left of the left shoulder. (Two.) Resume the guard. 1. *Left*, 2. PARRY. Raise the hand above and six inches in front of the eyes, the elbow somewhat bent, edge of the blade to the left, point downward, and parry the blow aimed at the left side. (Two.) Resume the guard. 1. *Left, head*, 2. PARRY. Raise the saber quickly above the head, the right arm vertical, edge upward, point to the left and about twelve inches below the guard. (Two.) Resume the guard. 1. *Right head*, 2. PARRY. Raise the saber quickly above the head, edge up, point to the left and higher than the head, the right forearm nearly vertical. (Two.) Resume the guard. 1. *Against infantry*, 2. *Left* 3. PARRY. Turn the head and shoulders to the left, raise the saber, the arm extended upward to the front and left, the hand in tierce, back of the blade to the front, point upward. (Two.) Describe a circle quickly on the left, from front to rear, parallel to the horse's neck, the arm extended; turn aside the bayonet with the back of the blade, bringing the hand, still in tierce, above the left shoulder. (THREE.) Resume the guard. 1. *Against infantry*, 2. *Right*, 3. PARRY. Turn the head to the right, throwing back the right shoulder, raise the saber, the arm extending upward to the right and rear, the hand in tierce, edge of the blade to the left, point upward. (Two.) Describe a circle quickly on the right, from rear to front, the arm extended; turn aside the bayonet with the back of the blade, bringing the hand as high as the head, the point upward. (THREE.) Resume the guard. See *Bayonet Exercise*, *Cavalry Parries*, *Fencing* and *Saber Exercise*.

PARSONS GUN.—The principle upon which Mr. Parsons makes his gun would seem to be similar to that of Captain Palliser's, *i. e*, by varying elasticity. As applied to strengthening a 68-pounder cast-iron gun, his method consists of boring into the breech of the gun, coincident with its axis, reaming out the bore into a slightly conical shape as far as the front of the trunnions, and then inserting into this space a reinforced wrought-iron tube, which is secured in its place by a breech-plug. The exterior of this compound tube is turned to fit the conical space easily, its length being cut so that it will be compressed longitudinally by screwing up the breech-plug, thus communicating to the outer cast-iron portion the entire longitudinal strain of the powder. This method is based on the fact that wrought-iron may be stretched three times as much as cast-iron, and will offer from three and a half to six times the resistance within the limit of its elasticity. Mr. Parsons has also proposed that the tube should be made of steel, having a solid breech, A, as shown in the drawing, the ingot not being bored through its entire length. He proposes to reinforce the tube with jackets of steel shrunk on, B, and to insert the whole tube and jacket, from the rear of the iron casting, the cast-iron gun being so bored out as to require force to insert the tube in its place. The tube being inserted, a steel plug, C, is to be screwed on from the rear, which presses against the rear of the tube, and the breech is then closed by a cast-iron lug representing the cascabel of the piece. See *Converted Guns*, *Ordnance*, and *Palliser Gun*.

PARTIALITY.—An unequal state of judgment or leaning in favor of one of two parties. Every member of a Court-Martial is sworn to do justice, without partiality, favor or affection. A previous opinion expressed by a member, before the Court is sworn, is deemed a good and sufficient cause of challenge by either the prisoner or prosecutor, and the individual cannot sit on the trial and judgment of the case.

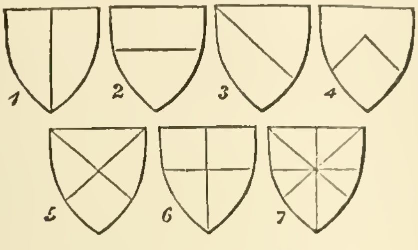
PARTISAN.—1. A name for a halberd or pike, or for a Marshal's baton. The name is also given to the leader of a detached body of light troops, who make war by harassing the enemy, rather than coming to direct fighting, by cutting off stragglers, interrupting his supplies, and confusing him by rapid strategy. The action of such a corps is known as *Partisan Warfare*.



2. Partisans are soldiers armed and wearing the uniform of their army, but belonging to a corps which acts detached from the main body for the purpose of making inroads into the territory occupied by the enemy. If captured, they are entitled to all the privileges of the prisoner of war.

Partisan warfare is advantageously pursued only in mountainous or thickly-wooded districts. In an open country, the cavalry very readily destroys them. See *Guerrillas*.

PARTITION LINES.—In Heraldry, lines dividing the shield in directions corresponding to the ordinaries. According to the direction of the partition lines, a shield is said to be party or parted per fess, per pale, per bend, per cheveron, per saltire; a shield divided by lines in the direction of a cross, is said to



Partition Lines in Heraldry.

be quartered; and a shield parted at once per cross and per saltire, is said to Gironné of eight. The partition lines are not always plain; they may be engrailed, invected, embattled, wavy, nebuly, indented, dancetté or raguly—forms which will be found explained under separate articles. See *Heraldry*.

PARTIZAN.—A species of *halberd*. The iron is long, broad, and double-edged; there is no axe, but barbs in the style of the ranseur. The *partizan* was known in France from the time of Louis XI. (1461) until the end of the 17th century, but its invention was not earlier than 1400. Also written *Partisan*.

PARTRIDGES.—In artillery, very large bombards formerly in use at sieges and in defensive works. They are mentioned in Froissart.

PARTY.—1. In Heraldry, parted or divided;—used in reference to any division of a field or charge. 2. Any small number of soldiers detached from an army or regiment on any particular duty either in peace or war time. A party is often sent out to forage, reconnoiter, and gain intelligence. The term is also applied to other duties which small bodies of men are engaged on such as *recruiting parties, working parties, storming parties, etc.*

PAS D'ANE.—The ring-shaped sword-guard below the cross-piece, on each side of the blade. It is not generally met with until the second half of the 16th century.

PAS DE SOURS.—Steps leading from the bottom to the top of a ditch in permanent fortification.

PASHA.—A title used in the Ottoman Empire, and applied to Governors of Provinces, or Military and Naval Commanders of high rank. The name is said to be derived from two Persian words—*pa*, foot or support, and *shah*, ruler—and signifies "The support of the Ruler." The title was limited in the early period of the Ottoman Empire to the Princes of the Blood, but was subsequently extended to the Grand-Vizier, the Members of the Divan, the Seraskier, Capitan-Pasha, the Begler-Begs, and other civil and military authorities. The distinctive badge of a Pasha is a horse's tail, waving from the end of a staff, crowned with a gilt ball; in war this badge is always carried before him when he goes abroad, and is at other times planted in front of his tent. The three grades of Pashas are distinguished by the number of the horse-tails on their standards; those of the highest rank are Pashas of three tails, and include, in general, the highest functionaries, civil and military. All Pashas of this class have the title of Vizier; and the Grand-Vizier is, *par excellence*, a Pasha of three tails. The Pashas of two tails are the Governors of Provinces, who generally are called by the simple title of "Pasha." The lowest rank of Pasha is the Pasha of one tail; the Sanjaks, or lowest class of Provincial Governors, are of this rank. The Pasha of a Province has authority over the military force, the revenue, and the administration of justice. His authority was formerly absolute, but recently a check was imposed on him by the appointment of local Councils. The Pasha is in his own person the military leader and administrator of justice for the Province under his charge, and holds office during the pleasure of the Sultan—a most precarious tenure, as the Sultan can at any moment, in the exercise of his despotic power, exile, imprison, or put him to death; and this has frequently been done in cases where the Pasha's power has excited the apprehension, or his wealth the avarice of his Royal Master. Also written *Bashaw* and *Pacha*.

PASS.—1. A straight, difficult, and narrow passage, which, well defended, shuts up the entrance to a country. 2. Permission granted by a Commanding Officer to a soldier to be absent from his quarters, recorded and signed by the Commanding Officer, so that the soldier may be able to show to others, if necessary, the authority for his being absent from his regiment. 3. A road or path leading from one side of a mountain to another. In latitudes where much snow falls, the "passes" are only open for egress or ingress during the summer months. In warfare, mountain passes play a very important part, if the operations, whether defensive or offensive, are carried on in a mountainous country.

PASSADE.—In fencing, a push or thrust; a sudden movement to the front. Often written *Passaod*.

PASSAGE—A movement in the School of the Soldier Mounted, for gaining distance to the right or left, executed as follows: To passage to the right, gather the horse and incline him to the right, by carrying the bridle-hand slightly to the right, and closing the right leg; then carry the bridle-hand well to the right, close the left leg behind the girth without leaning to the left, so that the haunches may move last, and hold the right leg near to support the horse and moderate his movement. The horse having obeyed, keep up the passage by a gentle application of the same means. To halt, replace the bridle-hand and left leg by degrees, and straighten the horse by carrying the bridle-hand slightly to the left and closing the left leg. In passaging, the movement of the horse's shoulders always precedes that of his haunches. To facilitate this, the horse is held inclined to the side toward which the passage is to be made. If the horse oblique too much, the rider carries the hand a little to the left, and increases the effect of the left leg. If the horse step too quickly to the side toward which he passages, diminish the effect of the reins and left leg, carrying the bridle-hand to the left, and holding the right leg close. If the horse back, bear his shoulders well toward the side toward which he should passage, diminish the effect of the reins, and increase that of the legs; a horse usually backs on account of the constraint he feels when his haunches have begun to move before his shoulders.

PASSAGE OF DITCHES.—In siege operations the passage of a dry ditch consists in the descent (which is by a blindage, if the ditch is not too deep, or a blindage and gallery for deep ditches) and a full sap, which leads from the outlet of the *descent* to the bottom of the breach. The passage of a wet ditch is more difficult, and specially perilous if the besieged can produce sudden freshets by flood-gates or other contrivances. The method usually followed is to build a dike or bridge of fascines and hurdles across the ditch. The abutment for this bridge is formed by excavating a grand gallery behind the counterscarp and throwing the earth taken from it into the ditch through the outlet of the DESCENT. The dike is carried forward from this abutment by sappers, who work on a raft carrying a musket-proof mask on the side of the enemy. A gabionade parapet on the exposed side of the dike serves to protect the men in bringing forward the fascines, hurdles, etc., to extend the dike.

PASSAGE OF RIVERS.—The passage is effected by surprise or by main force, and detachments are thrown by one means or the other upon the enemy's bank of the river before proceeding to the construction of bridges. The passage by force ought always to be favored by diversions upon other points. Infantry cross bridges without keeping step. Cavalry dismount in crossing, leading their horses. Wagons heavily loaded, pass at a gallop. See *Bridges* and *Ford*.

PASSAGES.—Openings cut in the parapet of the covered-way, close to the traverses in order to continue the communication through all parts of the covered-way. See *Traverses*.

PASSAGE WARRANT.—One among the numerous royal warrants issued for the guidance of the army. It relates, as its name implies, to the rules and regulations to be observed in applying for passages on board troop and other government ships. The accommodation granted to officers, and the quantity of baggage allowed, as well as messing costs, will be found in the copy of this warrant.

PASSANDEAU.—An ancient 8 pounder gun, which was 15 feet long, and weighed about 3,500 pounds.

PASSANT.—A heraldic term used to express the attitude of an animal in a walking position, with his

1 2 3

head straight before him, Fig. 1. Fig. 2. represents the attitude, *Passant gardant;* Fig. 3. *Passant regardant.*

PASS-BOX.—A wooden or metallic box with a lid and handles, used for carrying cartridges from the service magazine to the piece. The boxes are of various sizes to suit the caliber of the piece, one cartridge being carried at a time. The top is fastened on with two butt hinges and kept closed by strong hook and staple. A wooden handle is fastened with screws diagonally on one end, by which the box is carried.

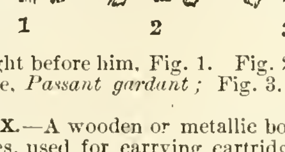
PASSEGARDES.—In ancient armor, ridges on the shoulder-pieces to turn the blow of a lance.

PASSE-MUR.—An ancient 16-pounder gun, which was 18 feet long, and weighed about 4200 pounds.

PASSES-BALLES.—Boards or machines made of iron or brass, used in disparting cannon, and fitted to every species of caliber.

PASSEVOLANT.—A light piece of ordnance, used in France in the 15th century.

PASSION CROSS.—A cross of the form on which our Saviour suffered, with a long stem and a short traverse near the top. It is of occasional occurrence



Passion Cross.

as a heraldic charge, though less frequent than many other varieties of cross. A passion cross, when elevated on three steps or degrees (which have been said by heralds to represent the virtues of Faith, Hope, and Charity), is called a Cross Calvary.

PASS OF ARMS.—In ancient chivalry, a bridge, road, etc., which the Knights undertook to defend, and which was not to be passed without fighting the person who kept it. He who was disposed to dispute the pass touched one of the armories of the other Knight who held the pass, that were hung on pales, columns, etc., erected for the purpose; and this was a challenge which the other was obliged to accept. The vanquished gave the conqueror such prize as was agreed upon.

PASSOMETER.—A watch-shaped instrument carried about the person to register the steps taken in walking. It consists of a dial and two hands, which are moved by a ratchet worked by a weight which the motion of walking causes to vibrate.

PASS PAROLE.—An order passed from front to rear of an army by word of mouth.

PASSPORT.—A warrant of protection and permission to travel, granted by the proper authority, to persons moving from place to place. Every Independent State has the right to exclude whom it pleases from its territory, and may require that all strangers entering it be furnished with properly authenticated documents, showing who they are, and for what purpose they are visiting the country. Passports are sometimes issued by the Ministers and Consuls of the country which the traveler intends to visit, which cannot, however, be done without the consent or connivance of the State of which the holder of the instrument is a subject; they properly proceed from the authorities of the State to which the traveler belongs, and ought to bear the *visa* or countersignature of the Minister or Consul of the country which he is about to visit. In some European States no one is allowed to go abroad without a passport from his Government authorizing him to leave the country—a provision used as a means of detaining persons charged with crime; and passports are even required by the natives to enable them to go from place to place in their own country. The regulations of different States have varied much regarding the use of passports; and of late years there has been a great relaxation of the stringency of the regulations connected with them. Since the facilities of traveling have so greatly increased, it seems to have become the prevalent opinion that the passport system tends to obstruct the free intercourse that is desirable between citizens of different countries; while it is ineffectual to prevent the entrance of dangerous or suspicious characters, who can obtain passports on false pretences, or make their way in without them. Within the United Kingdom no passports are required; but for a British subject traveling in some parts of the Continent they are still requsite. At one time the greater part of British subjects traveling abroad used to be furnished with passports from the Ministers or Consuls of the countries which they purposed to visit; the Lord Provost of Edinburgh was also in the way of issuing passports to Scotchmen. Of late years the passport most used by British subjects is that of the British Secretary of State for Foreign Affairs, which is now granted to any British subject for a fee of two shillings, and is good for life. If the applicant be not personally known to the Secretary of State, he must either be recommended to him by some person who is known to him, or produce an application in his favor by some banking firm established in London or elsewhere in the United Kingdom, or a certificate of identity signed by a Mayor, Magistrate, Justice of the Peace, Minister of Religion, Physician, Surgeon, Solicitor, or Notary, resident in the United Kingdom. In certain cases the production of a certificate of birth may be required. If the applicant be a naturalized British subject, his certificate of naturalization must be forwarded to the Foreign Office. If it be dated subsequently to Aug. 24, 1850, and previously to Aug. 1, 1858, his passport will be good for one year only; if subsequently to Aug. 1, 1858, for six months only. The passport of a British subject naturalized by Act of Parliament is good for life. Where the passport system is in full force, it is required that the passport be countersigned by the Minister or Consul of the country which the holder means to visit, the visa being only of force for a year. The French Government allows British subjects to enter and leave France, and travel in it without passports;

but they are said to be sometimes asked for when France is entered from the South and East. In Belgium, Holland, Germany, Switzerland, Austria, Italy, Denmark, Norway, and Sweden, passports are no longer required. For Greece and Portugal they are necessary, and the visa is insisted on in Russia, Turkey, and Egypt. In time of war, passports or safe-conducts are granted by the Supreme Authority on the spot—*i.e.*, the Officer in Command—to insure safety to the holders when passing from spot to spot, or while occupied in the performance of some act specified in and permitted by the passport. Passports may be granted for goods as well as individuals; and in time of war, the passport of a ship is the formal voucher of its neutral character. It purports to be a requisition on the part of the Government of a State to allow the vessel to pass freely with her company, passengers, goods, and merchandise, without hindrance, seizure, or molestation, as being owned by citizens or subjects of such State.

PASTE.—A tenacious mixture of flour and alum in the proportion of 2 lbs. of flour to 1 oz. of pounded alum mixed with 1 gallon of boiling water. The mode of preparing it is as follows: Heat it gently, stir it, and let it boil ¾ of an hour; when it becomes ropy, pour it into bowls, and pass it through a sieve before it is quite cold. It should be used cold, and only 2 or 3 days' supply made at a time, but it may be preserved longer by adding alum in the proportion of one-tenth the weight of flour. Paste is used in the laboratory in case-making, for portfires, rockets, light-balls, etc.

PATAREMO.—A sort of small swivel artillery, having a movable chamber.

PATCH.—1. A greased piece of cloth wrapped around a rifle bullet. 2. A block on the muzzle of a gun to do away with the effect of dispart; making the line of bore and line of sight parallel.

PATE.—1. In fortification, a sort of platform or terre-plein, irregularly built, yet generally constructed in an oval form. It is surrounded by a parapet, without anything to flank it, and having no other defense than what is front or fore right. *Patés* are usually erected in marshy grounds to cover the gate of a fortified town or place. 2. An iron or earthen pot filled with powder and grenades for throwing against besiegers; some were used at Lille, in 1708.

PATEREROS.—Small pieces of ordnance, now obsolete, worked on swivels; most commonly used on board ships, where they were mounted on the gunwale, and discharged showers of old nails, etc., into hostile boats. The French called them Pierriers from loading them with stones.

Patonce

PATONCE.—In Heraldry, a cross with its terminations expanding like early vegetation or an opening blossom.

PATOO.—A very formidable weapon with sharp edges, used by the Polynesian Islanders and New Zealanders as a sort of battle-axe to cleave the skulls of their enemies.

Patriarchal Cross.

PATRIARCHAL CROSS.—A cross like the patriarchal crosier, having its upright part crossed by two horizontal bars, the upper being shorter than the lower. A cross patriarchal fimbriated *or* was a badge of the Knights Templars.

PATRICK.—The Order of Saint Patrick is the national order of knighthood for Ireland, established by George III. Feb. 5, 1783, and enlarged in 1833. It consisted of the Sovereign, the Grand-master (who was the Lord-Lieutenant of Ireland for the time being), and 15 Knights. By the statutes of 1833 the number of Knights was increased to 22. The *Collar* of the order (of gold) is composed of roses alternating with harps, tied together with a knot of gold, the roses being enameled alternately white within red, and red within white, and in the center is an imperial crown surmounting a harp of gold, from which the badge is suspended. The *Badge* or the *Jewel* is of gold, and oval; surrounding it is a wreath of shamrock proper

Order of St Patrick.

on a gold field; within this is a band of sky-blue enamel charged with the motto of the order, QUIS SEPARABIT MDCCLXXXIII, in gold letters; and within this band a saltire gules (the cross of St. Patrick), surmounted by a shamrock or trefoil slipped vert, having on each of its leaves an imperial crown or. The field of the cross is either argent, or pierced and left open. A sky-blue RIBBON, worn over the right shoulder, sustains the badge when the collar is not worn. The STAR, worn on the left side, differs from the badge only in being circular in place of oval, and in substituting for the exterior wreath of shamrocks eight rays of silver, four of which are larger than the other four. The MANTLE is of rich sky-blue tabinet, lined with white silk, and fastened by a cordon of blue silk and gold with tassels. On the right shoulder is the HOOD, of the same material as the mantle. The order is indicated by the initials K. P.

PATROLS.—Patrols are of two classes, from the different objects had in view. The first are those made with a view of insuring greater security from the enemy's attempts to pass, or force the line of outposts, and may therefore be termed *defensive patrols*. They consist usually of three or four men, who go the rounds, along the chain of sentinels and between the posts; seldom venturing farther than a few hundred paces beyond the sentinels chain; the object being to search points which might present a cover to the enemy's scouts, and to keep the sentinels on the alert. The second class are those made exterior to the line of out-posts, with a view of gaining intelligence of the enemy's whereabouts; and may therefore be termed *offensive patrols*. They are composed of larger bodies of men than the first class, the number being proportioned both to the distance to be gone over, and the extent of front to be examined. In a position, presenting but few cross-roads, and sparsely settled, a patrol of ten or twenty horsemen, may be found ample, to search with all desirable thoroughness, from twenty to forty miles in advance of the position, along the principal avenues to it; whereas, with a more extended front, presenting many lateral avenues, double this number might be required for the same duty. From the information obtained, through the ordinary channels of maps, and by questioning the near inhabitants, the Commanding-Officer can usually settle, with sufficient accuracy, the strength of a patrol.

From the duties to be performed by patrols, cavalry are usually employed alone; in cases of very broken country, infantry may be necessary, but they should always be accompanied by some horse, if for no other purpose than to transmit intelligence promptly to the rear. The main duties of a patrol are to find the enemy if in the neighborhood; gain a good idea of his position and strength; to make out his movements, and to bring in an accurate account of his distance from the out-posts of their own force; and the character of the ground between the position occupied by the respective forces. From the nature of these duties; it is evident that both officers and men, for a patrol, should be selected with a special reference to their activity, intelligence, and the aptitude they may possess, from previous habits of life, for a service requiring a union of courage, prudence, and discriminating observation—usually to be met with only in individuals who have been thrown very much upon their own resources. When the character of the country admits of it, the employment of such individuals, singly, or in very small bodies, as scouts, is one of the most available means of gaining intelligence of an enemy, without betraying the secret of our own whereabout.

In conducting a patrol, the Commanding Officer should provide himself with a good map, telescope, and guides; and gain all the information he can before starting, by questioning persons in the neighborhood. Nothing should escape his eye along his line of search; and he should particularly note points which might be favorable to his defense, if driven back by the enemy; or by which his retreat might be endangered. The order of march of the patrol will be regulated by the circumstances of its strength, kind of troops employed, the character of the country passed over, the hour of the day, and the particular object in view. The intelligence and judgment of the officer in command will have sufficient exercise on these points; as he will be continually called upon to vary his dispositions. The general and obvious rule of keeping a look-out on all sides, will prompt the general disposition of an advanced-guard, rear-guard, and flankers, according to the circumstances of the case, however small his command. The sole object being to carry back intelligence of the enemy, no precautions should be omitted to cover and secure his line of march, without making, however, too great a subdivision of his force.

Too much circumspection cannot be shown in approaching points favorable to ambuscades; as woods, ravines, defiles, inclosures, farm-houses, villages, etc. The main-body should always be halted, in a good position beyond musket-shot, or where cover can be obtained, whilst a few men proceed cautiously forward, following at some distance in the rear of, but never losing sight of each other, to examine the suspected spot. If the officer deem it necessary, at any point, to detach from his command smaller patrols, to examine points at some distance on his flanks, he should halt the rest, at the point where they separate, until the detachments come in and report; or, if he decides to move forward, he should leave three or four men at the spot, to convey intelligence promptly to the rear; if anything is discovered, as well as to himself. It may frequently be found that some eminence on the flanks may present a good view of the surrounding country, in which case, if it be decided to use it, two or three men ought to be detached for the purpose, with orders to keep in sight of each other, but far enough apart to guard against a surprise of the whole. When the officer finds himself in the presence of the enemy, he should halt his command at a convenient spot, where they will be screened from the enemy's view; and, having made his dispositions against a surprise, he will proceed with a few picked men, to the most favorable point from which he can obtain a good look-out, to reconnoiter the position occupied, and the other points of interest. If he deem it advisable to keep his position, or change it for some other point more favorable, he will first transmit a report to the rear of what he has observed.

When the patrol moves by night, the ordinary precautions must be redoubled. Signals must be agreed upon to avoid danger, should any of the party become separated from the main body. Careful attention must be given to everything passing around; as the barking of dogs, noises, fires, etc. On approaching any inhabited spot, the command should be brought to a halt, whilst a few picked men move noiselessly forward, and if practicable, by stealing up to the windows, learn the character of the inmates. It cannot be too strongly impressed upon the mind of the officer in command of a patrol, that he must be all ears and eyes; that he will be called upon in turn, to exercise great boldness, caution, presence of mind, and good judgment, in accomplishing a mission where the enemy must be seen but not encountered; and such roads and halting points be selected, both in moving forward and returning, as shall be most favorable to his movements, and least liable to expose him to a surprise, or a disadvantageous collision with the enemy. See *Reconnoissance.*

PATTE D'OIE.—A term used in mining to describe three small branches which are run out at the extremity of a gallery. They are so called from their close resemblance to the foot of a goose.

Pattée.

PATTEE.—A cross in Heraldry, also called Cross Formée, a cross with its arms expanding towards the ends, and flat at their outer edges.

PATTERN.—The wooden model used in casting is technically called the Pattern. Models for casting should be made of one or several pieces, according to the form of the mold required. When the form is such that the whole model can be withdrawn from the sand at once, without injuring the mold, a single piece will suffice; but generally the model is composed of several pieces, so fitted that they can be put together in succession as the molding progresses, and finally taken apart and removed by piecemeal when the molding is complete. See *Molding.*

PATTISON PROJECTILE.—This shot has projections cast upon it to fit the rounded grooves of the gun. The windage is stopped by a simple leather band, which is driven upon the conical base of the shot by the powder-gas.

PAUL.—The name given to a Sepoy's tent. It is of a different pattern to the European soldier's tents being much smaller and lighter.

PAULDRONS.—In ancient armor, reinforcing metal plates covering the shoulders.

PAULIN.—A kind of *tarpaulin.* It is made of thick, unpainted canvas, and forms part of the equipment for each carriage of a field-battery of artillery. They are of four sizes, viz;—Magazine, large; Magazine, small; Camel paulins; Cart paulins. *Large paulins* are used on the floors of laboratory tents. *Small magazine paulins* are used in covering powder barrels and live shells in the batteries. *Camel paulins*, being of small size, are frequently very convenient, and are used for the same purposes as small magazine paulins. *Cart paulins* are used with tilts for artificers' carts. With the exception of the camel and cart paulins, which are made of coarse country canvas, all others are made of vitry.

PAVADE.—A term formerly applied to a short dagger in Scotland.

PAVAVA.—A conveyance drawn by a buffalo, and employed in the Philippine Islands. The drawing shows the manner of its construction and use. The shafts, framework, and body, are of bamboo; the collar and nose-band of the buffalo of chair cane, and the roof of the pandanus leaves. This arrangement furnishes a hint for making travées more comfortable. Unhappily, the bamboo, admirably suited

to the construction of litters and stretchers, is not available in this and many other countries.

PAVESIER.—An ancient militia who carried the (*pavois*) shield. Also written *Pavecheur*.

PAVILION.—1. In Heraldry, a covering in the form of a tent, investing the armories of Kings. 2. A tent raised on posts; a flag, colors, ensign, or banner.

PAVISE.—A large shield covering the whole body, having an inward curve, managed by a Pavisier, who with it screened an archer. Also written *Pavais*, *Pavas*, *Pavese* and *Pavesse*.

PAVISIERS.—Warriors armed with the pavise. In ancient encounters, bodies of *Pavisiers* were formed on each side; and, doubtless, these strong defenses were opposed, as much as possible, to the hostile archers. Also written *Pavisors*.

PAVOIS.—A small cuirass first worn by infantry soldiers about 700 B. C. It consisted of plates of metal sewed on to woven stuffs or skins. See *Pavise*.

PAVOIS D'ASSAUT.—A German shield of the fifteenth century, 44 inches by 72 inches, composed of wood covered over with leather. It was also constructed in various shapes and sizes.

PAVOISIENNE.—A small hand shield of the middle of the fourteenth century. It was one foot and one quarter of an inch in diameter.

PAVON.—An ancient military flag shaped like a right-angled triangle.

PAY.—The stipend or salary allowed for each individual serving in the army. The following is a table of the monthly pay allowed in the United States Army:—

Pay of Officers in Active Service.

GRADE.	PAY OF GRADE.		MONTHLY PAY.			
	Yearly.	Monthly.	After 5 years' service.	After 10 years' service.	After 15 years' service.	After 20 years' service.
			10 *per ct.*	20 *per ct.*	30 *per ct.*	40 *per ct.*
General	$13,500 00	$1,125 00				
Lieutenant-General	11,000 00	916 67				
Major-General	7,500 00	625 00				
Brigadier-General	5,500 00	458 33				
Colonel	3,500 00	291 67	$320 83	$350 00	$375 00	$375 00
Lieutenant-Colonel	3,000 00	250 00	275 00	300 00	325 00	333 33
Major	2,500 00	208 33	229 17	250 00	270 83	291 67
Captain, mounted	2,000 00	166 67	183 33	200 00	216 67	233 33
Captain, not mounted	1,800 00	150 00	165 00	180 00	195 00	210 00
Regimental Adjutant	1,800 00	150 00	165 00	180 00	195 00	210 00
Regimental Quartermaster	1,800 00	150 00	165 00	180 00	195 00	210 00
First Lieutenant, mounted	1,600 00	133 33	146 67	160 00	173 33	186 67
First Lieutenant, not mounted	1,500 00	125 00	137 50	150 00	162 50	175 00
Second Lieutenant, mounted	1,500 90	125 00	137 50	150 00	162 50	175 00
Second Lieutenant, not mounted	1,400 00	116 67	128 33	140 00	151 67	163 33
Chaplain	1,500 00	125 00	137 50	150 00	162 50	175 00

Pay of Officers and Cadets at the Military Academy.

Grade.	Grade or assimilated pay.
Superintendent	Pay of Colonel.
Commandant of Cadets	Pay of Lieutenant-Colonel.
Adjutant	Pay of Regimental Adjutant.
Quartermaster and Commissary of the Battalion of Cadets	Pay of his grade in the Army.
Treasurer	......do.
Surgeon	......do.
Assistant Surgeon	......do.
Professor, of more than ten years' service at the Academy	Pay of Colonel.
Professor, of less than ten years' service	Pay of Lieutenant-Colonel.
Assistant Professor	Pay of Captain, mounted.
Senior Assistant Instructor of Tactics	......do.
Assistant Instructor of Tactics, commanding a Company of Cadets	......do.
Acting Assistant Professor	Pay of his grade in the Army.
Acting Assistant Instructor of Tactics	......do.
Instructors of Ordnance and Science of Gunnery and of Practical Engineering	Pay of Major.
Sword Master	
Cadet	$540 per annum.

Pay of Enlisted Men of the United States Army.

	FIRST ENLISTMENT.					FIRST RE-ENLISTMENT. $2 EXTRA.				
YEAR IN EACH ENLISTMENT	1st year.	2d year.	3d year.	4th year.	5th year.	1st year.	2d year.	3d year.	4th year.	5th year.
YEAR OF TOTAL CONTINUOUS SERVICE	1st year.	2d year.	3d year.	4th year.	5th year.	6th year.	7th year.	8th year.	9th year.	10th year.
	Retain nothing.	Retain nothing.	Retain $1.	Retain $2.	Retain $3.	Retain $1.	Retain $1.	Retain $1.	Retain $1.	Retain $1.
RANK AND SERVICE.										
COMPANY.										
Private—Artillery, Cavalry, and Infantry Private—(Second class) Engineers, Ordnance and Signal Corps Musician—Engineers, Artillery, and Infantry Trumpeter—Cavalry	$13	$13	$14	$15	$16	$18	$18	$18	$18	$18
Wagoner—Artillery, Cavalry, and Infantry	14									
Artificer—Artillery and Infantry	15									
Corporal—Artillery, Cavalry, and Infantry Blacksmith and Farrier—Cavalry Saddler—Cavalry	15	15	16	17	18	20	20	20	20	20
Quartermaster Sergeant	17									
Sergeant—Artillery, Cavalry, and Infantry Private—(First class) Engineers, Ordnance, and Signal Corps	17	17	18	19	20	22	22	22	22	22
Corporal—Engineers, Ordnance, and Signal Corps	20	20	21	22	23	25	25	25	25	25
First Sergeant—Artillery, Cavalry, and Infantry Saddler Sergeant—Cavalry	22	22	23	24	25	27	27	27	27	27
Sergeant—Engineers, Ordnance and Signal Corps	34	34	35	36	37	39	39	39	39	39
REGIMENT.										
Chief Trumpeter—Cavalry Principal Musician—Artillery and Infantry	22	22	23	24	25	27	27	27	27	27
Chief Musician—Artillery, Cavalry, and Infantry	60									
Sergeant Major—Artillery, Cavalry, and Infantry Quartermaster Sergeant—Artillery, Cavalry, and Infantry	23	23	24	25	26	28	28	28	28	28
Sergeant Major and Quartermaster Sergeant—Engineers	36	36	37	38	39	41	41	41	41	41
Veterinary Surgeon (senior)	100									
Veterinary Surgeon (junior)	75									
Teacher of Music at M. A.	90									
POST.										
Hospital Matron	10									
Hospital Steward (First class)	30	30	31	32	33	35	35	35	35	35
Hospital Steward (Second class)	22	22	23	24	25	27	27	27	27	27
Hospital Steward (Third class)	20	20	21	22	23	25	25	25	25	25
Ordnance Sergeant Commissary Sergeant	34	34	35	36	37	39	39	39	39	39

The General of the Army has been retired, without any reduction in his current pay and allowances. The maximum pay of a Colonel is by law $4,500 per annum; hence full 40 per cent. cannot accrue. The maximum pay of a Lieutenant-Colonel is by law $4,000 per annum; hence full 40 per cent. cannot accrue. An Aid-de-Camp to a Major-General is allowed $200 per year in addition to the pay of his rank, not to be included in computing the service increase. An Aid-de-Camp to a Brigadier-General is allowed $150 per year in addition to the pay of his rank, not to be included in computing the service increase. An Acting Commissary of Subsistence is allowed $100 per year in addition to the pay of his rank, not to be included in computing the service increase. Assistant Surgeons are entitled to pay of Captain after five years' service. Retired officers receive 75 per cent. of pay (salary and increase) of their rank. A retired Chaplain receives three-fourths of the pay (salary and also increase) of his rank (Captain not mounted). The officer having charge of the public buildings and grounds (Washington) has, while so serving, the rank, pay, and emoluments of a Colonel. The Aides-de-Camp and Military Secretary to the Lieutenant-General, selected by him from the Army, have, while so serving, the rank and pay of Lieutenant-Colonel. The principal assistant in the Ordnance Bureau of the War Department receives a compensation, including pay and emoluments, not exceeding that of a Major of Ordnance. Only one Veterinary Surgeon, at $75 per month, is allowed each of the cavalry regiments, from the First to the Sixth Regiment, inclusive; two, one at $100 and one at $75 per month are allowed each of the Seventh, Eighth, Ninth, and Tenth Regiments; the senior in date of appointment entitled to the higher grade. The Teacher of Music, who shall be leader of band at Military Academy, receives $90 per month. The clothing account is settled June 30 and December 31 of each year. Balances found due United States are charged soldier on muster-rolls of those dates. Balances due soldier are carried forward on company books credited to his current clothing account; any balance remaining due him at discharge is credited on final statements. Enlisted men of Signal Corps have the pay of Engineer soldiers of a similar grade.

PAY ACCOUNTS.—The Paymaster's vouchers for payments of salary made to officers and in final settlements with discharged soldiers. The form of the account used by officers is shown on page 496.

PAY BILLS—In the British Service, accounts regularly tendered by Captains of troops or companies of the money required by them for the effectives of such troops or company.

PAY DEPARTMENT.—That department of a government which takes charge of all matters relating to the pay of the army. In the United States Army, the Pay Department consists, at present, of one Paymaster-General, with the rank of Brigadier-General; two Assistant Paymaster-Generals, with the rank of Colonel of Cavalry; two Deputy Paymaster-Generals, with the rank of Lieutenant-Colonel of Cavalry; and forty-eight Paymasters, with the rank of Major of Cavalry. An Act of Congress, making appropriations for the support of the Army for the year ending June 30, 1884, *provides* that vacancies that may hereafter occur in the Pay Corps of the Army in the grades of Lieutenant-Colonel and Major, by reason of death, resignation, dismissal, or retirement, shall not be filled by original appointment until the Pay Corps shall, by such vacancies, be reduced to forty Paymasters, and the number of the Pay Corps shall then be established at forty and no more.

PAYMASTER.—An officer appointed in the army for the purpose of keeping its pay accounts, and the disbursing of moneys in payment of troops. In the United States Service, it is the duty of Paymasters to pay all the regular and other troops; and to insure punctuality and responsibility, correct reports must be made to the Paymaster-General once in every two months, showing the disposition of the funds previously transmitted, with accurate estimates for the next payment of such regiments, garrisons, or departments, as may be assigned to each. When volunteers or militia are called into service, the President may assign to any officer of the army the duty of Paymaster. Paymasters are required to give bonds.

In the British Service, Military Paymasters are either "Control" or "Regimental." Of the latter, who constitute by far the more numerous class, there is one to every brigade of artillery, regiment of cavalry, and battalion of infantry. The Paymaster holds no other commission, but the appointment is nearly always conferred upon some person who has previously held a combatant rank in the army. The functions of Paymaster comprise issuing and accounting for the pay of officers and men, and having charge generally of all the finances of the corps. In discipline, the Paymaster is responsible to the Officer Commanding the Regiment; but in all money matters he looks for orders to the War Office alone. He commences with a pay of 12s. 6d. a day, with the relative rank of Captain; and after 20 years' service attains the pay of £1, 2s. 6d. a day and relative rank as Major. Regimental Paymasters were first appointed during the French war. Control Paymasters have financial charge in the military districts or sub-districts. They form a separate Department under the Surveyor General of the Ordnance, comprising Paymasters, Deputy Paymasters, and Assistant Paymasters.

PAYMASTER-GENERAL.—The Paymaster-General, in conformity with the laws and regulations, is charged with all necessary instructions to his subordinates in reference to the supply and distribution of funds for the payment of the Army, and all other things pertaining to the financial duties of his Department, and the accountability of its officers. In these and all other matters having relation specially to the internal administration of the Pay Department, the correspondence between the Paymaster-General and his subordinates, and between the Division and Department Chief Paymaster and their subordinates, is direct. In England the Paymaster-General is an officer of the British Ministry, but not of the Cabinet, charged with superintending the issue of all moneys voted by Parliament. He is virtually the Paymaster of the public service, having no control over the sums issued, paying merely on the order of the Department concerned and receives £2,000 a year as Chancellor of the Duchy of Lancaster. He is always either a Peer or a member of the House of Commons, and changes with the Ministry. Of late years the office has been held in conjunction with that of Vice-President of the Board of Trade. The Paymaster-General is assisted by a Deputy and a staff of clerks, the annual cost of the whole department amounting to about £25,000. The first notice of this office is in the early part of the reign of Charles II., when the Paymaster-General was nothing more than the sole Paymaster of the Army. The present extensive duties of the office have been added by degrees during the 19th century.

PAYMASTER-SERGEANT.—A Non-commissioned Officer, in the British Army, whose duty it is to act as clerk to the Paymaster. He ranks with other staff sergeants, and receives from 1s. 11d., to 2s. 11d. a day, according to his corps, with an increase of 6d. after 3 years' uninterrupted service as Paymaster-Sergeant.

PAYNIZING.—A process for preserving and hardening wood, invented by a Mr. Payne. It consists in placing well-seasoned timber in an air-tight chamber, and then, when, by means of a powerful air-pump, the wood is deprived of its air, a solution of *sulphuret of calcium*, or a sulphuret of barium is admitted, and readily fills up the empty vessels all through the wood. The air-pump is again used, and the superfluous moisture is drawn out, and a solution

The United States,

To..*Dr.*

Salary.	Station.	From...	To...	Months.	Pay, per year.	Amount.
For over..............years' service.		the .... of ...., 18......	the .... of ...., 18......			
On leave of absence from my station........................ Since.. Under S. O., No............., dated Headquarters.......................... Extended by S. O., No............., dated Headquarters.................... .... Returned to duty..........................				Deduct half pay for.......months ....days leave of absence.		$

I certify on honor, that the amounts charged in the foregoing account are correct and just, as authorized by law, and that they are rightfully due me as stated; and that I am not in arrears with the United States on any account whatsoever.

I was last paid to ...., 18..., by Paymaster ...., and I acknowledge to have received, this .... day of ...., 18..., of Paymaster ...., U. S. A., in full of this account, the sum of ....$\frac{}{100}$ dollars, by check No. ...., on.................

(Signed in duplicate.)

....

....

The following is the form of account to be used by discharged soldiers:

The United States,

To ....

Discharged from....................... *Company* .... *U. S.*,.................... Dr.

	Dollars.	Cents.
For pay from 1st of............, 188–, to.........of............, 188–, being............months ....days, at..................dollars per month..................................		
For retained pay due		
For pay for traveling from......................................, the place of my discharge, to......................................the place of my residence,.............................. miles, at twenty miles per day, equal to......................days, at............dollars per month..		
For deposits,...... .... Interest,..........................		
....		
For subsistence for traveling as above,....................days, at 30 cents per ration, or day..		
For clothing due soldier..		
Amount..		
Deduct for Army Asylum.. $		
Due United States for clothing..................................		
Due United States for tobacco..................................		
....		
Balance..		

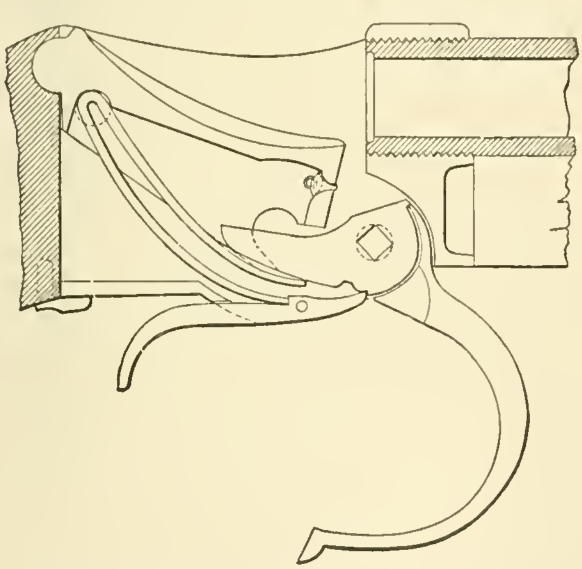
Received of..........................., Paymaster, U. S. A., this..................day of...................., 188–, ...$\frac{}{100}$dollars in full of the above account, by check No............on........................ this date and amount.

(Signed in duplicate.)

of sulphate of iron is injected; this acts chemically upon the sulphuret of barium or of calcium, and forms all through the wood either the insoluble sulphate of barium (heavy spar) or of lime (gypsum). The addition of these mineral materials renders the wood very heavy, but it becomes also very durable, and almost incombustible.

PAY-ROLL.—A roll or list of persons entitled to payment, with the sums which are to be paid on them. In the United States Army, at each regular muster of the troops, one ordinary muster-roll and three Muster and Pay-rolls are made. The muster-roll is transmitted by the mustering officer to the Adjutant General's Office, at Washington, within three days after the muster. Two copies of the pay-roll are for the Paymaster, the other is kept with the company records. Muster, and Muster and Pay-rolls are made on the printed forms furnished from the Adjutant General's Office; and in making the rolls special attention must be given to the printed directions thereon. The calculations on the Pay-rolls are made by the Paymaster. They are transcribed by the Captain on the copy retained with the company records, in order that an exact account of each soldier's pay may be kept. If it should become necessary to use manuscript forms, they should embrace all the data required to insure justice to the soldier, and guide the Paymaster in making payment. Companies are designated on the Muster, and Muster and Pay-rolls by the names of their Captains, whether present or absent. Soldiers in hospital, patients, and nurses, except stewards, are mustered on the rolls of their company, if it be present at the post.

PEABODY-MARTINI RIFLE.—This rifle is a combination of the Peabody and Martini systems, the former covering the mechanism for closing the breech and extracting the cartridge shell, after the rifle has been fired, and the latter covering the device for igniting the cartridge. This rifle was adopted by the



English and Turkish Governments, after long and exhaustive trials in competition with all the prominent breech-loading rifles of the world. It endured the test of actual experience in war during the contest between Russia and Turkey, and obtained the highest reputation for solidity, accuracy, long range, and other desirable qualities of a military weapon. The official reports from the armies in the field, and the letters of army correspondents, unite in praise of the Turkish rifles. The parts composing the breech mechanism combine the greatest possible strength with simplicity of construction, and the system, in its present perfection, is the result of long and careful study to produce a rifle meeting all the requirements of military service. Its form is compact and graceful, and the symmetry of its lines is nowhere infringed upon by unseemly projections, which besides being offensive to the eye, are often prejudicial to the comfort of the soldier on the march or in the performance of its necessary manipulations. No movement of the barrel, or any other parts, except those immediately connected with the block, is required in the performance of any of its operations. These are performed in the simplest possible manner, and without in the least infringing upon the strength and durability of the rifle, which is equal, in these respects, to the best muzzle-loader. In the operation of loading, the whole movement of the block is made within the breech-frame or receiver the end of the block-lever falling but a short distance from the stock. The block itself is a strong, substantial piece, and when in position for firing, is so firmly secured as to ensure its perfect safety, as has been repeatedly shown in the severe tests to which it has been subjected.

The drawing shows the Peabody-Martini breech system. The position of the block, when it is drawn down for loading, is such as to form an inclined plane, sloping toward the breech of the barrel, and the groove in its upper surface corresponding with the bore of the barrel, facilitates the entrance of the cartridge so that it slides easily into the chamber, without the necessity even of looking to see that it is properly inserted. The adoption of the coil main-spring in place of the common gun-lock main-spring, is considered a great improvement, and this opinion is confirmed by the experience of the English and Turkish troops who have been supplied with the Peabody-Martini rifles. It has been found that, in several instances, where the coil main-springs were broken, the defects were not noticed, and the springs compressed in the blocks worked as usual. Had such mishaps occurred to the old gun-lock mainsprings, the arm would have been rendered useless. The accuracy and range of this rifle are very remarkable. The system of rifling used is that known in England as the Henry. There are seven grooves, of peculiar shape, with a sharp twist (one turn in twenty inches). After a long series of experiments, with different kinds of rifling, the English Arms Commission finally decided upon this system as giving the most satisfactory results, both with regard to accuracy and range.

The manipulations for loading and firing are of the simplest kind: Throw down the block-lever with considerable force, pressing with the thumb of the right hand: insert the cartridge; and return the lever to its place, which raises the block to its proper position when the rifle is ready for firing.

After firing, throw down the block-lever with force, and the empty cartridge shell is thrown out clear from the rifle, leaving the chamber ready for the insertion of another cartridge. This extraction of the cartridge shell is effected by the action of an elbow lever, which throws it out with unerring certainty, the instant the block-lever is lowered. This elbow lever derives its power simply from the action of the block itself, and cannot become deranged, as its action is not dependent upon any spring and is of such strength as to prevent the possibility of breakage or derangement by any service to which it can be subjected. If it is desired to preserve the cartridge shell for reloading, throw down the block-lever with a gentle movement, and it is drawn out into the groove of the block, from whence it can readily be taken by the person firing.

For rapidity of firing, this rifle is believed to be equal, if not superior to any other single loader, and in continuous firing, to any repeater. It cannot be fired until the block is in its proper position, so that it is impossible for accidents from premature explosion to occur. The objection to the excessive recoil of this rifle, which has been raised in some quarters, has been obviated in the arms manufactured by the Providence Tool Company, by the adoption of a different form of ammunition. After the decision of the English Arms Commission in favor of the Peabody-Martini rifle, and its subsequent adoption as the standard national arm, the Imperial Ottoman Government contracted with the Providence Tool Company to manufacture 600,000. The productive capacity of this Company's factories is 1000 rifles per day. In conclusion it may be said, that wherever the rifle has been introduced, its superior qualities of safety, strength, simplicity, easy manipulation, accuracy, and range, have been fully conceded. See *Martini-Henry Rifle*.

PEACE ESTABLISHMENT.—The reduced number of effective men of an army during peace time; regiments are raised to their full complement in war time, or, as it is termed, to a *war establishment*. In Great Britain the raising of the army from a peace to a war establishment is effected by calling out the reserve, the militia, enrolled pensioners, and volunteers; in continental armies, where the compulsory service is in force, by calling out the men on furlough and the reserves.

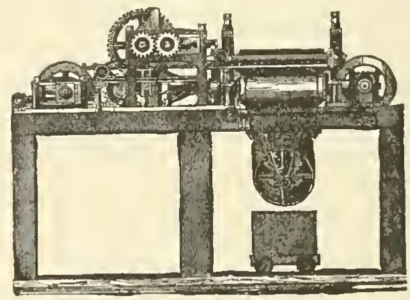

Pean.

PEAN.—One of the furs borne in Heraldry, differing from Ermine only in the tinctures: the ground being sable, and the spots of gold. See *Heraldry*.

PEA-ORE.—A form of compact brown iron ore (hydrated peroxide of iron), consisting of round, smooth grains, from the size of mustard-seed to that of small pease. Sometimes the grains are still smaller and flattish. This iron ore is very abundant in some places in France, and is smelted.

PEA-RIFLE.—A rifle of small bore carrying a ball of the size of a pea.

PEBBLE POWDER.—Since the pellet powder was first brought into use, another description of large grain powder, called "pebble powder," has been introduced for service with guns of large caliber. This pebble powder is formed of large grains ranging from $\frac{1}{16}$ of an inch to as much as 2″ cubes; and to manufacture this class of powder expeditiously and cheaply, has brought forth another description of machine for forming the pebbles by cutting up previously compressed cake into cubes of the required dimensions. This is done in the following manner, by a very simple self-acting machine: The cake as brought from the press-house is, to begin with, of the thickness of the required cubes, and this cake the machine has to cut up—first, into long strips of the same width as the thickness of the cake; and, secondly, to cut these long strips transversely into cubes. This is accomplished in the machine by means of two pairs of rollers in the following manner: The cake is fed into a hopper placed immediately above the first pair of rollers, and, as these are provided with knives upon their surfaces, they cut the cake up into long strips. These strips fall upon an endless traveling band, which conveys and carries them forward to the second pair of rollers, where they are cut transversely into cubes. They then drop into a spout, and are delivered into a revolving sifter covered with copper wire, which conveys the perfect cubes into a number of wooden boxes contained in a small gun-metal truck; but the dust and small pieces fall through the sifter into other boxes, and are taken back to the press-house and worked up again. The framing of this machine (like most of the other machines used in the manufacture of gunpowder), is composed entirely of gun-metal, and has the requisite seatings cast upon it for the reception of the several brackets and pedestals which are also of gun-metal, as well as the cutting rollers, each pair being about 7″ in diameter, with a number of equidistant teeth or knives formed upon their surfaces, cut out of the solid metal. These rollers are securely fixed upon wrought-iron shafts, which receive their motion from a main driving shaft by means of spur gearing. The underside of the bearings of these rollers are planed and faced so as to slide in their respective brackets. One of each pair of bearings is fitted with a spring box controlled by a set-screw, by means of which the amount of resistance to the opening of the rollers is adjusted. Blocks of hard wood are also fitted between each pair of bearings to act as stops, and thus determine the minimum distance between the surface of the rollers, and an adjustable gun-metal scraper is fitted to each roller for removing the surplus powder from its surface. A skeleton carrying band, made of two leather belts fitted with ash cross-bars of a triangular section and at about 3″ apart, is provided. These



wooden cross-bars are rivetted with copper rivets to the leather belts and to gun-metal strips upon their underside, these strips being of such a form as to serve the purpose of teeth for driving the band. This endless band works upon two gun-metal drums; the one is driven by gearing from the main shaft, and the other is fitted in adjustable bearings, which can be tightened by means of a screw so as to take up any slack in the band. These drums are made with flanges at each end, and have recesses formed on their barrels to receive the gun-metal projections or strips upon the carrying band. A sliding table made of hard wood and provided with four gun-metal grooved wheels, which travel upon V rails, also made of gun-metal, is fitted to work underneath the carrying band, and travels at the same uniform rate of speed. The top surface of this table is covered with leather, and made perfectly smooth; a reciprocating motion is given to it by means of an endless chain made of sheet copper, upon one link of which a stud is fitted and works in a gun-metal block that slides in a bracket fixed upon the underside of the table. A weighted gun-metal frame is also provided, and so adjusted that the underside of it rests upon the upper surface of the bars of the carrying band; the ends of this frame are fitted with gun-metal stay-rods, which project and work in slotted brackets connected to the machine; the frame is by this means free to rise if the pressure from any cause exceeds that of the weight by which it is held down. The underside of this frame is planed and made perfectly smooth, so as to allow the carrying band to work freely between the underside and the upperside of the sliding table.

The feeding web—which is made of strong Dowlas canvas—is driven by a gun-metal drum 7″ in diameter, the following roller being 1¼″ in diameter; the top surface of this web is supported by a board to prevent its sagging, and, in addition, the bearings wherein the shaft of the driving drum revolves are provided with slides made adjustable by means of screw gearing. A revolving sifter is fitted underneath the second pair of rollers, and works in bearings bolted to the underside of the framing of the machine; this sifter is composed of a number of gun-metal drums keyed upon a shaft, and its periphery is covered with copper wire, the whole being enclosed in a wooden casing. Underneath the sifter three sliding boxes are placed to receive the dust and small pieces which pass through the copper wire covering of the screen. At the end of the sifter a gun-metal traveling truck or carriage is provided, with four wheels adapted to run on V gun-metal rails fixed upon the floor; this carriage is capable of holding five wooden boxes, each about 18" square, into which the finished pebbles fall from the end of the sifter as it slowly revolves. A wooden hopper of sufficient width to cover the entire length of the rollers is provided for feeding the press-cake into the first pair, and a sheet copper casing is fitted to the second pair, with a spout at the bottom for conveying the pebbles into the sifter. All exposed parts, such as the ends of wrought-iron shafts, etc., are covered with recessed gun-metal washers securely fixed to them, and any others which may be made of iron or steel are covered with leather. All bearings are fitted with suitable lubricators, and channels or pipes for conveniently and efficiently lubricating the rubbing surfaces; and, as it is of the utmost importance that no oil or grease be permitted to come in contact with the powder, the bearings of the cutting rollers are fitted with sheet copper casings made in halves and hinged, so that the upper part can be lifted and the bearings cleaned. The copper casings at the geared end of the rollers are sufficiently large to contain the wheels and act as drip-pans. The pebbles from this machine, as well as the pellets from the hydraulic apparatus are generally taken to the glazing barrels, the treatment they there receive glazes them and also rounds off the sharp corners, thereby rendering them much better adapted for transport, storage etc. See *Gunpowder*.

PECTORAL.—Among the Romans, the poorer soldiers, who were rated under 1,000 drachmas, instead of the *lorica*, or brigantine (a leathern coat of mail) they wore a *pectoral*, or breast-plate of brass, about twelve fingers square. Some modern troops, such as the Cuirassiers, etc., wear pectorals for the direct purposes of defense and bodily protection; but, in general, small ornamental plates with clasps have been substituted.

PECULATION.—A term used in a military sense for embezzling public moneys, stores, arms, or ammunition. See *Articles of War*, 60.

PEDDOWK.—A tree which grows in the forests of Burmah and the Andaman Islands. It resembles mahogany in its color. It was formerly much used by the Burmese for gun carriages, and was introduced, some years back, into the gun carriage manufactory at Madras. A cubic foot of unseasoned wood weighs from 65 to 70 lbs.

PEDESTALS.—Props made of wood, and used for the support of stool beds of carriages when the elevating screws are removed.

PEDIEUX.—Coverings for the feet, used in the fourteenth century, and made of thin plates of steel or iron.

PEDOMETER.—An instrument for measuring walking distances. A common form consists of a string with a piece of lead at the end, and knotted at distances of 44 feet apart. It is to be used in connection with a seconds watch. Forty-four feet bears the same relation to an English statute mile (=5280 feet) that $\frac{1}{2}$ minute does to an hour; that is, the knots are $\frac{1}{120}$ of a mile apart. Drop the lead and allow the string to pass through the hand, the number of knots slipping through the hand indicate the rate of walking in the number of miles per hour. Small Pedometers, to be worn on the person, consist of a train of wheels in a small case, and a dial which registers the number of impulses derived from a cord attached to the foot. In this form it becomes a register of the number of *paces*. In Payne's English pedometer there is a repeating watch, which shows seconds minutes and hours; and also the day of the month. See *Odometer*.

PEDRO.—An early gun of large caliber, employed for throwing stone balls.

PEEL.—1. A small tower or fort. The term *Peel-house* is applied to any small fortified place. 2. To strip; to plunder; to pillage.

PEEL-TOWERS.—The name given to the towers erected on the Scottish borders for defense. They are square, with turrets at the angles, and the door is sometimes at a height from the ground. The lower story is usually vaulted, and formed a stable for horses, cattle, etc. For an account of these old towers, now mostly in ruin, see *History of Peebles-shire*, by W. Chambers, 1864.

PEE-MAH.—A tree which grows in India and Burmah, and is made use of in the Madras gun carriage factory for certain portions of gun carriages. It is a light and tough wood. There are two descriptions of it, red and white colored; the former is the tougher of the two. A cubic foot of unseasoned wood weighs from 50 to 52 lbs.

PEEP-SIGHT.—The basis of the sights used at Creedmoor in the most approved long-range rifles is the old-fashioned "peep and globe." To insure accurate shooting, the rear sight is made with a vernier

scale operated by a screw, by which an alteration of one-hundreth of an inch, and even of half that amount, can be made in the elevation, the result being exact, and recorded in figures—the only way in which a correct record of elevations can be kept. On the Remington rifle the divisions on the vernier are termed degrees and minutes, and on the Sharps decimals of an inch. On the former each minute is $\frac{1}{92}$ of an inch, and corresponds upon a 34-inch barrel with $1\frac{1}{18}$ of an inch, at each 100 yards. On the Sharps rifle each subdivision is $\frac{1}{100}$ of an inch, corresponding theoretically to $1\frac{1}{2}$ inch to every one hundred yards. As no man can hold or sight a rifle at 1 000 yards within ten inches, the elevation on both rifles is practically the same, or about two inches to each 100 yards for each subdivision on the vernier that is, twenty inches at 1,000 yards. The elevations on the Metford and Rigby rifles is about the same. The subdivisions upon the wind-gauge of both the

Remington and Sharps rifles are about $\frac{1}{40}$ of an inch, and are equivalent in practice to two inches at each 100 yards, or 20 inches at 1,000 yards, on the 34-inch barrel.

As the errors incident to aiming at long range will, in most cases, increase the effect of any alteration in the sights, care should be taken to keep well within the elevations which would be mathematically correct. It must also be recollected that the velocity of a bullet decreases with the distance, and as it loses its velocity it becomes more likely to be affected by currents of air. Consequently the effect of any change upon the sights is greater proportionately at long than at short range. The effect of wind, etc., increases in a still greater proportion, that which would require an alteration of 2 points in the elevation at 800 yards, requiring 2½ at 900, and 3 at 1,000. The best riflemen prefer to have the peep-hole of the rear sight of considerable size, as affording more light, and consequently allowing a better sight to be taken. In the Metford rear sight, discs having different sized apertures may be used; and it has been stated by some of the Irish team of 1874 that they have, in foggy or dark weather, done good shooting by removing the disc entirely, so as to leave an aperture of nearly a quarter of an inch. Every rifleman should, therefore, have an extra disc, with a large aperture, to use in dusky weather. The vernier sight is usually placed upon the small of the stock. General Dakin and others who shoot on their backs, have it placed upon the heel of the butt. When the latter is the case, it makes the distance between the two sights nearly a third greater than when placed upon the small of the stock, and consequently a proportionately greater allowance both for elevation and wind will be required.

PEETERS BULLET.—A form of bullet first used with the rifled musket by the Belgian infantry. It has a considerable cavity of a peculiar form. The metal of the projectile is left about the axis and projects downward, filling about one half of the forward half of the cavity. In consequence of the cavity, this bullet is somewhat lighter than the bullet for the rifle à tige.

PEISHWA.—The title of the personage third in rank and authority at the Court of the Mahratta Maharajahs of Satara, there being only the *Priti-nidhi* (Delegate of Rajah), between him and his Sovereign. However, during the weak reigns of Sevajee's descendants, the Minister increased in importance, till, about the commencement of the 18th century, Balajee Biswanath, the then Peishwa, and a man of distinguished administrative ability and diplomatic talents, made himself virtually the Ruler of the Mahrattas.

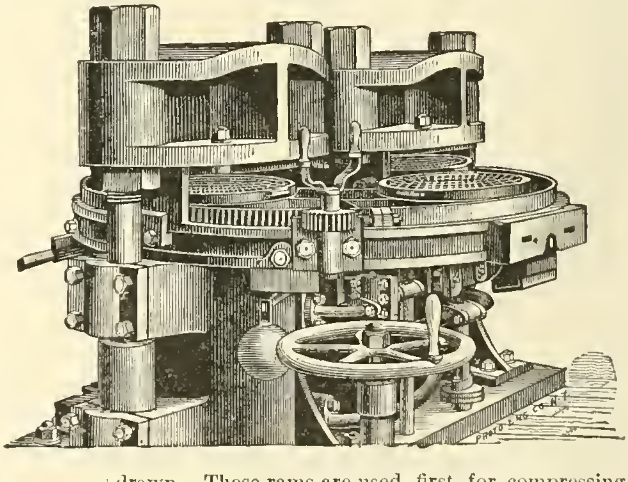
PELICAN.—In Heraldry, the pelican is drawn with wings indorsed, and wounding her breast with her beak. When represented in her nest feeding her young with her blood, she is called a pelican *in her piety.*

Pelican, in Heraldry.

PELLET.—1. An old word for shot or bullet. 2. In English Heraldry, a roundle sable. *Ogrees* has the same signification.

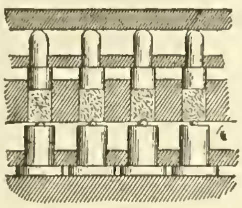
PELLET POWDER.—In consequence of the very great increase in the size of modern rifled cannon, and the large charges of gunpowder which have now to be used (from 300 lbs. to 500 lbs. being frequently employed), it soon became evident that some modification would have to be made in the description of gunpowder used. It was found that the ordinary large-grain powder hitherto adopted for small charges was not suitable for guns of large caliber, owing to the very rapid generation of the gases, and the inordinate strain to which the gun was thereby subjected. Extensive experiments were therefore carried out, with a view to determine the kind of powder that would give to the projectile a high initial velocity, and at the same time reduce the strain upon the gun to a minimum. This resulted in the adoption of a very large-grain powder called "pellet powder," which upon trial was found to give very remarkable results, as high an initial velocity as 1,600 per second being obtained, with a low pressure in the interior of the gun of not more than from 21 to 23 tons per square inch. These pellets are formed by compressing the powder meal into metal molds; various shapes and sizes were tried, some were flat discs, others prisms, but the shape which found most favor at first was the cylindrical pellet, 3-4" in diameter by ½" in length, and weighing 95 grains. Originally, these were made by hand, but it was soon apparent, that, if required in large quantities, machinery would have to be devised for their production; consequently a large machine of somewhat novel description, and capable of making 400 pellets at one time, was designed by Dr. John Anderson, and manufactured at Birmingham. This machine is worked entirely by means of hydraulic power derived from an accumulator, which affords a pressure equal to 1,000 lbs. per square inch.

This machine—which has given most excellent results—consists of two hydraulic cylinders, with a division in the center of each—thus, in reality, making four cylinders; in the two upper ones a plain cylindrical ram is fitted, which merely rises and falls as the water is admitted underneath the ram or is withdrawn.



These rams are used, first, for compressing the pellets, and second, for ejecting them, when finished, out of the mold plates. The two lower divisions are fitted with piston rams, securely attached to crossheads, which are united together, and also connected to two other crossheads above the cylinders by means of strong wrought-iron side rods, provided with collars working between lugs cast upon the hydraulic presses, and so adjusted as to allow only a certain limited travel either up or down. The upper crossheads can be adjusted to their exact positions by means of screwed threads and lock nuts on the upper end of the side rods. The use of the lower piston rams is to close the upper openings in the mold plates by bringing the top punches—which are connected to the upper crossheads by a gun-metal plate, down upon the mold plate, and thus confine the meal powder in the molds. The upper rams are now slowly raised, and these, acting upon the lower punches, compress the powder in the mold plate. After the proper density has been secured, the action of the lower rams is reversed, by which means both the lower and upper crossheads receive an upward motion, thereby raising the upper punches clear out of the way, so as to admit of the compressed pellets being ejected out of the mold plate, and this is done by giving a further upward motion to the two plain cylindrical rams. This will be better understood by referring to the enlarged view, where the mold plate—which is double—may be supposed to contain a charge of meal powder in the mold ready for compressing into a pellet. The lower part of the mold is closed by the lower steel punch that fits the mold very accurately, while the point of the punch rests upon the top surface of the plain cylindrical ram in the upper part of the hydraulic cylinder. The upper punch is also of steel, but much larger in diameter than the lower one.

To compress the powder in the mold, and form a pellet, requires four distinct movements of the machine. First, the upper punch is brought down until it rests upon the mold plate and closes the mold; this is effected by a downward motion of the two lower piston rams, to which the upper and lower



crossheads are connected together with the upper punches. Secondly, the lower punches are raised by the two upper plain rams, and the powder is compressed in the mold between the two punches. Thirdly, when the pellet is sufficiently compressed, the upper punches are raised from off the mold plate, this being done by reversing the action of the two lower piston rams until the upper crosshead and punches are at a sufficient height to admit of the compressed pellet being ejected out of the mold plate. This fourth and last operation of ejecting the pellet is effected by allowing the upper plain rams to rise still further, and thus force the finished pellet out of the mold by means of the lower steel punches. All these operations are simply and readily performed by means of a very ingenious arrangement of valves, the attendant having nothing to do beyond placing a handle in the several positions indicated on a dial. These valves are so constructed that the water power is admitted to the two presses simultaneously, whilst, by a self-acting arrangement, the pressure is shut off by the press itself when it has traveled the required distance. A relief valve is also provided, to allow any excessive pressure to escape should it accumulate from any cause, and this prevents damage happening either to the pipes or other parts of the apparatus.

It will thus be seen that a machine of this description is capable of easily making pellets of almost any shape, such as cylindrical, hexagonal, prismatic, or —what is possibly the best of all—spherical, by merely altering the form of the mold and punches. In the machine referred to, there are (on a revolving table, the framework of which is made of gun-metal) four mold plates fitted; each contains 200 holes, but as there are only two hydraulic presses to the machine, it follows that only two sets, or 400 molds, are under compression at one time, so that when we number these mold plates consecutively, then Nos. 1 and 3 will be under pressure whilst No. 2 and 4 are being filled. When the powder in Nos. 1 and 3 mold plate is sufficiently compressed, and the pellets formed therein have been removed, the entire table is turned one-fourth of the way round by means of a handle and toothed pinion working into corresponding teeth provided round the periphery of the gun-metal table, the revolving of which is much assisted by eight small anti-friction rollers fixed to the cast-iron frame of the machine; these rollers support the gun-metal table as it revolves upon its own center. Nos. 2 and 4 mold plates, which have been wholly filled with meal powder, are now brought under the crossheads of the machine and are in position for the powder contained therein to be compressed into pellets, whilst Nos. 1 and 3 in turn take their places to be refilled; the operation, therefore, of pressing and refilling are continuous, and the machine is capable of producing a large quantity of pebble powder per day, and with very little waste. See *Gunpowder*.

PELTA.—A small, light shield, sometimes attributed to the Amazons, but used by numerous nations of antiquity, such as the inhabitants of Thrace, Spain, and Mauritania, before its general introduction among the Greeks. It consisted mainly of a frame of wood or wicker-work covered with skin or leather, without the metallic rim, and of a great variety of shapes. It was sometimes round, as in the special case of the *Cetra*, sometimes elliptical, but most commonly crescent-shaped or lunated. Soldiers bearing the *pelta* were called *Peltastæ*.

PELTASTÆ.—Grecian soldiers who were intermediate between the *Oplitai* and the *Psiloi*. The peltast corresponded to our *élite* corps of infantry, selected for enterprises requiring both celerity and a certain firmness. The formation of the peltastæ and psiloi was analogous to that of the oplitai, the number of files being 8, instead of 16 as in the last. See *Oplitai*.

PEMMICAN.—This was originally a North American Indian preparation only, but it was introduced into the British Navy victualing-yards, in order to supply the arctic expeditions with an easily preserved food, containing the largest amount of nutriment in the smallest space. As made by the Indians, it consists of the lean portions of venison dried by the sun or wind, and then pounded into a paste, and tightly pressed into cakes; sometimes a few fruits of *amelanchier ovata* are added, to improve the flavor. It will keep for a very long time uninjured. That made for the arctic voyagers was chiefly of beef. In making pemmican, it is necessary to remove the fat completely.

PENAL SERVITUDE.—A punishment awarded by the Articles of War for certain crimes committed by soldiers.

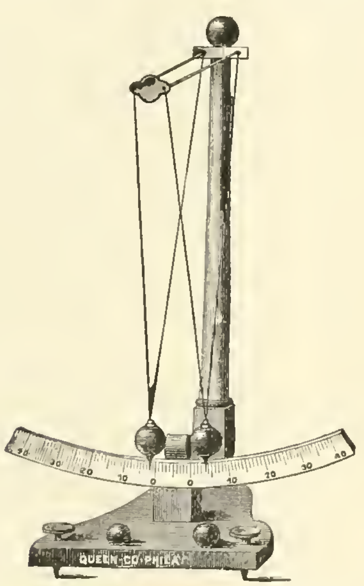
PENALTY.—A sum of money declared by some statute or contract to be payable by one who commits an offense or breach of contract. It is considered as a kind of punishment, and constituting indirectly a motive to the party to avoid the commission of the act which induces such a consequence. Many contracts executed between parties and government contain a clause that one or other of them who fails to perform his part of the contract will incur a penalty, *i.e.*, will be liable to pay a fixed sum of money to the other party. In such cases, a distinction is drawn between a liquidated and unliquidated penalty; and whether it is of the one kind or the other, depends on the language used in the contract. If it is a liquidated penalty, then, when the breach of contract is committed, the party in default must pay that precise sum, neither more nor less; but if it is unliquidated, then he is not to pay the whole sum, but merely such part of it as corresponds to the amount of injury or damage done, and of which proportion a jury is the sole judge in an action of damages.

PENCEL.—A small flag or streamer which was formerly carried at the top of a lance. Also called *Pennoncel*.

PENDANT—PENNANT.—1. In Heraldry, a part hanging from the label, resembling the drops in the Doric frieze. 2. A narrow flag of great length, tapering to a point, and usually carried at the head of the principal mast in a royal ship, to show that she is in commission. In the British Navy the Pendants are borne of three colors—red, white, or blue—according to the color to which the Admiral commanding the fleet pertains. On shore, Pendants are frequently employed at rifle ranges to indicate the strength and direction of the wind.

PENDULUM.—In its widest scientific sense, a pendulum is a body of any form or material which, under the action of some force, vibrates about a position of stable equilibrium. In its more usual application, however, this term is restricted, in conformity with its etymology, to bodies suspended from a point, or oscillating about an axis, under the action of gravity. The *simple* pendulum consists (in theory) of a heavy point or particle, suspended by a flexible string without weight, and therefore constrained to move as if it were always on the inner surface of a smooth spherical bowl. If such a pendulum be drawn aside into a slightly inclined position, and allowed to fall back, it evidently will oscillate from side to side of its position of equilibrium, the motion being confined to a vertical plane. If, instead of being allowed to fall back, it be projected horizontally in a direction perpendicular to that in which gravity tends to move it, the bob will revolve about its lowest position; and there is a particular velocity with which, if it be projected, it describes a circle about that point, and is then called a *conical* pendulum.

If the bob of the simple pendulum be slightly displaced in any manner, it describes an ellipse about its lowest position as center. This ellipse may, of



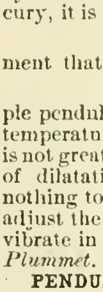
course, become a straight line or a circle. The bob does not accurately describe the same curve in successive revolutions; in fact, the elliptic orbit just mentioned rotates in its own plane about its center, in the same direction as the bob moves, with an angular velocity nearly proportioned to the area of the ellipse. This is an interesting case of *progression of the apse*, which can be watched by any one who will attach a small bullet to a fine thread; or, still better, attach to the lower end of a long string, fixed to the ceiling, a funnel full of fine sand or ink which is allowed to escape from a small orifice. By this process, a more or less permanent trace of the motion of the pendulum is recorded, by which the elliptic form of the path and the phenomena of progression are well shown. The very simple arrangement of apparatus, shown in the drawing, will be found convenient for the demonstration of the principles of pendulums, as also the laws of impact, both in elastic and non-elastic bodies.

It is readily seen that there should be no progression if the pendulum could be made to vibrate simply in a straight line, as then the area of its elliptic orbit vanishes. It is, however, found to be almost impossible in practice to render the path absolutely straight: so that there always is from this cause a slight rate of change in the position of the line of oscillation. But as the direction of this change depends on the direction of rotation in the ellipse, it is as likely to effect the motion in one way as in the opposite, and is thus easily separable from the very curious result obtained by Foucault, that on account of the earth's rotation, the plane of vibration of the pendulum *appears to turn* in the same direction as the sun, that is, in the opposite direction to the earth's rotation about its axis. To illustrate this now well-known case, consider for a moment a simple pendulum vibrating at the *pole* of the earth. Here, if the pendulum vibrates in a straight line, the direction of that line remains absolutely fixed in space, while the earth turns round below it once in 24 hours. To a spectator on the earth, it appears, of course, as if the plane of motion of the pendulum were turning once round in 24 hours, but in the opposite direction. To find the amount of the corresponding phenomenon in any other latitude, all that is required is to know the rate of the earth's rotation about the vertical in that latitude. This is easy, for velocities of rotation are resolved and compounded by the same process as forces, hence the rate at which the earth rotates about the vertical in latitude λ is less than that of rotation about the polar axis in the ratio of sin. λ to 1. Hence the time of the apparent rotation of the plane of the pendulum's motion is $\frac{24 \text{ hours}}{\sin \lambda}$. At the pole, this is simply 24 hours; at the equator, it is infinitely great, or there is no effect of this kind; in the latitude of Edinburgh (56° 57′ 23.2″), it is 28 hr. 37 m. 48 seconds.

We have not yet alluded to the obvious fact, that a *simple* pendulum, such as we have described above, exists in theory only, since we cannot procure either a single heavy particle, or a perfectly light and flexible string. But it is easily shown, although the process cannot be given here, that a rigid body of any form whatever vibrates about an axis under the action of gravity, according to the same law as the hypothetical simple pendulum. The length of the equivalent simple pendulum depends upon what is called the radius of gyration of the pendulous body. Its property is simply this, that if the whole mass of the body were collected at a point whose distance from the axis is the radius of gyration, the moment of Inertia of this heavy point (about the axis) would be the same as that of the complex body. The square of the radius of gyration of a body about any axis, is greater than the square of the radius of gyration about a parallel axis through the center of gravity, by the square of the distance between those lines. Now, the length of the simple pendulum equivalent to a body oscillating about any axis is directly as the square of the radius of gyration, and inversely as the distance of the center of gravity from the axis. Hence, if k be the radius of gyration of a body about an axis through the center of gravity, $\sqrt{k^2+h^2}$ is that about a parallel axis whose distance from the first is h; and the length, l, of the equivalent simple pendulum is $l=\frac{k^2+h^2}{h}$. This expression becomes infinitely great if h be very large, and also if h be very small (that is a body vibrates very slowly about an axis either far from, or near to, its center of gravity). It must therefore have a minimum value. By solving the equation above as a quadratic in h, we find that l cannot be less than $2k$, which is, therefore, the length of the simple pendulum corresponding to the quickest vibrations which the body can execute about any axis parallel to the given one.

As the length of a rod or bar of any material depends on its temperature, a clock with an ordinary pendulum goes faster in cold, and slower in hot, weather. Various contrivances have been devised for the purpose of diminishing, if not destroying, these effects. The most perfect in theory, though perhaps not the most available in pratice, is that of Sir D. Brewster, founded upon the experimental discovery of Mitscherlich, that some crystals *expand* by heat in one direction, while *contracting* in the perpendicular one; and therefore that a rod may be cut out of the crystal in such a direction as not to alter in length by any change of temperature. In the method of correction usually employed, and called *compensation*, advantage is taken of the fact that different substances have different coefficients of linear dilatation; so that if the bob of the pendulum be so suspended as to be raised by the expansion of one substance, and depressed by the expansion of another, the lengths of the effective portions of these substances may be so adjusted that the raising and depression, taking place simultaneously, may leave the position of the bob unaffected. There are two common methods of effecting this, differing a little in construction, but ultimately depending on the same principle. Of these, the *mercurial* pendulum is the more easily described. The rod and framework are of steel. Inside the framework is placed a cylindrical glass jar, nearly full of mercury, which can be raised or depressed by turning a nut. By increase of temperature, the steel portion is lengthened by an amount proportional to its length, its coefficient of linear dilatation, and the change of temperature, conjointly—and thus the jar of mercury is removed from the axis of suspension. But neglecting the expansion of the glass, which is very small, the mercury rises in the jar by an amount proportional to its bulk, its coefficient of cubical dilatation, and the change of temperature, conjointly. Now, by increasing or diminishing the quantity of mercury, it is obvious that we may so adjust the instrument that the length $\left(\frac{k^2}{h}\right)$ of the equivalent simple pendulum shall be unaltered by the change of temperature, whatever be its amount, so long as it is not great enough to sensibly change the coefficients of dilatation of the two metals. The screw has nothing to do with the *compensation*, its use is to adjust the length of the pendulum so that it shall vibrate in one second. See *Bob*, *Gun-pendulum*, and *Plummet*.

PENDULUM-HAUSSE.—A contrivance used to point field-pieces, and at the same time to obviate the error which arises when the wheels of the carriage stand on uneven ground. It consists of a *scale* and *slider*. The scale is made of sheet-brass; at the lower end is a brass bulb filled with lead. The slider is of thin brass, and is retained in any desired position on the scale by means of a brass set screw with a milled head. The scale is passed through a slit in a piece of steel, with which it is connected by a brass screw, forming a pivot on which the scale can vibrate laterally; this slit is made long enough to allow the scale to take a vertical position in any ordinary inequality of the ground on which the wheels of the carriage are required to stand; the ends of this piece of steel form two journals by means of which the scale is supported on the seat attached to the piece, and is at liberty to vibrate in the direction of the axis of the piece. The *seat* for suspending the pendulum-hausse upon the piece is screwed to the base of the breech in such a manner that the centers of the two journal notches shall be at a distance from the axis equal to the greatest exterior radius of the base of the breech. The height of the front-sight being equal to the dispart of the piece, a line from the top of the muzzle-sight to the zero, which is the pivot of the scale, is parallel to the axis of the piece; hence the vertical plane of sight passing through the center line of the scale and the top of the muzzle-sight, will be parallel to the axis in any position of the piece; the scale will therefore always indicate correctly the angle which the line of sight makes with the axis. The hausse, the seat, and the muzzle-sight, vary, in their construction and arrangement, with the piece for which they are intended. The graduations on the scale are the tangents of each quarter-degree to a radius equal to the distance between the muzzle-sight and the center of the journal-notches, which are in all cases one inch in rear of the highest point of the base of the breech.



PENETRATION OF PROJECTILES.—The most common substances encountered by projectiles are arranged in the following series, in the order of their resistance to penetration: *air*, *water*, *sand*, *wood*, *lead*, *copper*, *wrought-iron*, *soft steel*, *cast-iron*, *chilled-iron*, *hardened steel*, etc. All other substances may be arranged between these, or in continuation of the series. *Air* opposes the motion of a projectile by its inertia, elastic force, and the pressure due to its weight. The projectile compresses the air in its front and disperses it laterally, while the rear of the projectile is relieved by its motion of the normal pressure of the air. A small amount of resistance is also met with in the shape of friction. In the case of *water* these resistances are increased by the greater density and weight of this substance, and there is also a slight additional resistance due to the cohesion among the particles. *Sand*, being a solid, or at least made up of solid elements, presents the additional resistance of "crushing-strength." It cannot be penetrated at a high velocity without crushing some of the grains, and the higher the velocity the greater the amount of work expended in this manner. This resistance to crushing implies a continuation of the elastic force beyond the elastic limits, and involves indirectly tensile strength, since a solid in being crushed must enlarge laterally and finally yield to a strain of tension. In penetrating *wood*, *lead*, or any of the other materials, "tensile strength" forms the chief element of the resistance, while inertia and friction become of minor importance.

The office of elasticity in all these cases is to transmit the effect of the projectile from those particles first acted upon to those more remote, and thus calling into play their inertia or tensile strength, as the case may be; and were it not for this property, the statical resistance of a plate of any material to perforation would be entirely independent of the thickness of the plate; a thick plate would offer no greater resistance than a thin one, since each layer or unit of thickness would be perforated without receiving any assistance from its neighbors. The *work* of penetration would then vary directly with the distance penetrated, or the thickness of the plate; elasticity, however, has its maximum point of usefulness in resisting penetration, and beyond this it becomes a great disadvantage. While increasing the number of fibers or elementary portions of the material broken at once, thereby increasing the statical resistance, it diminishes the time during which this resistance opposes the motion of the projectile in like ratio; and the amount of motion destroyed or generated increases with the time as well as with the force or resistance. For this reason hardened steel and chilled iron are less efficient in stopping projectiles than soft iron, although they offer a much greater statical resistance to penetration. There are many reasons for believing that a general formula for the penetration of projectiles in all materials may be deduced, when experiments have been sufficiently extended, in which the constants will simply require changing to suit any particular case under consideration.

That the penetration of an elongated projectile is influenced by the form of its head has been shown by experiment, many different forms of head having been tried. The flat head has been strongly advocated, because it is asserted to be a better form for punching than any of the pointed heads, and because it is also asserted that it will bite into an iron plate at such an oblique angle as would cause a pointed head to merely glance. But the truth of these assertions has not been generally admitted. The flat-headed projectile is objectionable both as regards accuracy and velocity, and it has also a tendency to upset or bulge at the head on impact, and this result is very marked. The pointed projectile is superior in accuracy and range, and does not upset on impact to any thing like the same extent. It is asserted that it cuts through an iron plate to a better advantage, or rather tears through, bending back the plate.

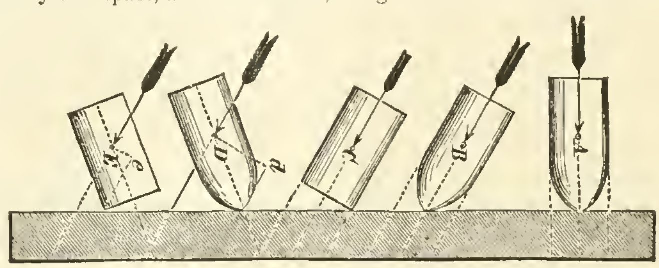
Another point in connection with the penetration of elongated projectiles is the effect of different forms of head upon the rotation of the projectile when the impact is oblique. If the axis of the projectile is tangent to the trajectory on impact, and at the same time normal to the target, there will be no tendency to rotate about any axis parallel with the plane of the target. In the drawing, if we suppose a projectile to arrive at A, under these conditions it will undoubtedly penetrate the plate directly. But let one arrive at D or E, and there will be a tendency to rotate, and this tendency will depend upon the form of the projectile as well as upon the angle between the trajectory and its axis.

It is often asserted, however, that the advantage in the latter case will be in favor of the flat-headed projectile, since the moment of the rotating-force will be the variable resistance of the plate multiplied by the lever arm *Dd*, for the pointed projectile, and the same multiplied by a much shorter lever arm, *Ee*, in case of the flat-headed projectile, and this may be negative; or in other words, there may be a tendency to rotate towards the normal, which would be a decided advantage. This would take place when the line of the trajectory passed within the base of the shot. In the third case, represented at B and C, a projectile is moving with its axis tangent to the trajectory, but oblique to the target; here there is also a tendency for the flat-headed projectile to rotate toward the normal, but it is questionable whether such rotation would be advantageous. The pointed projectile would have a less tendency to such rotation.

On the other hand, the respective motions of a flat and pointed headed projectile on oblique impact are explained as follows: It is asserted that the flat-headed projectile, on striking, cuts out a portion of the face of the plate, which it carries along in front, thus increasing the thickness to be penetrated; and, remaining nearly parallel to its original direction, it has to pass through the plate obliquely. While, if the projectile has a pointed head, the point enters at first more deeply into the plate than the flat head, and the center of gravity moving forward, the projectile turns around more readily than with the latter, so that its axis becomes perpendicular, or nearly so, to the face of the plate, having then only the least thickness to penetrate.

It is difficult to obtain for comparison the results of practice with the flat and pointed headed projectiles of the same material fired at targets inclined to the line of the range; the former having been so little used, as its form is so objectionable, both as regards accuracy and velocity. On the whole, it may be said that in the case when the projectile ought to be capable of piercing the plate or target, there is little difference between the effect of a flat head and a hemispherical head; but when the target is beyond the power of the projectile, the hemispherical head makes the deepest indent.

The impact of a projectile, in addition to indenting or penetrating a target, produces more or less bending, tearing, and other damage at a distance from the point of impact; which effects may be classed under the term "Concussion." The effect of concussion is transmitted from the point of impact in all directions, in the same manner as sound-waves, and increases with the elasticity of the material. Whatever tends to diminish the elasticity of the structure, as dividing it into many pieces, or using soft ductile material to receive the projectile, will diminish the effect of concussion. This effect is expended in two ways—*First*, in giving motion to the structure or in developing inertia; and, *Second*, in overcoming the tenacity of the material, either in bending or tearing those portions first acted upon from those more remote. Both of these components increase with the whole amount of work expended by the projectile, other conditions being equal. See *Impact of Projectiles* and *Projectiles*.



PENETRATIVE EFFECT.—Generally speaking, the penetrative effect depends on the shape and material of the projectile, on its energy and diameter, and the direction with which it strikes the target. It is quite impossible to accurately determine the coefficients of resistance for the different materials of projectiles and plates; but practically the amount of penetration, whether for iron or steel plates, or masonry, or earth, may be determined by experiment. Various empirical laws suffice to give approximate results; but they do not stand the test of any general application. In consequence of the varying qualities of resistance both in projectiles and targets, the variation in shape of the projectile on impact, the possibility of the projectile breaking up, and the amount of heat developed on impact, strictly analytical investigations cannot be made. If V is the velocity required for a projectile to pierce an armor-plate with right-angled impact, its energy per inch of circumference (See *Energy*) is $\frac{WV^2}{2g.\pi d}$. But if the projectile strikes obliquely at an angle A, then, if it turns in on its point and perforates *normally*, it is readily seen that the velocity for perforation must be $\frac{V}{\text{Sin } A}$, and consequently the energy per inch of circumference for oblique perforation will be $\frac{WV^2}{2g\pi d.\sin^2 A}$;

that is the number of foot-tons per inch of circumference to perforate an armor-plate obliquely is found by dividing the number of foot-tons required for perforation by right-angled impact by the square of the sine of the angle of impact. If the projectile goes straight through the plate without turning in, the energy per inch of circumference for oblique perforation will be $\frac{W V^2}{2g \pi d. \text{ Sin } A}$

In this case we would have best results for flat-headed projectiles and comparatively thin armor-plates.

The results of experiment show that the amount of penetration is directly proportional to the product of the weight of the projectile. multiplied by its velocity raised to powers that vary but little from unity for the different resisting bodies. The penetration into masses, such as earthen parapets and thick plates, is inversely proportional to the area of cross-section of the projectile. From these deductions we obtain the expression $W = \frac{p v}{d^2}$ in which W, called the penetrative effect, is taken as a measure of the projectile's power, p = weight of the projectile in pounds, v = velocity of impact in feet. d = diameter of shot in inches. Letting S = penetration of the shot in inches, we have (1) $S = \frac{1}{A} \cdot \frac{p v}{d^2} = \frac{W}{A}$, A being a coefficient, depending upon the shape of the projectile and the nature of the resisting substance, to be determined by experiment. For the best quality of wrought-iron plates, subjected to the action of ogival projectiles of steel or chilled cast-iron, the above formula may be used. For plates not exceeding $2\frac{1}{2}$ inches in thickness A = 575, whence (2) $S = \frac{W}{575}$. For plates of a greater thickness than $2\frac{1}{2}$ inches (3) $S = \frac{W}{360} - 1.5$ inches. For plates not exceeding 20 inches in thickness, this formula gives results closely approximating those determined by experiment. The depth to which a projectile will bury itself in a resisting body, which is too thick to be perforated, is less than the thickness of the obstacle that it will just pass through. For example, the shells of the 2.76 inch Italian field-gun, at 1,000 yards range, pass through a brick wall 1.97 feet thick, but only penetrate 1.66 feet into a similar wall 3.94 feet thick. In speaking of the penetration into masses of earth, wood, or masonry, the depth of penetration is meant, and S in formula (1) gives the number of inches the projectile will bury itself in a resisting body too thick to be perforated. The thickness of plate that the projectile can just pass through is generally taken as a measure of the power of guns against iron plates, and S in formulas (2) and (3) has this signification. The penetration of a projectile depends not only on its velocity, but also upon the direction in which it strikes the object, the component of the velocity normal to the surface struck determining the penetration. In this case the cosine of the angle of incidence should be introduced.

To find the penetrating power of a projectile, at any point of its flight, into armor-plates, the empirical formula of Major Noble, of the Royal Artillery. is used ·

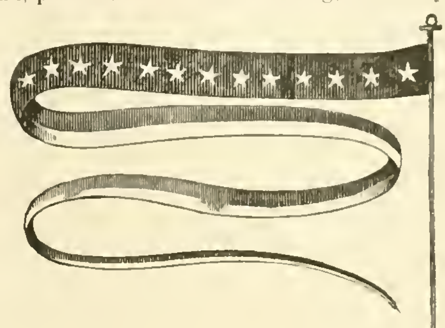
$$b = v \left(\frac{W}{4 r R g k} \right)^{\frac{1}{2}}$$

in which, b = penetration in feet; v = velocity on impact, in feet per second; W = weight of shot, in pounds; r = ratio of diameter to circumference of circle, 3.14159; R = radius of shot, in feet; g = force of gravity, 32.16 pounds; k = a co-efficient determined by experiment, depending on the nature of the wrought-iron in the plate, and the nature and form of the head of the shot. For a spherical projectile against an unbacked plate, (k) is 5,357,200. For an ogival headed projectile against a backed plate (k), is assumed to be 4,821,480. The plate is considered to be vertical, and the trajectory to be in a plane perpendicular to the plate. Should the shot strike the plate obliquely, the value of (b) determined as above, must be multiplied by the sine of the angle of incidence. For a given projectile and a plate of known thickness, the work required to produce penetration will be found from the equation placed under the form, $\frac{W v^2}{2g} = 2 r R k b^2$; and the velocity needed at impact, from the same equation solved with reference to (v).

PENNATED DAGGER.—An Italian *main gauche* with three blades expanding by means of a spring when a button was pressed in the handle, and forming a guard of great length and breadth, in which the adversary's sword might be caught and snapped.

PENNETIÈRE.—A pocket or small bag in which slingers carried stones and leaden balls. Also written *Panetiere*.

PENNON.—1. Formerly a copper wing of a long, light arrow (*Vireton*) substituted for a feather. 2. A small, pointed, or swallow-tailed flag, carried by the



mediæval knight on his lance, bearing his personal device or badge, and sometimes richly fringed with gold. The device was so placed as to appear in its proper position when the weapon was laid for the charge. *Pennoncelle* is a long streamer-like flag, the diminutive of the pennon. See *Flags*.

PENSIONS. — In the United States pensions are most generously granted by Act of Congress in the many cases of persons who have seen active service in the Army or Navy, and who have been honorably discharged. They are also awarded to widows, orphans, or other persons dependent on those instanced above. The existing pension-list of the United States includes those which have been granted for account of services rendered in the War of 1812; the Mexican War, and the War of the Rebellion. For the laws governing the distribution of pensions, and their amounts, etc., see *Revised Statutes of the United States*.

In England, pensions are awarded for good service, for mere faithful ordinary service, for wounds, and to representatives of deceased officers. *Good-service Pensions* are rewards to selected Officers in the British Navy for distinguished service. In 1873 they were as follows: 12 Admirals had £300 each, 25 Captains £150, 1 General of Marines £300, 5 do. £200, 2 Colonels £150, and 5 Medical Officers £100: total £9,150. In 1875-76 the total was £7,500. The corresponding pension in the Army is called a Reward for Distinguished Service.

The *Pensions for Long Service* are awarded in the army to Non-commissioned Officers and Soldiers who have served 21 years in the infantry, or 24 years in the cavalry, or earlier if disabled from further service, according to the wounds, loss of health, and conduct of the pensioner. The amount is fixed by the Commissioners of Chelsea Hospital, and varies from 1½d. to 3s. 6d. a day, the lower rates being mainly confined to Negro Pensioners from the West India regiments. Pensioners are either In-Pensioners of Chelsea, or Kilmainham Hospitals, in which case they forego their proper pensions, and receive board, lodging, and a small sum for tobacco-money, or Out-Pensioners residing where they please, and drawing their pensions from the Staff Officers of Pensioners, of whom there is one in every considerable town. These men can follow other pursuits, often do so with very great success, as their military habits of regularity stand them in good stead in civil life.

Pensions for *Wounds* are common to both services, and are limited to officers. They are awarded respectively by the Secretary of War and Lords of the Admiralty, for serious bodily injury, as the loss of a limb or eye, and vary according to the rank of the recipient and other circumstances. In cases of serious injury, temporary pensions are sometimes granted, or gratuities. The charge for Pensions for Wounds for 1875-76 was—army, 172 recipients, £16,-453; navy, 85 recipients, £9,036; total; £25,479. In the case of Common Soldiers and Sailors, wounds may serve to hasten or augment the pension for service, but they have no distinctive Pension for Wounds.

Widows of Commissioned and Warrant Officers in the army and navy receive pensions so long as they remain unmarried, provided they have been married severally twelve months when their husbands die, and that the latter were under 60 years of age (50 for Warrant officers) when they married the Claimants. Such pension is not granted if the widow be left in wealthy circumstances, and lies dormant during a second marriage, though it may be revived should she again become a widow. The amount of pension varies according to rank, and there are three distinct classes for each rank: 1st, When the husband was killed in the battle, or died within six months of wounds received therein; 2d, When he died from some cause distinctly falling within the sphere of his duty, but not from wounds in action; 3d, When he died in the course of nature.

In an elaborate opinion given by Mr. Attorney-General Cushing, published by the War Department in General Orders, No. 11 of 1855, he draws the conclusion that "the phrase 'line of duty' is an apt one, to donote that an act of duty performed must have relation of causation, mediate or immediate, to the wound, the casualty, the injury, or the disease producing disability or death." Every person (says Mr. Cushing) who enters the military service of the country—officer, soldier, sailor, or marine—takes upon himself certain moral and legal engagements of duty which constitute his official or professional obligations. While in the performance of those things which the law requires of him as military duty, he is in the line of his duty. But at the same time, though a soldier or sailor, he is not the less a man and a citizen, with private rights to exercise and duties to perform; and while attending to these things he is not in the line of his public duty. In addition to this, a soldier or sailor, like any other man, has the physical faculty of doing many things which are in violation of duties either general or special; and in doing these things he is not acting in the line of his duty. Around all those acts of the soldier or sailor which are official in their nature the pension laws draw a legislative line, and then they say to the soldier or sailor: If, while performing acts which are within that line, you thereby incur disability or death, you or your widow or children, as the case may be, shall receive pension or allowance; but not if the disability or death arise from acts performed outside of that line; that is, absolutely disconnected from, and wholly independent of, the performance of duty. Was the cause of disability or death a cause within the line of duty or outside of it? Was that cause appertaining to, dependent upon or otherwise necessarily and essentially connected with, duty within the line; or was it unappertinent, independent, and not of necessary and essential connection? That is the true test-criterion of the class of pension cases under consideration.

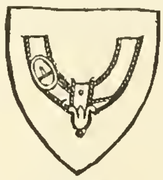
PENSTOCK.—A machine composed of timber, which, by means of a movable board, enables the defenders of a fortress to allow such a rush of water from the batardeaux as to inundate and destroy the works which the enemy may have constructed in the ditch.

PENTAGON.—In fortification, a figure bounded by five sides, which form so many angles, capable of being fortified with an equal number of bastions.

PENTATHLON.—The five exercises performed in the Grecian games, namely, leaping, running, quoiting, darting, and wrestling.

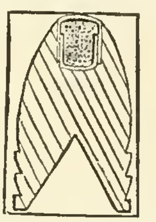
PENTHOUSE.—1. A shed hanging forward in a sloping direction from the main wall of a place. 2. A small house, made of boards united by hooks and staples, for protecting a gun and its carriages mounted *en barbette* from the weather.

PEON.—In India, a term formerly given to a foot-soldier, but in these days it does not bear this signification. Native servants or messengers attached to the Government offices in India are designated Peons, and wear a belt with a brass plate bearing the name of the office to distinguish them from private servants.


Perclose.

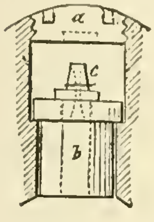
PERCLOSE.—PERCLOSE or DEMI-GARTER, in Heraldry, is the lower half of a garter with the buckle.

PERCUSSION BULLETS.—Percussion bullets may be made by placing a small quantity of percussion powder, enclosed in a copper envelope, in the point of an ordinary rifle-musket bullet, or by casting the bullet around a small iron tube, which is afterward filled with powder and surmounted with a common percussion-cap. The impact of the bullet against a substance no harder than wood is found to readily ignite the percussion charge or cap, and produce an effective explosion. These projectiles can be used to blow up caissons and boxes containing ammunition at very long distances. See *Bullet* and *Projectiles*.



PERCUSSION CAPS.—Small copper cylinders, closed at one end, for conveniently holding the detonating powder which is exploded by the act of percussion in percussion-arms. Caps were not used with the earliest percussion-arms, which the Rev. Mr. Forsyth, of Belhelvie, Aberdeenshire, patented in 1807; but they became tolerably general between 1820 and 1830, and were adopted for the army by 1840. With the adoption of breech-loading arms, the use of *separate* caps has been discontinued. The cap now forms a part of the cartridge, and at one operation is placed with it in the opened breech of the gun. The manufacture is extremely simple: A sheet of thin copper is stamped into pieces of appropriate shape, which are bent into the form of caps by stamping-apparatus closing round a mandril, the whole being done in one machine by two operations. The caps are then placed in a tray, mouths upward; and the inside of each is touched with a strongly adhesive varnish. Over this is dusted the detonating powder, all the particles which fail to adhere being blown, dusted, or shaken out. A stamper once more is forced into the cap, to fix and compress the powder, and the operation is completed. For muskets, the caps are charged with equal parts of fulminating mercury and chlorate of potash; for cannon, with a mixture composed of two parts of chlorate of potash, two parts of native sulphuret of antimony, and one of powdered glass; the last ingredient taking no part in the chemical action, and being added merely to increase the friction. See *Center-fire Metallic-case Cartridge*, and *Lock*.

PERCUSSION FUSE.—A percussion-fuse explodes by the striking of some particular point of a projectile against an object, as in the case of rifle-cannon projectiles. One of the best and simplest forms of this kind of fuse is the ordinary percussion-cap placed on a cone affixed to the point of the projectile. The piece to which the cone is attached may be fixed or movable; in either case, the apparatus should be covered with a safety-cap to prevent the percussion-cap from taking fire by the discharge of the piece. The drawing represents a fuse of the percussion kind, in which *b* is a movable cone-piece, bearing a musket-cap (*c*); and *a* is the safety-cap which covers the fuse-hole. When the projectile is set in motion, the cone-piece, or "plunger," by its inertia, presses against the shoulders of the fuse-hole; when its motion is arrested, the inertia of the cone-piece causes the percussion-cap to impinge against the safety-cap, which produces explosion. The explosion of the projectile may be made to take place at any desired time, after the explosion of the cap, by interposing grain, or mealed powder, between the cap and bursting charge. Experience has shown that the plunger should be enclosed in a tight metal case to prevent it from being fouled by the action of the powder; and to prevent premature explosions, the cone-piece should be confined by a screw or other device, to prevent it from moving until the projectile strikes its object.



The essential requirements of a good percussion-fuse are: that it should not be ignited by the shock of discharge or on striking water; that it shall be ignited on the impact of a shell against the object, and that it may not be liable to explode by handling or during transport. The percussion-fuse has many points in its favor: it assures the bursting of the projectile; it can be used for all ranges, be they never so great; it admits—a very important desideratum in war—of estimating distances, and of correcting the error of the estimation; it augments the result of firing by adding great moral to physical effect, due to the explosion of the projectile in the midst of the enemy. Its only inconvenience is its inability to cause the bursting of the projectile before it has touched the object, thus rendering the effects of fire dependent upon the nature and conformation of the target at the point of impact. See *Fuse*.

PERCUSSION-LOCK.—A lock of a gun in which gunpowder is exploded by fire obtained from the percussion of fulminating powder. Before the invention of friction-tubes, percussion caps or wafers were used in connection with a lock, which was screwed to the body of field pieces, and to the lock-pieces in heavier ordnance. The percussion powder was placed in a thin layer between two circular pieces of cartridge-paper, united by glue, pressed firmly together, dried and varnished with any water-proof varnish forming the *wafer*. The *caps* were made by forming the wafer at the bottom of a paper cap which fitted on the end of the lock hammer.

PERCUSSION-POWDER.—Powder composed of such materials as to ignite by slight percussion; fulminating powder. See *Gunpowder*.

PERCUSSION-PRIMERS.—The percussion-primer has a wafer or flat-head attached to a quill-barrel. The process usually observed in selecting the material and manufacturing the primers is as follows: Each quill must be clarified and furnish a barrel at least two and a half inches long. The barrel is to be round, free from flaws, pith, and brittleness occasioned by clarifying, or any other defect which may render it unfit for the purpose required. It must not exceed in diameter nineteen-hundredths of an inch at any part, nor be less than seventeen-hundredths of an inch, within one and one-half inches of the end that is cut from the quill. The small end must not be broken or bruised. Cut the barrels of the quills close from the feather, and insert them into the socket of a wooden block made two inches deep and two-tenths of an inch in diameter. A punch, having ten cutters radiating from the stem, is entered into each quill-barrel, and driven down with a smart tap, so as to slit the upper end of the barrel into ten prongs, and as far as the upper surface of the block permits. Turn back the prongs, so that they will lie on the surface of the block; a circular punch is applied to each, and made by a blow to cut off the prongs to its own diameter (0.52 inch). Very stout paper, previously prepared by two coats of shellac-varnish (gumlac dissolved in alcohol), is punched with holes 0.17 inch in diameter, and so arranged as to correspond with the sockets of the wooden block. The quill-barrels are freed from pith, the punched paper laid on the block, the holes corresponding and the varnished side up, the quill-barrels put through the paper into the sockets of the block, filled with grained powder, seven grains Troy, and pressed firmly down with their prongs flat on the varnished side of the sheet of stout paper. Brush the shellac-varnish over the spaces of paper between the heads of the quill-barrels, and spread a sheet of good writing-paper, slightly moistened with water, over the entire surface of the stout sheet and the prongs of the quills. Put the block and the sheets thus stuck together, with the quill prongs between them, into a press, apply a force of about thirty tons, and keep them long enough to set the prongs and make the sheets of paper adhere firmly. Each quill is separated from the card by means of a circular punch, which cuts out a disc 0.62 inch in diameter, and of course includes the prongs enclosed between them. A stellated disc to cover the head of the primer is punched out of linen-made paper of the finest and closest fabric. This disc has twelve points—diameter from exterior points, 1.25 inches, from interior 0.7 inch. Metal plates are at hand with superficial recesses about 0.65 inches in diameter. On each of these a stellated cover is placed, and four grains of fulminate deposited on it. This is composed of five parts of fulminating mercury and one of mealed powder, both dry. Place the head of the primer on the charge of fulminate, holding it by the quill-barrel and pressing it down firmly; brush good wheat-paste on the points of the cover and on the under surface of the head, turn the points over, and unite them neatly and closely on the paper head. The primer is now made and only requires to be protected from moisture. For this purpose, shellac is dissolved in alcohol, so as to be thin enough to be laid on with a brush. This is of a brownish yellow; a portion is prepared with lamp-black. Coat over the the quill-barrel with shellac, then the under side of the wafer with the black shellac-varnish. Then shellac the upper surface of the wafer. Tip the end of the quill-barrel with black varnish, and apply a second coat of uncolored shellac thickly about the primer. See *Friction-primers*.

PERCUSSION-WAFER.—The earliest percussion-primers in use were made in the form of wafers. The wafer was placed in the vent of the piece, the metal of the gun being cut away in such a manner as to form a recess at the exterior orifice of the vent, in which the wafer was deposited, and exposed to the direct action of the hammer.

PERDU.—A word adopted from the French, signifying to lie flat and closely in wait. It likewise means employed on desperate purposes; accustomed to desperate enterprises.

PERER.—An old form of gun, used mostly on ships, for throwing stone-shot.

PERFORATED DISC GUNPOWDER.—Compressed gunpowder, perforated with a certain number of holes. From the excessive pressure given to the discs, the powder burns slowly; it has been, and is still used for discharging rifled ordnance by some foreign artilleries. In the British artillery it is not used. See *Gunpowder*.

PERJURY.—The crime committed by one who, when giving evidence on oath as a witness in a Court of Justice, or before some constituted authority of the same kind, gives evidence which he knows to be false. But in order to make the giving of the false evidence liable to criminal punishment, it must have been not only false to the knowledge of the witness, but the matter must have been material to the issue raised. If the falsehood occurred as to some trifling or immaterial fact, no crime is committed. Moreover, it is necessary, in proving the crime, that at least two persons should be able to testify to the falsehood of the matter, so that there might be a majority of oaths on the matter—there being then two oaths to one. But this rule is satisfied though both witnesses do not testify to one point. The perjury must also have taken place before some Court or Tribunal which had power to administer the oath. Though in some Courts affirmations are allowed instead of oaths, yet the punishment of false affirmation is made precisely the same as for false swearing. The punishment for perjury was, before the Conquest, sometimes death or cutting out the tongue; but, latterly, it was confined to fine and imprisonment, and at present the latter is the only punishment, with the addition of hard labor. The crime of subornation of perjury—*i. e.*, the persuading or procuring a person to give false evidence, is also punishable as a distinct offense.

PERKERNUCKA.—An Indian term for Petty Officers.

PERMANENT ANGLE.—It is always important that the gunner should be able to aim directly at the object, so as to reduce the *personal equation* to a minimum. But in consequence of the deviation due to the rifling, there is always a deflection from the line of sight. To avoid this, the rear sight is set at a *permanent angle* of deflection, so that, no matter how much it is raised, the line of sight will always pass through the object. The formula for determining the angle for each range is

$$\tan A = \frac{\text{deflection}}{\text{range}} \times \text{cosec. elevation.}$$

Let $b\,c$ represent a perpendicular rear sight, and f the front sight of the gun; then $b\,f\,t$ represents the

line of sight, the gun being laid on the target, t, at the angle of elevation, $b\,f\,c = e$. Suppose s to be the point where the shot falls, then $t\,s$ measured at right angles to the line of sight, represents the deflection of the shot. Join $s\,f$, produce it to a, draw $b\,a$ at right angles to $b\,t$, and join $a\,c$; now a is the point at which the head of the rear sight should be placed in order to compensate for the deflection $t\,s$; and $a\,c\,b = A$ is the angle of deflection required. Let the range $f\,t$ equal r, and the deflection $t\,s$ equal d. Now, in the similar triangles,

$$\frac{ab}{bf} = \frac{st}{tf} = \frac{d}{r};$$

but, $ab = bc \tan A$, and $bf = bc \operatorname{cosec} e$,

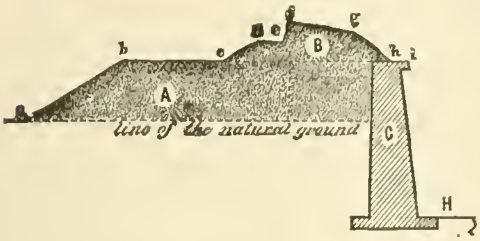
$$\therefore\ \frac{d}{r} = \frac{bc \tan A}{bc.\operatorname{cosec} e};\quad \tan A = \frac{d}{r}\operatorname{cosec.} e.$$

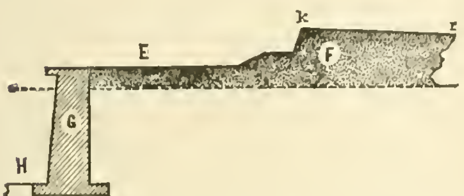
It is found practically that for ordinary service angles of elevation, the values of the ranges and lateral deviations vary in such a way that when the angle e is changed, the product of the three variables in the expression $\frac{d}{r}$ cosec e is always very nearly constant. A is always small and never exceeds about 38. It varies for different ordnance, and is practically found by firing a series of rounds at different ordinary elevation to find the corresponding mean ranges and drifts; the value of tan A, from the above formula, for each elevation is then calculated, and the mean of all the values of A thus found is called the *permanent angle of drift*. By this means one adjustment of the scale is sufficient instead of two, and the deflection leaf is only used for occasional fine adjustment and for accidental circumstances, such as cross wind or difference of level of wheels. With howitzers, however, the varying charges prevent the use of this plan, and no *permanent angle of drift* can be found for them, which will do under all circumstances; their tangent scales are therefore exactly perpendicular to the axes of the piece and of the trunnions, and they are provided with long deflection bars.

PERMANENT FORTIFICATION.—Permanant fortifications are designed to secure the possession of those points that are of importance to the safety of the country, and also those that will or may have an important influence on the operations of a defensive or an offensive war, in which the country may be engaged. To secure them, they must be made so strong that to gain possession of them, an enemy would have to resort to the tedious, laborious, and costly operations of a siege or blockade. Whatever diversity of opinion may be found amongst engineers and writers on permanent fortification, as to the best mode of arranging the elements of these defenses to attain this end, most of them agree on certain general conditions as necessary.

These conditions, thus generally admitted, may be enunciated as follows: 1st. They should be of sufficient strength to resist with success all the ordinary means resorted to by an assailant in an open assault. 2d. Have secure and easy means of communication for the movement of the troops, both within the defenses and to the exterior. 3d. Be so planned that every point exterior to the defenses within cannon range shall be thoroughly swept by their fire. 4th. Be provided with suitable shelters to protect the troops, the armament, and the magazines of provisions and munitions of war, required for their defense, against the destructive measures of the assailant of every description. 5th. And, finally, be provided with all such accessory defensive means as the natural features of the position itself may afford, to enable the garrison to dispute with energy the occupancy by the assailant of every point both within and exterior to the defenses. The defensive branch of the military engineer's art consists in a knowledge of the means which are employed to fulfil the above conditions, and of their suitable adaptation to the natural features of the positions he may be called upon to fortify.

The most simple mode of fortifying a position in a permanent manner consists in inclosing it with a rampart surrounded by a parapet, with a ditch the scarp of which, when dry, is revetted with masonry, and so covered by an earthen mask that it cannot be breached except by batteries placed on the border of the counterscarp. The general form of the parapet and ditch to fulfil the *first* of the general conditions given above will be better understood by an examination of the profile which is a section made by a vertical plane perpendicular to the general direction of the principal bounding line, in plan. The rampart serves to give the troops and armament, which are placed on top of it and behind the parapet, a commanding view over the ground to be guarded by the fire of the defenses; whilst at the same time, it increases the obstacle to an open assault, by the additional height it gives to the scarp. The top sur-





A, Rampart; B, Parapet; C, Scarp wall; H, Ditch G, Counterscarp; E, Covered-way; F, Embankment of covered-way. a b, rampart slope; b c, terre-plein; c d, banquette slope; d e, banquette tread; e f, interior slope; f, interior crest; f g, superior slope; g h, exterior slope; h i, berm; k r, glacis.

face of the rampart, b,c. in rear of the parapet, termed the *terre-plein*, affords the troops and armament a convenient position for circulation from point to point, where they are sheltered from the direct views of the assailants' fire. The rampart is usually terminated on the interior, a,b, by allowing the earth to assume its natural slope, or one somewhat less steep, and which is termed the *rampart-slope*. In cases where this slope would take up too much of the ground within the defenses it is replaced by a wall, termed the *parade-wall*, which rises from the level of the interior ground, termed the *parade*, to the interior line of the *terre-plein*. Inclined planes of earth, termed *ramps*, lead from the parade to the terre-plein, being placed against the rampart-slope, or the parade-wall. The ramps are, in some cases, terminated, inwardly, with the same slope as that of the rampart; in others, this slope is replaced by a wall, which rises to the top surface of the ramp, or a little above it. The essential properties of the parapet are to afford cover to the troops and armament from the missiles of the enemy, and every facility for sweeping his positions by the fire of its artillery and small-arms. Its form and dimensions are therefore so adjusted as to fulfil these requirements. The *exterior slope*, gh, is the part of the parapet towards the enemy; it is usually made with the same slope that the earth when first thrown up naturally takes. The top of the parapet, fg, called the *superior slope*, is the line along which the assailed fire on the enemy. Its inclination is generally taken at $\frac{1}{6}$ that is, six base to one perpendicular. A greater slope than this would make the portion of the parapet about the interior crest, weaker, and less would not so well defend the ground directly in front. A greater slope would be attended by the inconvenience of firing, under a greater depression than $\frac{1}{6}$, which would necessitate using very deep embrasures for the guns or raising the platform so high to the rear that the men serving the guns would be exposed to fire. The *interior slope*, ef, sometimes called the *breast height*, is the part against which the assailed naturally lean in the act of firing. It has usually a slope of $\frac{3}{1}$, three perpendicular to one base. This is a result of experience, being the most convenient one for a soldier leaning forward to fire over the parapet. The *banquette* is a small terrace on which the soldier stands when firing; the top is called the *tread*, and the inclined plane by which it is ascended, the *slope*. The *tread* is placed four and one-half feet below the interior crest and is two feet wide. This width is increased when more than one rank are to use it or where other causes require it. The *slope* of the banquette may have an inclination of $\frac{1}{2}$, or $\frac{1}{1}$, or may be replaced by steps. The *terre-plein* is placed generally from eight to twelve feet below the interior crest with a fall to the rear of one foot to drain off the surface-water.

The *thickness* of the parapet, which is estimated by the horizontal distance between the interior and exterior crests, seldom exceeded twenty feet. This was the dimension usually given in European constructions of important works. Experience showed that it was sufficiently great to afford protection against the fire of the heaviest guns then used. At present, the profile most generally adopted for this part of the parapet and rampart is one in which the portion of the top of the rampart, for a distance of 15 feet back from the interior crest, is held on a level of $6\frac{3}{4}$ feet below the interior crest and serves as a general barbette for heavy guns; whilst the remaining portion of the top surface is placed at a level of eight feet below the interior crest, and made wide enough to serve as a roadway in rear of the general barbette; the two levels being connected by a slope of $\frac{1}{1}$ or $\frac{1}{2}$; and the roadway receiving a slight pitch to the rear for drainage. In the later profile, the interior slope is $\frac{1}{1}$, and has a banquette tread of only 2 feet, with only a banquette slope of only $\frac{1}{1}$. Where guns are mounted either in barbette or embrasure, the interior slope is increased to $\frac{3}{1}$, and the banquette and its slope removed; the earth taken off by these modifications serving to form the merlons between the shallow embrasures cut into the parapets. When the foot of the exterior slope rests on the top of the scarp wall, a berm of two feet in breadth is left between it and the edge of the coping. This breadth of berm is objectionable, as giving a good landing-place for a scaling party in an open assault; and it is proposed, when the work is in danger of an attack, to reduce the berm to 18 inches or one foot, by increasing the thickness of the parapet 6 inches or one foot.

Circumjacent to the rampart a wide and deep ditch is made, which from its position and proximity to the parapet, serves the double purpose of increasing the obstacle which the enemy must surmount before reaching the assailed, and of furnishing the earth to form the rampart, parapet and glacis. Its width and depth will depend mainly upon the amount of embankment required, and therefore will result from the calculation for equalizing the excavation and embankment which these demand. It has been the practice to make the main ditch when dry, from 20 to 30 yards wide, and from 30 to 45 yards when wet. These dimensions may be reduced to within 10 or 12 yards where the embankments are not great and circumstances are unfavorable to an attempt at escalade. The bottom of the ditch, when dry, usually receives a slight slope from the foot of the scarp and counterscarp to its center, where a small drain, termed a *cunette*, is dug to receive the surface water and keep the ditch dry. In some cases, from motives of economy, the difference of level between the cunette and the foot of the counterscarp wall is increased, thus giving a less height of wall.

To give strength and durability, the faces of the ditch are revetted with walls of masonry which sustain the pressure of the earth, protect them from the effects of the weather, and by their height and steepness present an additional obstacle to an open assault. The wall of masonry toward the rampart rises to the level of the foot of the exterior slope of the parapet, sustaining the pressure of the rampart and the parapet, and is called the *scarp wall* or *scarp revetment;* the face of it towards the ditch, the *scarp.*

The line in which the face of the scarp wall if prolonged would intersect the upper surface of the coping is termed the *magistral.* This is a very important line in drawing the plans of permanent works, serving as the directing line to fix, both upon the drawing and upon the ground, in setting out the work, the dimensions and relative positions of all the bounding lines. The top portion of the coping, from the foot of the exterior slope outwards, is termed the *Berm.* The opposite face of the ditch is usually revetted in the same manner. It is called the *counterscarp wall*, and its face towards the ditch, the *counterscarp.*

The *command* of the parapet over the exterior ground and any outworks of the defenses, its *relief*, or height above the bottom of the ditch, and its *height* above the top of the scarp wall, are all points which call for a careful consideration on the part of the engineer in any combination of these that he may be called upon to make. The fire over the parapet should thoroughly sweep all the ground within range, at least up to the glacis crest; and the more so as the closer the assailant's trenches approach the work, the greater will be the plunge obtained upon them, and the more difficult it will be for the assailant to cover himself by his trenches. The parapet should command all outworks within range of its fire, otherwise, when seized by the assailant, these outworks would have a plunging fire upon the main work. The relief of the parapet of the flanking parts of the work should be such that every point along the foot of the scarp wall shall be swept by its fire. This supposes also a certain correlation between the relief and the length of the lines flanked, so that this condition shall be satisfied; a relation that can always be easily found, either by calculation, or by geometrical construction.

The width and depth of the ditch also call for a careful consideration on the part of the engineer. A deep and narrow ditch offers the advantage of presenting more difficulty to the assailant in reaching the bottom of it, either in an open assault, or by a gallery in the attack by regular approaches, thus prolonging the defense. It masks better the sally-ports from the enemy's fire by allowing them to be placed so low that the projectiles coming over the counterscarp cannot reach them. In like manner by drawing in the crest of the glacis nearer to the scarp the latter will be better masked by it from the plunge of the distant fire of the assailant's batteries; and cannot be breached so low down from his batteries placed along the glacis crest. On the other hand, when the ditch is narrow and deep it may be partly filled by breaching the scarp, and then blowing in the counterscarp so as by the united *débris* to form an easy roadway for an assaulting column to enter the work. A wide ditch, on the other hand, requires more labor to construct the trench across it by which the assailant can reach the foot of the breach under cover. This is a consideration of some importance in wet ditches, where the assailant is obliged to construct a dike upon which the parapet of his cover is placed.

These considerations suggest that nothing like absolute rules can be laid down so as to give a routine character to the practice of this branch of the military art. The rules here given with respect to the form and dimensions of the general profile of the enceinte are founded upon reasons growing out of the nature of the question, and as such have served as guides to engineers in the practice of their profession. As they have stood the test of long experience, it is safe to follow them, whilst at the same time the engineer should not hesitate to vary from them when satisfied, after careful examination, that the case before him requires it. Fortification, it must be remembered, is like all other arts. It has its canons, which are founded upon the nature of the question and its rules of practice based upon these and upon experience. As the latter presents to the Engineer new facts, his practice must be made to conform to them; but the general principles of his art must ever remain the same, and be his invariable guide. See *Counterscarp Wall, Fortification, Frontier Defense, Interior Retrenchments, Irregular Sites*, and *Scarp Wall.*

PERMANENT RANK.—A rank in the military service which does not cease with any particular service, or locality of circumstances; in opposition to local or temporary rank.

PERMUTATIONS AND COMBINATIONS.—A combination, in mathematics, is a selection of a number of objects from a given set of objects, without any regard to the order in which they are placed. The objects are called elements, and the combinations are divided into classes, according to the number of elements in each. Let the given elements be the four letters *a, b, c, d;* the binary combinations or selections of two are *ab, ac, ad, bc, bd, cd*—six in all; the combinations of three are *abc, abd, acd, bcd*—four in all; while there is only one combination of four, namely, *abcd.*

Permutation, again, has reference to the order of arrangement; thus, the two elements *a* and *b* may stand *ab* or *ba*, so that every combination of two gives two permutations; the three elements *a, b*, and *c* may stand *abc, acb, bac, bca, cab, cba*, one combination of three thus affording six permutations. The combinations of any order with all their permutations are called the *variations.* Formulas are given in works of algebra for calculating the number of permutations or combinations in any given case. Suppose seven projectiles marked 1, 2, 3, to 7, and that two are to be drawn; if it is asked how many possible pairs of projectiles there are this is a question of the number of combinations of seven elements, *two* together, which is found to be 21. If we want to know how many times the same seven persons could serve at a piece of artillery, with a different arrangement each time, this is to ask how many permutations seven objects admit of, and the formula gives $7\times6\times5\times4\times3\times2=5{,}040$. The theory of probabilities is founded on the laws of combination. Thus, in the case of drawing two tickets out of seven, since there are 21 possible pairs, the chance or probability of drawing any particular pair is 1 in 21, or $\frac{1}{21}$. In working out questions in "combinations," advantage is often taken of the fact that whatever number of elements be *taken* from a group to form a combination, the number *left* gives the same number of combinations; thus the number of combinations of 10 elements *three* together, is the same as that of 10 elements *seven* together, etc.

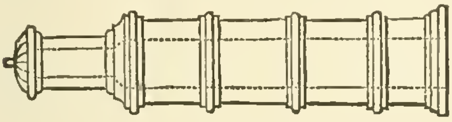
PERPENDICULAR.—A straight line standing on another straight line is said to be perpendicular to that other when the angles it makes on both sides are equal. A line is said to be perpendicular to a plane when it is at right angles to any line in that plane meeting it. Planes are said to be perpendicular to each other when any line in the one plane perpendicular to their common line of intersection is also perpendicular to all lines meeting it in the other plane. The word "perpendicular," in common usage refers to a direction at right angles to the surface of still water, and is synonymous with vertical.

PERPENDICULAR DIRECTION.—In the march of a line, the direction at right angles to the line which each man should take in a direct movement to the front. Without the strictest attention is paid to this essential principle in all movements, the greatest irregularity, and ultimately the greatest confusion, must ensue. Perpendicular and parallel movements constitute, indeed, the whole system of good marching. When several columns, divisions, or companies advance, the lines and directions of marching must be strictly perpendicular and parallel to each other, otherwise the distance will be lost, and the ultimate object of forming a correct line must be defeated.

PERPENDICULAR FORTIFICATION.—This system of fortification owes its origin to the Marquis de

Montalembert, a distinguished French General, who published his work upon the subject in 1776. Vauban had, it was admitted, rendered the art of attack superior to that of defense. Montalembert strove to reverse this relation, and in his endeavors, rejected entirely the bastion system of the older engineers. Instead of the occasional bastions, with intervening curtains, with which they surrounded their *enceinte*, he broke the whole polygon into salient and re-entering angles, the latter being generally right angles. Before the connected redans thus formed were counter-guards of low elevation and ravelins, to which the approaches were through casemated *caponnières*. In the salient angle of each redan, he built a brick tower, 40 feet in diameter, twelve-sided, and four stories high. The second and third tiers were built for heavy guns, and the upper loopholed for musketry. In the center of the tower was a circular *réduit*, intended as a last refuge for the garrison. Montalembert maintained that from these towers every possible approach could be commanded, which to a great extent is true; but it must be also remembered that the greater space a gun commands, by so much the more is it raised above the plain, and rendered visible. These towers would have little chance against the rifled ordnance of the present day. Montalembert's system was violently attacked by the French engineers, but Carnot subsequently adopted it, with some modifications, and it enters largely into the modern German defensive works. The system has never, however, found favor with British engineers.

PERRIERE.—The early bombards being very unsatisfactory, to economize the action of the powder, and give a more accurate direction to the projectile,



the interior space, or bore, was made nearly cylindrical, from 4 to 8 calibers long; it was terminated at the bottom by a very narrow and deep chamber, the object of which was to increase the effect of the powder, by retarding the escape of the gas before it acted on the projectile. These cannon were further improved by making the bores perfectly cylindrical; and were called *perrieres*, from the fact that they fired stone balls. They were principally employed to breach stone walls, and for this purpose were fired horizontally. See *Bombard*.

PERSIAN WHEEL.—A contrivance for raising water from a well or stream, and used in the country from which it takes its name. It is also extensively used in Egypt, where it is known as the *saguieh*, in nothern India, in the Punjab, in Sinde, and also in Spain as the *noria*. It consists of a wheel, about 4 feet in diameter, revolving on a wooden axle, which is flush with the mouth of the well, and is set in motion by means of a driving wheel turned by a pair of bullocks. The wheel has on its rim pins of wood inserted into it, at short distances apart, to which buckets or jars are suspended by means of an endless band or double rope; the buckets descend on one side into the well and ascend on the other filled with water, and discharge themselves into a reservoir at the mouth of the well. The Persian wheel, used for raising water from a stream instead of a well, has the buckets somewhat differently arranged for lifting the water, but the principle is the same.

PERSONAL SALUTES.—Civil and diplomatic authorities receive salutes as follows: The President of the United States receives a salute, to be given both on his arrival at and final departure from a military post or station provided with artillery, of 21 guns. The Vice President of the United States, 19 guns. Members of the Cabinet, the Chief Justice, the Speaker of the House of Representatives, the Governors within their respective States or Territories, 17 guns. A Committee of Congress officially visiting a military post or station, 17 guns. The Sovereign or Chief Magistrate of a foreign State, to be given both on arrival at and final departure from a military post or station provided with artillery, 21 guns. Members of the Royal Family, *i. e.*, the Heir-apparent and Consort of the reigning Sovereign of a foreign State, 21 guns. The Viceroy, Governor-General, or Governors of Provinces belonging to foreign States, 17 guns. Ambassadors Extraordinary and Plenipotentiary 17 guns. Envoys Extraordinary and Ministers Plenipotentiary, 15 guns. Ministers Resident accredited to the United States, 13 guns. Chargés d' Affaires, or subordinate diplomatic agents left in charge of missions in the United States, 11 guns. Consuls-General accredited to the United States, 9 guns.

Military and naval officers receive salutes as follows: The General-in-Chief, Field Marshal, or Admiral, 17 guns. Lieutenant General or Vice Admiral, 15 guns. Major General or Rear Admiral, 13 guns. Brigadier General or Commodore, 11 guns. Officers of volunteers and militia, only when in the service of the United States, the salute specified for their rank. Officers of foreign services visiting any military post or station provided with artillery, are saluted in accordance with their rank.

In addition to the foregoing, occasions of a public nature frequently arise when salutes are both desirable and proper. Orders will govern in such cases. Personal salutes are, however, strictly confined to the foregoing, and are fired but once, unless otherwise specified. The President of the United States, the Sovereign or Chief Magistrate of a foreign country traveling in a public capacity, is saluted when *passing* in the vicinity of a military post. A vessel-of-war on which the President of the United States is traveling displays the nationel ensign at the main. In the case of foreign sovereigns, vessels diplay the royal standard of the sovereign in like manner.

Personal salutes, in compliment to foreign diplomatic authorities,are to be fired only for those whose nations pay the same compliments to United States diplomatic ministers in their territories. Personal salutes at the same place and in compliment to the same person, whether civil, diplomatic, military, or naval, are never to be fired oftener than once in twelve months, unless such person shall have been, in the meantime, advanced in rank. Officers on the retired list, whether military or naval, are not to be saluted. This, however, does not apply to funeral ceremonies. An officer, whether civil, or military,or naval, holding two or more positions, either of which entitles him to a salute, receives only the salute due to the highest grade. In no event is the same person to be saluted in more than one capacity. When several persons, each of whom is entitled to a salute, arrive together at a post, the one highest in rank or position is alone saluted. If they arrive successively, each is saluted in turn. An officer assigned to duty according to brevet rank receives the salute due to the full rank of the grade to which he has been assigned. As a rule, a personal salute is to be fired when the personage entitled to it enters the post. When the troops at a military post are to be reviewed by a personage entitled to a salute, it is most appropriate to fire the salute from field guns at the place of review; and at the time, just previous to the review, when the personage arrives on the ground. See *Salutes*.

PERSONAL SERVICE.—The term "*Personal Services*," employed in section 3,705, Revised Statutes, means services which are contracted for because of some special confidence reposed in the person who is to render them, based upon his supposed peculiar fitness as an expert, and irrespective generally of his pecuniary or any other resources; such, for instance, as the services of a Civil Engineer or Surveyor, a Lawyer or Surgeon, Telegraph Operator, etc.

No person belonging to, or employed in, the military service of the United States shall, in behalf of the United States, purchase from any other such person, or make any contract with such person to furnish supplies or services; nor make any purchase or contract in which such person shall be admitted to any share or part, or to any benefit to arise therefrom.

No person belonging to, or employed in, the military service of the United States shall be pecuniarily interested, directly or indirectly, in the purchase or sale, on behalf of the United States, of any article appertaining to such service; nor shall take, receive, or apply to his own use any gain or emolument, under the guise of presents or otherwise, for negotiating or transacting any public business, other than what is or may be allowed by law.

PRESONNEL.—In speaking of an army, this term represents the officers and soldiers, as opposed to the *Matériel*, in which are comprised the guns, provisions, wagons, and stores of every description. The *Personnel of a Battery* comprises all the officers and men necessary for the maneuvering, management, and care of a battery.

PERSPECTIVE.—The art of representing natural objects upon a plane surface in such a manner that the representation shall affect the eye in the same way as the objects themselves. The distance and position of objects affect both their distinctness and apparent form, giving rise to a subdivision of perspective into *linear perspective* which, as its name denotes, considers exclusively the effect produced by the position and distance of the observer upon the apparent *form* and *grouping* of objects; while *aerial perspective* confines itself to their *distinctness*, as modified by distance and light. The necessity of attending to the principles of perspective in all pictorial drawing is apparent when we consider, for instance, that a circle, when seen obliquely, appears to be not a circle, but an ellipse, with its shortest diameter in line with the spectator and its longest at right angles to this. A square, when looked at from a position opposite the center of one of its sides, appears as a trapezoid, the sides which are perpendicular to the direction of the vision appearing to be parallel, while the other two appear to converge to a point in front of the spectator, etc. For the same reason, two rows of parallel pillars of equal height, seen from a point between and equidistant from each row, appear not only to converge at the further end, but to become gradually smaller and smaller. An excellent idea of a perspective plan can be easily obtained by interposing a vertical transparent plane (as observance of which painters may be enabled to produce an effect true to nature. After the "scope" (*i. e.*, the number of objects to be introduced, and the distance at which they are to be viewed) of the picture has been determined, and before the design is commenced, it is necessary to draw upon the perspective plan three lines: 1. The *base line*, or *ground line*, which limits the sketch towards the operator, and is the base line of the picture. 2. The *horizontal line*, which represents the ordinary position of the sensible horizon. The height of the horizontal line is about one-third of the height of the picture, when the sketcher is placed at or a little above the level of the horizon; but it may rise in a degree corresponding to his increase of elevation till it reaches near to the top of the perspective plan. The general rule is to have a high horizontal line when the view is taken, or supposed to be taken, from an eminence; but when the station is on a level, either actual or assumed, as is the case when a statue or a mountainous landscape is figured, the horizontal line must be low. The horizontal line in nearly all cases is supposed to be level with the spectator's eye. 3. The *vertical line*, which is drawn from the supposed position of the sketcher, perpendicular to the *ground* and *horizontal* lines, meeting the latter in a point which is called the *point of sight*, or center of the picture. The vertical line has no representative in nature, and is merely a mechanical adjunct to the construction of the picture, all vertical lines in nature being parallel to it in the picture. The point of sight, being the point directly opposite to the observer, is properly placed in the center of the picture, for it is most natural that the view should lie symmetrically on each side of the principal visual line; but this is not by any means a universal rule, for we very frequently find it on the right or left side, but always, of course, on the horizontal line. All lines which in nature are perpendicular to the ground line, or to a vertical plane which is raised upon it as a base, meet in the point of sight, which is thus their *vanishing point* (see the line of the tops and bottoms of the pillars in Fig. 1). The *points of distance* are two points in the horizontal line on each side of the point of sight, and in a "direct" sketch are at a distance from it equal to the horizontal distance of the sketcher's eye from the ground line. The equality of distance of these points from the point of sight is not, however, necessary, as it occurs only in those cases where the lines, of which the points of distance are the *vanishing points*, are inclined (in nature) at an angle of 45° to the base line; but, in all cases, the two points of distance are about twice as far apart as the

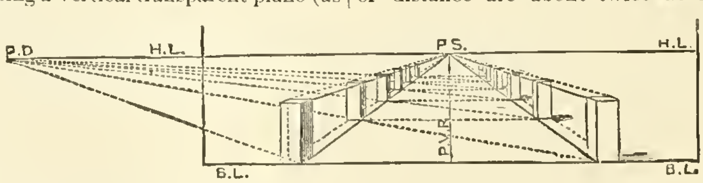


Fig. 1.—Illustrating the more important points and lines; PVR is the principal and visual ray.

of glass—a window, for instance) between the observer and the objects of his vision, and supposing that the objects he sees are not seen *through* the glass, but painted *on* it. A sketch made on a glass plane in this position, by following with a pencil all the lines and shades of the objects seen through it, the eye being all the time kept quite steady, would form a picture in perfect perspective. In practice, however, it is found, unfortunately, that the glass is not a suitable material for sketching on, and that the vertical position is not the most convenient; it is therefore preferable to make a careful study of the effects produced by change of position and distance on the appearance of objects in nature, and from the results of this to compile a body of rules, by the eye is from the picture. One important use of the points of distance is to define the distance of objects in a row (Fig. 1) from each other. For this purpose two points of distance are not necessary, as when the position of one pillar is found, that of the opposite is at once obtained by drawing a line parallel to the base or ground line. We have seen that the point of sight is the vanishing point of all level lines which meet the ground line or a vertical plane on it at right angles, and that the points of distance (in a *direct* picture) are the vanishing points of all lines which cut the ground line at an angle of 45°; but there are many other groups of parallel lines in a picture which have different situations, and therefore different vanishing points. Such lines with their vanishing points (called for distinction's sake, *accidental points*) are represented in Fig. 2. If the accidental point is above the horizontal line, it is called the *accidental point aerial*—if below, the *accidental point terrestrial;* and a little consideration makes it evident that these points may or may not be situated within the plane of the picture. Such are the points and lines necessary for the construction of a plan in true perspective; and from the above explanation, we may deduce the two general principles: 1. That all parallel straight lines in nature are no longer parallel when projected on the perspective plane, but meet in a point which is called the vanishing point, and is some one of the three above described, unless these lines happen to be also parallel to the ground line or the vertical line, in which

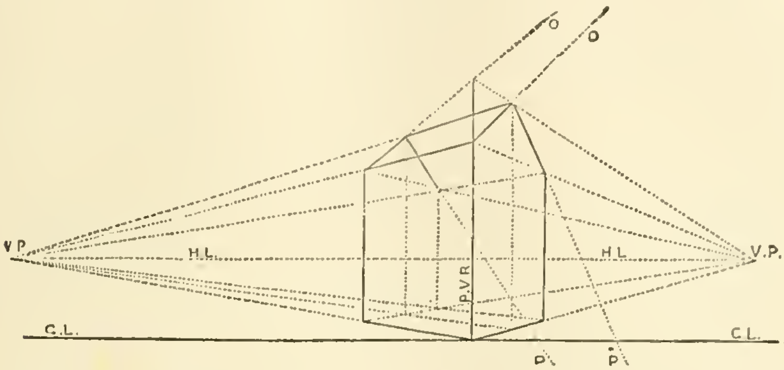


Fig. 2.—The lines O O converge to the accidental point aerial, and P P to the accidental point terrestrial.

case they remain parallel when transferred to the picture; and 2. That since the bodies drawn below the horizontal line are seen as if from above, those above as if from below, and those to the right and left of the point of sight as if observed from the left and right, it follows, that straight lines which in the picture are above the horizontal line lower themselves, and those below raise themselves to it; those to the left, following the same law, direct themselves to the right, and *vice versâ*. *Aerial perspective*, consists in a modulation of the brightness and colors of objects in accordance with the state of the atmosphere, the depth of the body in the perspective plane (*i.e.*, distance in nature from the ground line), and other accidents of place and time. As the distance of objects increases, their illuminated parts are made less brilliant, and their shaded parts more feeble. The bluish tint imparted by a large mass of the atmosphere to the bodies seen through it, is frequently imitated by the mixing of a slight tint of blue with the colors to be applied; a yellow object thus assumes a greenish tint; a red one a violet tint, etc. The air, when charged with vapor, is represented by a diminution of the brightness of colors, and by the grayish tint imparted to them. But in this part of the subject rules are of little avail, for experience alone can guide the painter in faithfully copying the myriad aspects presented by nature. A thorough knowledge of perspective is a *sine qua non* to the painter or designer, and though many are inclined to think it a superfluity, and that the sketcher has only to make use of his eyes, and copy justly, the very fact that such is their opinion shows that they have never made the attempt; for it is impossible for the painter, and much more so for the designer, to execute a copy of nature with sufficient accuracy by the sole aid of the eye and hand, a fact that is unfortunately much too frequently proved by many of the sketches exhibited in fine-art collections. Perspective was known to the ancients, but seems to have become extinct during the disturbances that convulsed Italy, and was revived by Albert Drürer, Pietro del Borgo, and Bramantino of Milan (1440), whose body of rules was extended and completed by Peruzzi and Ubaldi about 1600.

PETARD.—An instrument for blowing open gates, demolishing palisades, etc. It consists of a half-cone of thick iron filled with powder and ball; this is firmly fastened to a plank, and the latter is provided with hooks, to allow of its being attached securely to a gate, etc. The Petardiers attached the petard, lighted the slow-match by which it was to be fired, and fled. When the explosion took effect a supporting column charged through the breach, while the defenders were yet in consternation. The petard has been almost universally superseded by the use of powder-bags. Large petards contained as much as 13 lbs. of powder. Various curious devices were employed, in ancient times for preventing the close propinquity between the petard and the gate; one of the most curious of which was a kind of enormous rat gin, set in such a manner as to close at once on the petard and the soldiers applying it.

PETARDS.—In pyrotechny, small paper cases filled with powder. One end is entirely closed, and the other has only a small hole left for a piece of quick-match, to communicate fire to the powder. Petards are placed at the bottom of lances; they are also used to imitate the fire of musketry. See *Fireworks*.

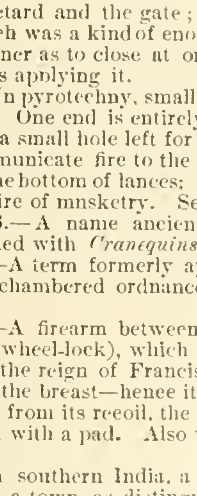
PETAUDIERS.—A name anciently given to the foot-troops armed with *Cranequins*.

PETERERO.—A term formerly applied to a very short piece of chambered ordnance. Also written *Pedrero*.

PETRONEL.—A firearm between a carbine and a pistol (with a wheel-lock), which was used by the French during the reign of Francis I.; it was fired resting against the breast—hence its name. To prevent any injury from its recoil, the soldier who used it was provided with a pad. Also written *Petrinal* and *Poitrinal*.

PETTAH.—In southern India, a term applied to the *Enceinte* of a town, as distinguished from the fortress by which it is protected.

PETTMAN-FUSE.—This fuse consists of the fol-



lowing parts: A, body; B, top-plug; C, plain ball; D, steady plug; E, detonating ball; F, cone plug; G, lead cup; and H, suspending wire. The steady and top plugs are cupped in the center to receive the small plain ball of brass wire which holds them apart; and to prevent the ball adhering from corrosion, the cups are slightly larger in diameter than the ball. Round the top of the steady plug runs a groove filled with detonating composition, and two fire-holes pass from the composition down through the plug.

The composition in the annular groove is covered with thin sheet brass. The detonating ball, which is coated with composition, is covered with two hollow hemispheres of sheet-copper, and over these with silk. The cone plug (not at present coned) has three fire-holes and is supported by a copper wire which passes through the tube; but the hollow of the latter is enlarged below the wire to prevent its being choked. The lead cup (pure lead) does not rest on the bottom of the fuse, but is supported at the top on a shoulder on the cone plug.

The detonating composition in the steady plug and on the detonating ball consists of—

	Parts.
Chlorate of potash	12
Sulphide of antimony	12
Sulphur	1
Mealed powder	1

On the discharge of the gun the suspending wire is broken and the lead cup crushed in consequence of the inertia of cone and steady plugs and of balls, which do not move instantaneously with the fuse and lead cup; sufficient space is therefore left for the disengagement of the balls, and on impact the fuse ignited by the concussion of the detonating ball on the inside of the body, or by the plain ball on the composition in the groove of the steady plug, which continuing to move, after the sudden check to the motion of the fuse, presses the plain ball between itself and the top plug. See *Fuse*.

PEWTER.—A common and very useful alloy of the metals, tin and lead. Two other kinds of pewter have a more compound character. Common, or *ley-pewter*, consists of 4 parts of tin and 1 part of lead; *plate-pewter* is made of 100 parts of tin, 8 parts of antimony, 2 parts each of bismuth and copper; another kind, called *trifle*, is composed of 83 parts of tin and 17 parts of antimony. Although these are the standard formulas, each kind is often much varied to suit the purposes of the manufacturer; the chief alteration being the addition of a large proportion of lead to the last, and a large increase of the same metal in the other two.

PFEIL.—The German name of the arrow for the long bow.

PHALANX.—The ancient Greek formation for heavy infantry, which won for itself a reputation of invincibility, may be described as a line of parallel columns, rendered by its depth and solidity capable of penetrating any line of troops. The oldest phalanx was the Lacedæmonian or Spartan, in which the soldiers stood eight deep; the Athenian phalanx had been the same, until, at the battle of Marathon (480 B.C.) Miltiades reduced the depth to four men in order to increase his front. When Epaminondas organized the Theban army against Sparta, he felt that the Spartan line of battle would be impregnable to troops organized in their own manner. He therefore increased the depth and lessened the front of his phalanx, which enabled him to burst through the Spartan line, inflicting the sanguinary defeat of Leuctra (371 B.C.). Philip of Macedon had learned the Art of War under Epaminondas, and when he resolved to make his state a military power, he formed the celebrated Macedonian phalanx (359 B.C.), which enabled him to conquer Greece, and with which his son Alexander subdued the Eastern World. The Macedonian phalanx, as the latest form that organization assumed, and as the shape in which the phalanx encountered the military skill of the West, is deserving of description. The line was 16 deep; a grand-phalanx comprising 16,384 *Hoplites*, or heavy-armed soldiers, subdivided as follows: the grand-phalanx composed of four phalanxes or divisions, each under a General Officer, called a *Phalangarch;* his command was divided into two brigades or *Merarchies* (sometimes called *Telarchies*), each of these comprising two regiments, or *Chiliarchies*, of four battalions or *Syntagmata* each. A *Syntagma* answered accurately to a modern battalion, except that it was smaller. It was a perfect square, with 16 men each way, was commanded by a *Syntagmatarch* or *Xenagos;* and had an Adjutant, with one or two other Staff Officers who stood behind. Eight files united were under a *Taxiarch*, four under a *Tetrarch*, corresponding probably to a modern Captain, two files were under a *Dilochite* or Subaltern. A single file of 16 men was called a *Lochos* and the best man was placed at its head; a picked man, the *Ouragos*, also marching in the rear. The arms of all these phalanx-men were pikes or spears, 24 feet long, of which 6 ft. were behind and 18 ft. held in front of the combatant. As each man occupied with his shield 3 feet, the phalanx, when it advanced, had six tiers of spear-points in front, a wall of steel which no troops could withstand, especially as the bearers of the spears were pressed on by the ten ranks in their rear. By rapid movements the phalanx could change front, form in close column of syntagmata, and execute other critical maneuvers. The heavy-armed phalanx was ordinarily flanked by *Peltastes* or light infantry, similarly formed, but only eight deep, while the cavalry were but four deep. The phalanx, as representative of the heavy formation, came in contact with the lighter legion of Rome during the wars of Pyrrhus in Italy. At the great battle of Heraclea (279 B.C.), the phalanx won the day; but the victory was attributable to other causes as much as to any superiority of formation.

PHEON.—In Heraldry, the barbed head of a dart. It is represented as engrailed on the inner side, and its position is with the point downward, unless otherwise blazoned.

PHOENIX RIFLE.—A breech-loading rifle formerly manufactured by the Whitney Arms Company. This, like the Whitney and Kennedy rifles, which are improvements on it, is very simple of construction, and perfectly strong, safe and durable, while the ease of manipulation in opening and closing the breech, and extracting the shell or cartridge cannot be surpassed. These arms have less parts than any other breech-loading rifles in use, and the parts are of such form as to render them as strong and safe as rifles can be made. They have short top action, and are symmetrical in form. See *Kennedy Rifle* and *Whitney Rifle*.

PHOSPHOR-BRONZE.—Of the many useful inventions and discoveries recently made in the arts, that of phosphor-bronze has proved to be one of the most important. The invention is the result of a long series of careful experiments, which have established, as a scientific fact, the great superiority of phosphorized alloys of copper and tin over other alloys and metals. The chemical action of phosphorus on the metals composing the alloys is claimed to be two-fold; on the one hand it reduces any oxides dissolved therein, and on the other it forms with the purified metals a most homogeneous and regular combination, the hardness, strength and toughness of which are completely under control. No other metal combines, in so high a degree as phosphor-bronze, the conditions of toughness, rigidity, hardness, and great elastic resistance. From the drop-tests following its comparative relation in this respect to some of the best grades of wrought-iron is made very apparent; moreover, if jointly with these qualities the fact of the total absence of easily corroded metals, such as zinc, be taken into consideration, the advantages offered by the use of phosphor-bronze can scarcely be over-estimated.

In the following drop-tests, the weight of the drop was one hundred and forty-eight pounds; height of stroke, twelve inches, except where otherwise stated;

distance between supports, four inches; striking-face of drop, a blunted wedge-shape; test-bars, six inches long, two inches wide, and one-half inch thick. The fractions of inches stated in the table represent the permanent set of the test-bar after the blow.

The letters inserted in the table indicate the state of the surface of the test-bar, on the side opposite to that upon which the blow has been given:—*a*, sound; *b*, slight cracks at edge; *c*, cracks at edge increase in size; *d*, slight cracks in the middle of the test-bar; *e*, cracks in the middle increase in number; *f*, cracks in the middle increase in size; *g*, remains unaltered; —, straight; ⌢, test-bar reversed. It is apparent from these drop-tests that the rigidity of phosphor-bronze is greatly superior to that of best wrought-iron, for it takes thirteen blows to bend the bar XIV. B to the depth of one inch, whilst the best quality of forged charcoal iron takes eight blows, and the best charcoal scrap iron but six blows for the same bend. The strength of the phosphor-bronze bar No. 6×17 is superior to that of best charcoal scrap iron, it having stood five more blows of twelve inches than the latter before being again completely straightened. The relative strength of phosphor-bronze as to that of other qualities of iron tested needs no comment.

Renewed in consequence of their freedom from any adhering slag is a great point in their favor. Phosphor-bronze chisels, hammers, swages, scissors, key wedges, etc., are made of various sizes and possess fine temper, great hardness and are without any liability to give forth sparks. The application of phosphor-bronze will also be appreciated by all who have experienced the difficulty of removing brass or iron wood screws after they have been exposed to the weather for a short time. Brass screws are more likely to twist off than withdraw, and those made of iron become so rusted that their removal is next to impossible. For all fortification work, carriage finishing, and exterior fastenings, especially at the sea-side Garrisons, phosphor-bronze screws are recommended as the best article yet produced. See *Bronze*.

PHOSPHORUS.—One of the most unwelcome ingredients in iron ores, from the ease with which it passes into the metal during the smelting process, producing the most injurious effects, if present in more than a very small proportion. Practically speaking, all the phosphorus in the ore and in the fuel passes into the pig-iron made. Like silicon, it makes pig-iron weak; although it is thought that when the amount is not more than one-half to three-

Metals tested.	Number of blows.																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Phosphor-bronze, XIV. B.	3/16 a	1/4 a	3/8 a	7/16 a	1/2 a	5/8 a	11/16 a	3/4 a	25/32 a	13/16 d	7/8 g	15/16 g	1— f	⌢ 3/4 a	11/16 a	9/16 d	1/2 f	3/8 f Broke.		
Phosphor-bronze, 6×17.	3/16 a	3/8 a	1/2 a	5/8 a	23/32 a	13/16 a	15/16 a	1″ a	⌢ 7/8 a	3/4 a	9/16 a	1/2 a	3/8 a	1/4 a	— a	8 foot blows. 1″ b	⌢ — Broke. a			...
Rolled Charcoal Scrap-iron, best quality.	1/4 a	1/2 b	11/16 g	29/32 g	1 3/32 g	⌢ 7/8 a	9/16 a	7/16 a	3/16 a	— a	8 foot blows. 1 5/16 a	⌢ — d Broke.		...	...	...	...	...	...	...
Best Charcoal Fire-flox Plate-iron.	5/32 a	9/32 a	7/16 b	9/16 c	11/16 c	13/16 c	29/32 c	1″ c	13/16 a	5/8 a	7/16 d	1/4 f Broke.			...	...	...	...	...	...
The same, cut crosswise off plate.	3/16 b	3/8 c	9/16 c	3/4 c Broke	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Charcoal Tank Plate-iron.	1/8 a	9/32 h	7/16 c	9/16 c	3/4 c Broke	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Best Forge Charcoal Iron.	3/16 a	3/8 f	9/16 fe	11/16 f	13/16 f	15/16 fb	1 1/16 fc	⌢ 13/16 d	11/16 f Broke.		...	...	...	...	...	...	...	...	...	...

The important applications of phosphor-bronze have received constant and careful attention, and the use of the special alloy has become so widely extended into almost every branch of industry that it has become known as the "best" metal for bearings; it has been adopted by many of the leading railroads for bearings of their locomotives and cars, and large quantities are in use in rolling mills, foundries, steam engines, steam ships, and industrial works of all kinds throughout the country. Phosphor-bronze tuyeres have been in use for several years in the iron furnaces of the United States with great success. They have proved much more durable than those made of iron, and after long service are found to be free from incrustation by scoria of the furnace. The facility with which they can be re-

fourths per cent., the strength of the pig-iron is not materially affected by it.

Phosphorus occasionally forms between one-fiftieth and one-sixtieth part of the weight of cast iron, but about one-hundredth part is a more common proportion of phosphorus. It exists in combination with a portion of the metal as *phosphide* of iron, and is derived either from phosphate of iron contained in the iron, or from phosphate of lime, which is frequently present in the limestone employed as a flux, and in minute quantity in the coal. These phosphates contain phosphorus in a state of combination with oxygen, which is abstracted by the carbon of the fuel in the blast-furnace, and the phosphorus, thus set free enters into combination with the iron. So completely is the phosphorus taken up by the metal, that only traces of that element in the form of phosphates are usually found in the slag from the blast-furnace.

The effects of phosphorus are to harden cast-iron, decrease its strength, and to increase its fusibility. Iron made from ores containing much phosphorus is always *cold-short*, or incapable of being wrought cold under the hammer without breaking. See *Cast-iron*.

PHOTO-GLYPHOGRAPHY.—A process, invented by Mr. Fox Talbot, for etching a photograph into a steel plate. It consists in coating the plate with a mixture of bichromate of potash and gelatine, and exposing under a negative. The effect of this treatment is to render the gelatine insoluble, just in proportion to the intensity of the light's action, after which a solution of perchloride of iron, of a certain definite strength, is poured over the film, which solution penetrates those parts unacted on by light, reaching the steel plate, and biting itself in, but is repelled by that portion of the gelatine rendered insoluble; the plate being thus protected from the action of the solvent. Because a dilute solution of perchloride of iron soaks into a film of gelatine more readily than a strong solution, it is very important that the etching fluid should possess that amount of dilution which has been found by practice to yield the best results.

The utility of such a process for copying old and rare original manuscripts or maps and plans of all kinds for the use of engineers and others will at once be apparent, and it has already been largely adopted in the Ordnance Survey Office, Southampton, for the reproduction of maps and old manuscript records; at the India Museum, London, for the reproduction of the patterns of Indian fabrics; and at Woolwich Arsenal, for the reproduction of drawings of ordnance, equipment, etc. It is also largely used by the War Departments of the various European States and in America, but in no country in the world has Photo-glyphography been so extensively and so usefully applied to the reproduction of maps as in India, where skilled lithographic draughtsmen and engravers are very scarce. It has been most successfully worked in the Surveyor General's office, Calcutta, in the office of the Superintendent of the Great Trigonometrical Survey, Dehra Dhoon, and in the Photozincographic Office of the Bombay Government at Poonah. By its aid the maps of the various surveys are issued to the public within a few months after the completion of the survey, instead of being kept back for years, as they would be, had they to be lithographed or engraved. Besides being used in so many Government Offices, this process is extensively worked by many private individuals in Europe and America.

PHOTOGRAPHY. The art of producing pictures by the action of light upon certain chemical preparations. The adaptation of this art to military purposes, in copying, enlarging, and in reducing maps, etc., also in reconnoissances, has been greatly extended during the last few years. One of its most useful applications to surveying consists in taking small circular pictures or panoramas round each station of the triangulation into which the survey is divided. These panoramas are printed by the ordinary photographic method, and are cut out and fastened on a sheet of drawing paper in the relative position to each other which they occupied on the ground to be surveyed; and straight lines or radii being produced from the center of each, through the objects shown in them, give by their intersections the relative position of each object on the paper, so that the "filling in," as it is technically termed, is completed as rapidly as these intersections can be found. Such a system dispenses with the very slow process of observing each object separately, and the liability to any possible error in recording the observation in the field-book, which is now quite done away with. The great interest taken in field photography of late years, at posts and on the march, is due in a great measure to the improvements made in the apparatus, which began with the introduction of the dry plates. These are sensitive gelatino-bromide dry plates, and can be carried about with little trouble. Formerly, when the wet plates were in use, it was necessary for an amateur to carry around with him a chemical laboratory and an extemporized dark-room. Solutions had to be ready beforehand. With dry plates it is not necessary to bother with chemicals while in the field. All that is necessary is to keep the plates, after the exposure, from the light. They can be packed away in cases to be developed in the dark room at home. If the party wishes to make his picture at the time, a dark closet can be arranged under canvas. Only two solutions are necessary, and they can be carried in small bottles. Many explorers develop their plates when they get back at night from a day's photographing tramp. Others save their plates and take them to a professional in the city to be developed.

Fig. 1, shows a camera designed especially for field-service by the Rochester Optical Company. It is a very accurate, simple and practical instrument and may be operated by any soldier, of ordinary intelligence. The camera-box, in three sizes, is made of the best seasoned cherry, well finished in the natural wood. The focusing screen is *hinged* to the camera-back, which is more convenient than where loose, and liable to loss and breakage. The back with screen slides upon the bed, being fastened by a set screw when the focus has been obtained. The tripod is attached to the bed by a screw which, while it allows of the swinging of the box horizontally, or its

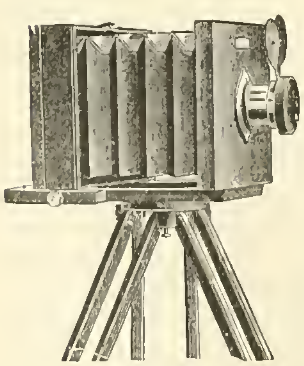


Fig. 1.

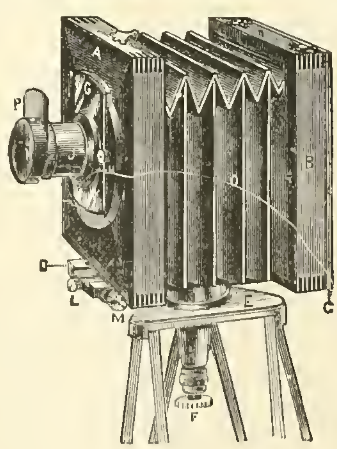


Fig. 2.

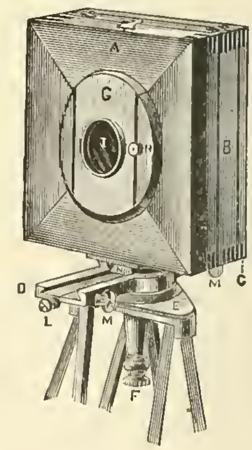
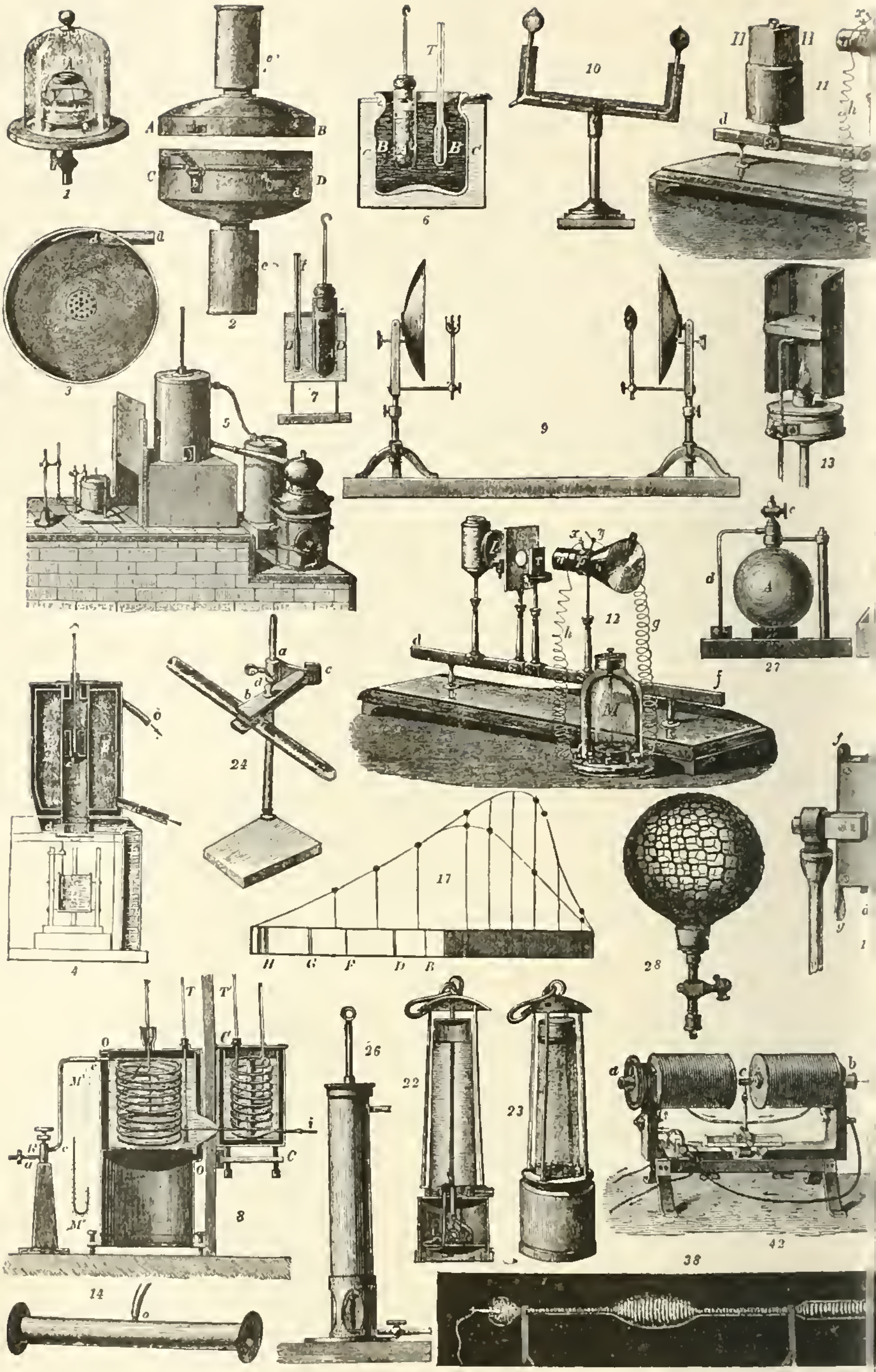


Fig. 3.



PHYSICS. 1. Apparatus for congealing water by evaporation. 2, 3. Vessel for reception of solid ca
heat. 10. Leslie's differential thermometer. 11, 12, 15. Melloni's apparatus for radiation of c
thermo-column. 17. Spectral curve of thermic intensity. 18. Curves of intensity of the chem
ture of a flame with wire netting. 22, 23. Davy's safety-lamp. 24. Conduction of heat by v
constant pressure. 28. Formation of mist by expansion of steam. 29, 30. Generation of he
34. Magnetic induction. 35. Attraction and repulsion of parallel currents. 36. Current-breake
polarization by electro-magnets. 43. Induced currents. 44, 45. Action of the magnetic poles c

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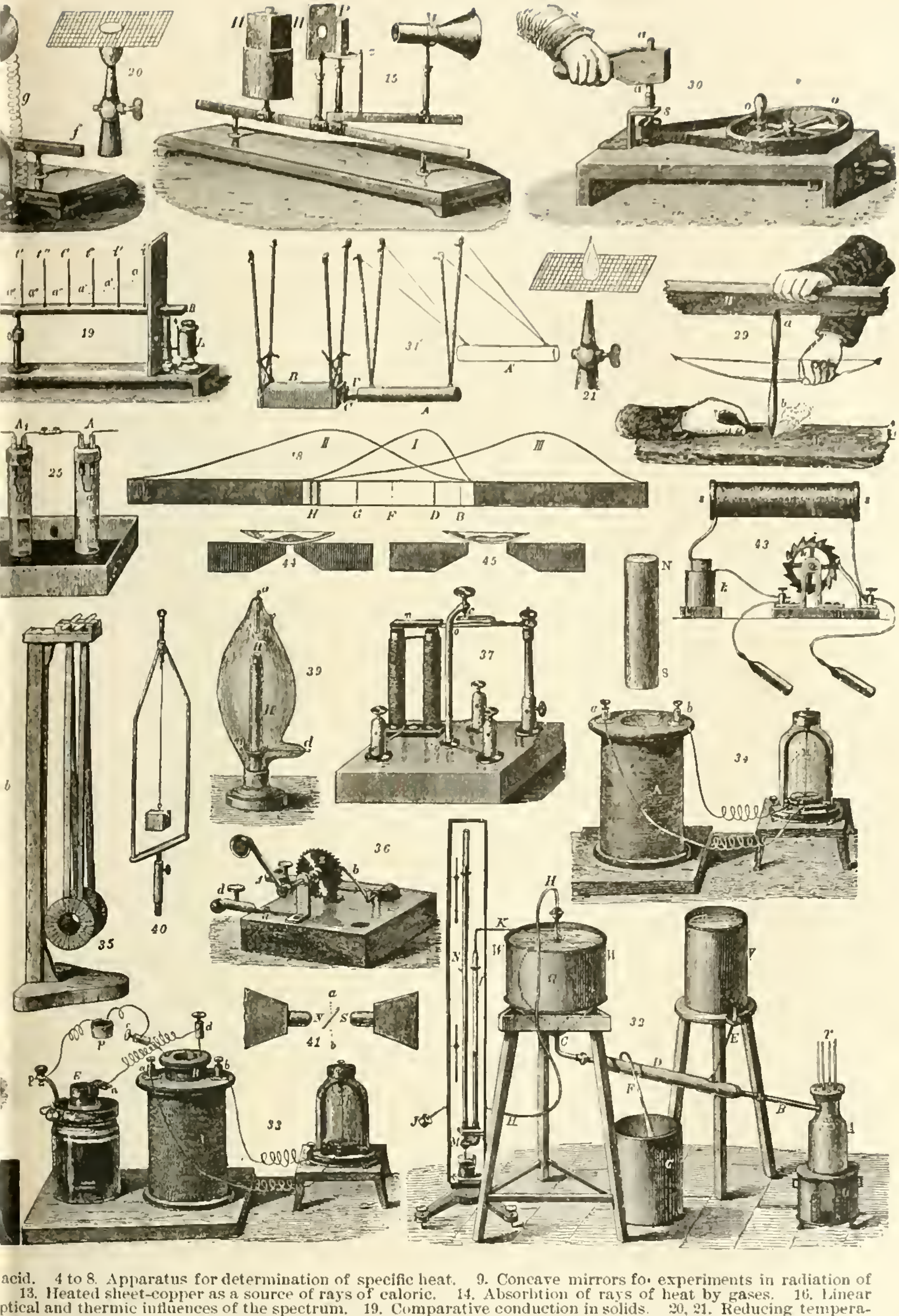


acid. 4 to 8. Apparatus for determination of specific heat. 9. Concave mirrors fo· experiments in radiation of
13. Heated sheet-copper as a source of rays of caloric. 14. Absorbtion of rays of heat by gases. 16. Linear
ptical and thermic influences of the spectrum. 19. Comparative conduction in solids. 20, 21. Reducing tempera-
25. Conduction of heat by gases. 26. Generation of heat by compressing air. 27. Specific heat of air under
friction. 31. Generation of heat by compressing lead. 32. Tension of aqueous vapor. 33. Induced currents.
Magnetic hammer. 38, 39. Geissler's tubes. 40. Rotating copper cube. 41. Diamagnetic repulsion. 42. Circular

removal, remains in its socket at all times, thus obviating loss. The lens is of remarkably fine quality, giving sharp definition and great depth. The diaphragms are *removable*—a point of the greatest importance, to compensate for the varying strength of different lights. The plate-holder is made on an improved plan, doing away with ledges and thus exposing the full plate to the action of the light, making a picture the full size of the glass. By the old method a quarter of an inch all around was lost. The Tripod Legs are jointed, capable of folding to half length, but when in position are rigid and firm. These cameras are provided with rising and falling fronts, swinging backs, hinged and folding beds (almost indispensable adjuncts on some views), and are adjustable for stereoscopic work, having double lenses, on interchangeable fronts and partitions.

Figures 2 and 3, show a swivel-bed camera. The front is mitered in four pieces, giving it a very elegant appearance. The bed swivels under the box, as shown in the drawing *L*, Fig. 3, is a focusing screw, and *M*, a lock nut for fastening the box in position when the focus is obtained. The tripod head, *E*, is adjustable, so that the camera may be leveled without the necessity of moving the tripod legs. The rising and falling front, *G*, is reversible for packing more compactly. The diaphragms are removable. The focus screen is hinged and falls down at the camera back, thus offering the least resistance to wind. This camera is but two inches thick when closed, thus making it most compact for transportation. The lens is of great depth, and fine quality, giving a sharp and clear cut picture.

One of the latest of instantaneous cameras consists of a small wooden box which can be carried easily under the arm. Inside the box is the lens through which the picture is taken. This is covered by a shutter, which by the mere pressing of a little knob on the outside uncovers the lens for an instant. On the upper side is another lens, and underneath a ground-glass plate. This is simply to enable the photographer to see the image he wishes to take. When it falls on the right spot in the plate he presses the little knob for less than a twentieth of a second, the dry plate is exposed and the picture is taken. Troops in motion, exploding shells, etc., have thus been photographed. With a little practice, instantaneous photographing reaches so fine a point that a longer exposure than one-twentieth of a second is not required.

It is not within the province of this article to go into an abstruse demonstration of optical, chemical or mechanical facts, but simply to direct attention to an art of no little value to Topographical Engineers, and all others in the active service of the military profession. The dark room, preparation of chemicals, manipulation of camera, development, printing, and toning may form special studies for those desiring to become experts. The art of photography is now taught as a part of the regular course at the Artillery School, Fortress Monroe, and in most of the Military Schools of other Countries.

PHOTO-LITHOGRAPHY.—The application of photography to engraving on stone. A lithographic stone is coated with a mixture of water, gum-arabic, sugar, and bichromate of potash, dried in the dark, exposed in the camera, or under a negative. The effect of the luminous action is to render the gum almost insoluble. A solution of soap is then applied, which serves the double purpose, by its decomposition, of yielding a greasy printing surface, and by its solvent action to remove those portions unacted on by light; its action being inversely proportionate to the extent to which the gum was fixed by the light. In this condition the stone is freely washed with water, and when dry, receives a coating of printer's ink from the roller, which, by uniting with the soap, gives additional body to the picture. This process was patented by Mr. W. E Newton; but, in common with others of a kindred character, the resulting pictures were invariably deficient in middle tint, possessing a degree of hardness very unpleasant to the eye, which prevented its coming into general use.

PHOTO-MICROGRAPHY.—The enlargement of microscopic objects, by means of the microscope, and the projection of the enlarged image on a sensitive collodion film. The manipulatory details are the same as in the collodion process, only that, on account of the delicate nature of the markings to be rendered, it is necessary to employ a collodion yielding what is termed a structureless film. The principle upon which the enlargement is effected is that of the conjugate foci. This branch of microscopic and photographic science has proved a useful aid in the study of the sciences of botany, physiology, and entomology, by delineating, with unerring accuracy, woody fiber, ducts, starch granules, muscular fiber, blood discs, nerve papillæ, etc. Among the numerous experimenters attracted by this interesting study, Dr. Maddox is perhaps the only one who has attained to any renown; and by him, minute animalculæ, all but invisible by unassisted vision, have been magnified to a superficial area of 3 square inches, in which the most delicate details have been faithfully preserved. By reversing the arrangement necessary for these enlargements of microscopic objects, it will be seen that minute photographs of engravings, or other objects, may be produced which would require a microscope for their inspection. In this way communication was maintained, during the investment of Paris, when copies of letters and newspapers were inserted in quills, and fastened to carrier pigeons; and this is really by no means so difficult to accomplish as it may seem at first sight, since photographs no larger than a pin's head have been produced, including in that small space portraits of no less than 500 eminent men.

PHOUS-DAN.—An East Indian term for a commander of a large body of forces.

PHYLÆ.—A Greek word, meaning tribes, applied specially to the divisions of Attica, originally four, but made ten by Cleisthenes after the Pisistratidæ were driven from Athens. The number was still later raised to twelve. Each *Phyle* had a leader or Phylarch, who possessed certain authority, both of a civil and military nature, and each tribe sent fifty representatives to the Athenian Senate. In time the civil duties, such as presiding over the assemblies, were taken from the Phylarch and given to an officer called the Epimeletes.

PHYLARQUE. —A Grecian cavalry officer who commanded the cavalry of his tribe.

PIBROCH.—Music played on the bagpipe, which has a wonderful power in exciting the martial instincts and hilarity of the Highlanders. Its rythm is so irregular, and its notes in the quicker parts so much jumbled together, that a stranger has difficulty in following the modulations or reconciling his ear to them. The earliest mention of the military music of the bagpipe is in 1594, at the Battle of Balrinnes; indeed, prior to that period, the bagpipe can hardly be looked on as a national instrument of Scotland. There are appropriate pibrochs belonging to various clans and districts, but some of these may not be older than the beginning of the last century. One of the oldest known pibrochs is called the "Battle of Harlaw," but it may be doubted whether it was contemporary with that event (1411). In the ballad account of that battle there is mention of trumpets and horns, but none of the bagpipe; and the pibroch style of music has so obvious a relation to the bagpipe that it is difficult to suppose that it preceded the use of that instrument. According to Sir Walter Scott, the connoisseurs in pipe-music affect to discover in a well composed pibroch the imitative sounds of march, conflict, flight, pursuit, and all the current of a heady fight. Many remarkable instances have been recorded of the effect of the pibroch on the Highlanders. At the Battle of Quebec, in April, 1760, whilst the British troops were retreating in confusion, the pipers were ordered to strike up a favorite pibroch, and the result was that the Highlanders, who were broken, rallied the moment they heard the music, and formed with great alacrity in the rear.

PICADOR.—A horseman armed with a lance, who commences the exercises of a bull-fight by attacking the animal without attempting to kill him.

PICAROON.—A pillager or plunderer; one who violates the laws.

PICCOLO.—A flute of small dimensions, having the same compass as the ordinary flute, while the notes all sound an octave higher than their notation. In joyous as well as violent passages this instrument is sometimes very effective in a band.

PICKER.—A small, pointed brass wire, which was formerly supplied to every infantry soldier for the purpose of cleaning the vent of his musket.

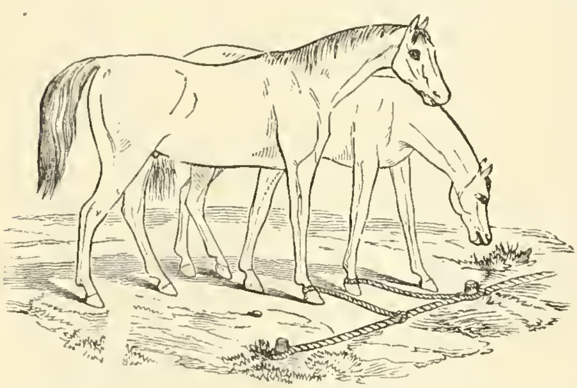
PICKERING.—A little flying skirmish, which the marauders make when detached for pillage, or before a main battle. Also writen *Pickerooning*, and *Picqueering*.

PICKET.— A technical term for an elongated conoidal projectile. See *Pickets.*

PICKET-GUARD.—A guard of horse and foot, always in readiness in case of alarm. See *Pickets.*

PICKET-LINE.—1. A position held and guarded by small bodies of men placed at intervals. 2. A rope to which horses are secured when groomed. The rope, which usually passes through holes near the tops of posts planted in the ground, is frequently replaced by a timber framed on the posts.

In the Crimea, the cavalry usually encamped in line with two rows of *picket-lines* and a line of shelter tents in front of and behind the picket-lines; the arms and equipments between the shelters and the



picket-lines. The picket-lines were stretched on the ground, and the horses secured to them by hobbles on the right fore-feet; the hobble being about three feet long and buckling around the pastern-joint. The drawing shows this arrangment, which is spoken of by the French officers as being the best manner of securing the horses.

PICKET-PIN.—An iron pin with a ring at the top. It is driven in the ground, and the lariat is attached to it to secure a horse while grazing.

PICKETS.—1. Stout wooden stakes driven into the ground and used for securing purposes, and in the construction of holdfasts. The ordinary stakes for siege-gun platforms answer for most cases. When very heavy strains are to be borne, posts from five to eight feet long are required, and are set into the ground by digging holes, or with a pile-driver. When the latter is used, the post should be shod with an iron point, and have a ring upon the head to prevent splitting.

2. An early military punishment where the culprit was held by the raised arm in such a position that his whole weight fell on one foot, which was supported on a picket with a blunt point. The time the man thus stood was proportioned to the offense. The punishment became, after a few moments, extremely painful; it has long been discontinued on sanitary grounds.

3. Detachments of troops whose principal duty is to guard an army from surprise, and oppose such small parties as the enemy may push forward for the purpose of reconnoitering. The main-detachments or pickets, which form the supports to the grand-guards and out-posts, occupy the principal avenues to the position of the main-body. As their duty is to hold the enemy in check, the points which they take up should be susceptible of a good defense; such, for example, as villages, defiles, etc.; whenever these advantages are not found at hand, resort should be had to any temporary obstacles, as abatis, etc., which can be readily procured, to place the troops under shelter. The points thus occupied should, as a general rule, be about midway between the line of out-posts and the position of the main-body. Small posts should be thrown forward by the pickets, between their position and the line of grand-guards; both for the greater security of the detachments, and as supports to the grand-guards. In like manner, when the line of pickets is of considerable extent, intermediate posts must be established,to keep open a communication between them, No pains should be spared to obstruct the approaches of the enemy to the points occupied by the pickets; particularly those which lead to the flanks; leaving open such only as will oblige the enemy to attack under the most unfavorable circumstances; and if, between the advanced-posts and the main-body, a defile, or other unfavorable pass should occur, which the enemy, by turning the line of the advanced-posts, might seize upon, and thus cut off their retreat, it should be occupied by a strong detachment; both to prevent such a manenver, and to favor the retreat on the main-body.

The entire strength of the advanced-posts, as well as the relative strength of the pickets, grand-guards, and out-posts, will depend upon the character of the ground covered by them; as being more or less open, and presenting more or less facilities for circumscribing the approaches of the enemy to the main-position. It rarely occurs that sufficient troops can be detached to cover all the accessible ground, and perform the duties in a thorough manner The strength of each picket, and the kind of troops of which it is composed, will depend on the degree of resistance to be offered to the enemy's attack; and the character of the position occupied. In most cases where a vigorous defense is called for, they will consist of troops of all the arms; and an aggregate of several hundred men. The grand-guards, out-posts, and patrols, should not as a general rule exceed one-third the strength of the pickets to which they belong. They will be composed of cavalry, or infantry, according to the more or less broken features of the ground. It rarely occurs that artillery is placed at the out-posts. Whenever it happens that a piece, or two, may be deemed necessary, to sweep some passage, or defile, in advance of the line of out-posts, the guns must be protected by a strong post, to insure their safety in a retreat. If, from the character of the ground, the out-posts are mainly of infantry, some cavalry should always be attached to them, to patrol in advance of the position, and to convey intelligence to the rear of what may be passing in the neighborhood of the out-posts. When the advanced-posts cover an advanced-guard, the Commanding Officer of the whole should take a position, with his artillery and the main-body of his command, at some central point, in the rear of the pickets; in order to be ready to support them if hard pressed by the enemy. The choice of this position is an object of the greatest importance; as the safety of the advanced-posts as well as that of the main-body, may depend upon the degree of judgment shown in his selection. So soon as the advanced-posts have taken up their stations, instructions should be given to the officers of the different posts, with respect to the points upon which they are to fall back, in case of their being forced in; the lines of communication they must of necessity retire by; and the position they must take up, when joining the supports to which they respectively belong. An officer in command of any of the out-posts must be capable of untiring vigilance and activity; to perform the various duties which devolve upon him. He should be provided with a good map of the country, a telescope, and writing materials. He will thoroughly reconnoiter the ground upon which he is to dispose his command; and also as far in advance as circumstances will admit; questioning closely any inhabitant he may find. After taking up his position, he should go forward with the half of his command, and post each sentinel himself. If, however, he relieves another in the command, and deems it advisable to make any changes in the dispositions of his predecessors, he should promptly report the facts to the commanding-officer in his rear. When the officer finds that the enemy is not in his immediate neighborhood, he should endeavor to feel his way cautiously towards him by patrols; and when in immediate presence, he should omit no means to watch the enemy's movements; and from the occurrences of the moment, such as noises, the motion of clouds of dust, camp fires, conflagrations, etc., endeavor to divine what is passing in his camp, and his probable intentions. Accurate written reports should be promptly sent to the officer in command, in the rear, on all these points. The reports should be *legibly* written, and should clearly, but *concisely*, state what has fallen under the officer's eye; what he has learned from others; and the character of the sources from which his information is drawn. The post under the officer's command, whether horse or foot, should not all be allowed to sleep or eat at once. The horses, when wanted, should be taken singly or by pairs, and always mounted. At night one-half of the command should be under arms, prepared for an attack; the others seated, their arms and the bridles of their horses in hand. The men should never be permitted to occupy a house; and if the weather is such that a fire out of doors is indispensable, it should be as much concealed as practicable; one-half being only allowed to sit near it; the other posted, at a convenient spot at hand, to fall on the enemy should he attempt a stroke. When the position taken up is to be held for some time, it will be well to change the locality of the posts occasionally; this should be done, particularly at night, in a hilly district, changing the post from the brow of the hill, where the men can best keep a look-out by day, to the low ground at night, as more favorable to detect any movement above. The out-posts are usually relieved at day-break, as being the most favorable moment for the enemy to attempt a surprise; the new-guard, will serve to reinforce the old. For the same reason, the old-guard should not be suffered to retire before the patrols come in and report all safe. See *Advanced-posts*, *Field-service*, *Grand Guards*, and *Outposts*.

PICRATES.—The picrates are salts of picric acid. Picric or trinitrophenic acid is a nitro-substitution product, formed by the action of nitric acid on carbolic acid (phenol, C_6H_6O). Three substitution products may be derived from this action, but only one, picric acid, possesses any marked explosive properties. Picric acid has the composition indicated by its symbol—$C_6H_3(NO_2)_3O$, or $C_6H_3N_3O_7$. Picric acid is found in commerce, being used to dye silk and wool yellow. If the acid is heated, it takes fire and burns sharply and rapidly without explosion. The picrates are all exploded with more or less violence by heat or blows. When used as explosive agents they are mixed with potassium nitrate (saltpeter) or potassium chlorate. A large number of picrates are known, but the potassium and ammonium salts are the only ones that have been much used in explosive preparations.

Potassium Picrate, $C_6H_2KN_3O_7$, is the most violently explosive of the picrates. Potassium picrate and potassium chlorate form a mixture nearly as powerful as nitro-glycerine, but it is so sensitive to friction or percussion as to render it practically useless. With potassium nitrate instead of chlorate a less violent mixture is obtained, but one still too liable to accidental explosion.

Ammonium Picrate, $C_6H_2(NH_4)N_3O_7$, has been proposed by Abel as an ingredient of a powder for bursting charges of shells. The properties of ammonium picrate are very different from those of the potassium salt. If flame is applied to the former, it burns quietly, with a strong, smoky flame. If heated it melts, sublimes, and burns without explosion. It is almost entirely unaffected by blows or friction. This salt mixed with saltpeter forms Abel's picric powder (Brugère's powder). Experiments with this powder in England indicate that it possesses some advantages when used in shells. A number of shells charged with it were fired from guns of different caliber without accidents. It is more powerful than gunpowder and less violent than nitro-glycerine and gun-cotton. It is insensitive to ordinary means of ignition. If flame is applied to it, the particles touched burn, but the combustion does not readily extend to the others. Blows or friction do not explode it. It must be confined in order to develop its explosive force. It does not absorb moisture from the air, so that it may be stored and handled like gunpowder, and is at least equally safe and permanent. It is prepared for use by the usual gunpowder processes of incorporation—pressing, granulation, etc.; so that it has the same form and may be handled in the same way. It may therefore be a good substitute for powder when a more violent explosive is wanted and neither gun-cotton nor nitro-glycerine are available. The mixture contains 46 parts of saltpeter and 54 parts of the picrate.

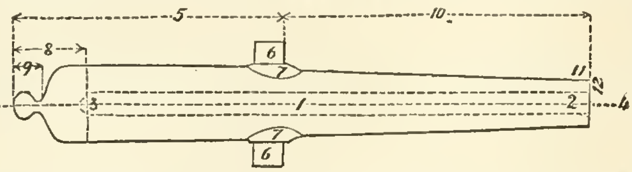
The picrate is prepared from picric acid and ammonia. The picric acid is dissolved in water, and ammonia added to neutralization. Another charge of picric acid is then dissolved in the same liquid, and ammonia again added. This is repeated several times, and the liquid allowed to stand for some time, when the ammonium picrate crystallizes out in large quantities. The mother liquor is drawn off, the crystalline deposit drained and dried. The mother liquor may be used for the preparation of successive lots of the ammonia salt until it becomes charged with impurities, when it may be otherwise treated or thrown away. In this way a considerable amount of the salt can be expeditiously prepared with little labor and without much loss. The working of the mixture is, of course, to be done at a powder-mill. See *Explosive Agents*.

PICRIC POWDER.—Picrate of potash. This powder, of a bright yellow color, has been recommended as stronger than gunpowder, and less susceptible to ignite by means of friction or a blow.

PICTS' WALL.—One of the barriers erected by the Romans across the northern part of England to restrain the incursions of the Picts.

PIECE.—1. In Heraldry, an ordinary or charge; as the fesse, the bend, the pale, the cross, the saltire, the chevron, called honorable pieces. 2. The terms *cannon* and *ordnance* are applied to all heavy fire-arms which are fired from carriages, in contradistinction to *small-arms*, which are fired from the hand. The term *piece* is applied to cannon; it also used to designate a cannon in union with its carriage with or without the limber.

The light artillery of the United States now comprises the following pieces, viz.: *three-inch rifle* and *three-and-one-half-inch rifled-guns; half-inch* and *one-inch mitrailleurs;* and the *twelve-pounder smooth-bore* gun. A .45-inch mitrailleur has just been adopted (1874); it is intended to ultimately replace the half-inch mitrailleur. The *three-inch rifle* was adopted in 1861. It is made of wrought-iron, by wrapping boiler-plate round an iron bar, so as to form a cylindrical mass, which is brought to welding heat and passed through rollers, so as to unite it solidly; the trunnions are afterward welded on, and the piece is bored and turned to its proper size and shape. The method originated at the Phœnixville Iron Works, Pa. The model for the *three-and-one-half-inch rifle* was adopted in 1870. It is to be made of wrought-iron or bronze, and in its general appearance will



closely resemble the three-inch rifle. The *mitrailleurs* are Gatling's, and were adopted in 1868; they are made of steel, some of the smaller parts being of brass. The *twelve-pounder*, or *Napoleon gun*, adopted in 1857, is still (1874) retained in the United States service, though abandoned by all other civilized nations. It is cast in gun-metal or bronze, which consists of ninety parts of copper and ten of tin, allowing a variation of one part more or less.

Description and nomenclature of light guns: The *bore* (1) is the hollow cylinder which receives the charge. The *mouth* (2) is that part of the bore nearest the front of the piece. The *bottom of the bore* (3) is its extreme rear; in the three inch rifle, it is a semi-elliptical surface. The bores of rifled-guns have *grooves;* the intervals between the grooves are called *lands*; the grooves and lands are of equal width. The *vent* is a cylindrical hole, perpendicular to the *axis of the piece* (4), near the bottom of the bore, through which fire is communicated to the charge. The surface of the piece in the immediate vicinity of the exterior orifice of the vent is called the *vent-field.* The *body* (5) is that part of the piece in rear of a plane perpendicular to the axis of the piece and tangent to the front part of the *trunnions* (6,6), or projecting cylinders at the sides of the piece, which are intended to support it on its carriage; their axes are in a line perpendicular to the axis of the piece, and in the same plane with it. The *rimbases* (7,7) are the short masses of metal which unite the two trunnions with the gun; their ends, or the *shoulders of the trunnions*, are planes parallel to each other and perpendicular to the axis of the trunnions. The *breech* (8) is that part of the piece in rear of a plane passing through the vent and perpendicular to the axis of the piece. The *base of the breech* is the plane, or curved, surface at the rear of the piece. The *seat for the pendulum-hausse* is screwed into the base of the breech. The breech includes the *cascabel* (9) which consists of a *knob* terminating the rear of the piece, and of a *neck*, or narrow part, which unites the knob to the base of the breech. When the body of the gun is strengthened by a band, or jacket, this addition is termed a *reinforce.* The *chase* (10) is that part of the gun in front of the trunnions. The *muzzle* (11) is the general term for the front of the gun; if the chase be enlarged at the muzzle, the enlargement is called the *swell of the muzzle*, and the part of the chase where the swell begins is called the *neck.* The *front*, or *muzzle, sight* is screwed into the muzzle, or into the swell of the muzzle at its highest point. The *face* (12) is the perpendicular plane terminating the front of the gun. *Preponderance* is the excess of the weight of the piece in rear of the trunnions over that in front; it is measured by the lifting power in pounds, which must be applied at the base of the breech to balance the piece when suspended freely on the axis of the trunnions. It is decided to dispense with preponderance in all guns hereafter cast. The bore is kept as dry as possible by depressing the piece and using a vent-cover and tompion. Great care must be taken not to bend or injure the front-sights, as it affects the accuracy of pointing. After firing, the bore of the gun must be washed out, and the piece depressed. Steel guns are bronzed or lackered on the exterior. Mitrailleurs are kept cleaned and oiled to prevent them from getting rusty; after marching over dusty roads and, if possible, before going into action, the barrels and carrier-block are wiped and the parts oiled, the crank being reversed to avoid unnecessary snapping. The foregoing are the principal dimensions and weights of pieces.

	Rifles.		Mitrailleurs.		12-Pdr. model of 1857.
	3-inch.	3½-inch	½-inch.	1-inch.	
	Inches.	Inches.	Inches.	Inches.	Inches.
Diameter of bore	3.	3.5	.5	1.	4.62
Length of bore	65.	65.	33.	33.	63.6
Whole length of piece	72.7	73.84	58.	68.15	72.55
Greatest exterior radius of base of breech	4.85	5.6	....	....	5.5
Greatest exterior radius of breech-casing	....	....	3.81	6.5	....
Length of front-sight	1.85	2.25	....	....	2.5
Length of trunnions	2.8	3.25	2.25	2.8	3.25
Diameter of trunnions	3.67	4.2	2.7	3.67	4.2
Depth of grooves	.075	.075	.01	.01	....
Twist of grooves	1 in 10 ft.	1 in 12 ft.	1 in 42 inch.	1 in 6 ft.	....
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
Weight	830	1,156	365	1,008	1,230
Preponderance	40	None.	45	110	105

In bronze, the weight of the three and one-half inch rifle is 1,299 lbs. There are seven grooves in the three-inch and three-and-one-half-inch rifles, and six grooves in the barrels of the mitrailleurs. In the twelve-pounder, the *windage*, or difference between diameters of bore and projectile, is 0.1 inch. See *Cannon*, *Gatling Gun*, and *Mitrailleur.*

PIERCED.—In Heraldry, a term used to indicate that a charge is perforated so as to show the field beneath it. The aperture is presumed to be circular, unless some other form, as square-pierced or lozenge pierced, be specified in the blazon.

PIERCER.—An instrument employed in the fabrication of ordnance. The boring of a cannon is commenced by placing the boring-rod, armed with the first cutter, called the *piercer*, in the prolongation of the axis of the piece, and pressing it against the metal. The piercer is used till it penetrates to the bottom of the chamber, after which a second cutter, or reamer, is attached to the boring-rod, and with this the boring is made complete to the round part of the chamber.

PIERRIER.—A term originally applied to an engine for casting stones, and later to a small kind of cannon. The term is now generally applied to a mortar used for discharging stones, etc.

PIERS.—In fortification, the buttresses on which the roadway of a bridge rests. In the case of wooden bridges, piers are made of barrels, etc.

PIES.—Counts Palatine, who were created in 1560 by Pope Pius IV, and who had precedence at Rome over Knights of the Teutonic Order and Order of Malta.

PIEZOMETER.—An instrument invented by Oersted for measuring the compressibility of liquids. It has been proposed to ascertain the pressure of the gases evolved by the combustion of gunpowder, by including in the cavity within which the pressure should be restrained a piezometer, which, by registering the compression of a liquid contained within it, should afford an indication of the pressure to which it had been exposed. This instrument, as employed in these experiments, is shown in the drawing. Fig. 1, is a section through its axis; Fig. 2, an exterior side view. The same letters are used in re-

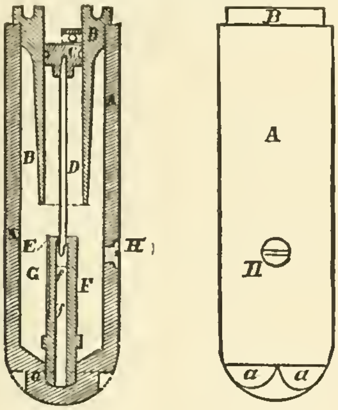


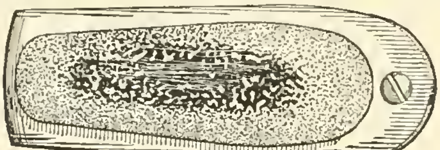
Fig. 1. Fig. 2.

ferring to like parts in each of the figures. A, is the body of the instrument. The general form of its lower (or outer end) is hemispherical, but it is flattened on four sides (as at *a* and *a*) for fitting a socket attached to the middle of a small oil-pan used in filling it. B, is the barrel to which the piston is fitted. It screws freely into the body, and makes with it a close joint. C, is the piston, packed with a leather ring occupying a groove; *c*, is the eye of the piston, by means of which it is withdrawn or turned when required. A special implement (not represented) is fitted to the eye for this manipulation. D, is a stem screwed into the piston. The lower end is squared, to fit a socket like that of a watch-key. As it is desirable to use a new stem for each experiment, special appliances were prepared for making duplicates readily and with accuracy. They are coated with a thin film of black varnish to render the marks they are to receive more distinct. E, is the point from which the stem receives the mark recording compression. F, is a tubular support for the point, and also a guide for the stem of the piston. To it is attached the spring, G, pressing the point against the stem; *f f*, are holes in the support to permit the oil within it to escape freely when the stem is suddenly thrust in, under the action of surrounding pressure. H, is a screw permitting the escape of oil when the instrument is being "set" for use, but also capable of closing tightly the opening in which it is situated. Tests were made of the tightness of the piston and of the joints.

In preparing the piezometer for an experiment, two items are to be specially observed; it must contain no air, and the "setting," or adjustment of the quantity of oil contained, must be done at the precise temperature the instrument is to have at the moment of firing. The procedure is simply as follows: All the parts are first oiled, over their whole surfaces. The adjusting-screw is inserted into the body of the instrument, which is then set upright in a socket attached to the middle of a small pan intended to catch any overflow, and is nearly or quite filled with oil, which should be made to flow down the side of the cavity rather than in a stream. The support of the marking-point, quite clean but covered with oil, is now screwed into its place, with the aid of a special implement, not described. When this is withdrawn, it will be necessary to replace the oil caused to overflow by its insertion. The barrel is now slowly put in its place and screwed firmly down. The hole in the piston for receiving the stem is filled with oil, the stem screwed in, and the piston inserted in the barrel. The adjusting-screw is loosened a little, permitting the piston to be pressed just below the top of the barrel, and again tightened. The next step is to bring the instrument and its contents to the setting temperature. For this purpose a water bath (a common wooden pail) is provided; also a narrow tin cup, deeper than the bath and weighted at the bottom so as to stand upright within it; and a pair of wooden pinchers for handling the piezometer, which instrument could be inserted in them in such a way as to be nearly enveloped and yet to leave the adjusting screw and piston readily accessible. The piezometer, seized in the pinchers, is placed at the bottom of the cup in company with the tools to be used in setting it, and is covered with a loose wad of cotton. The cup is set in the middle of the bath and surrounded with water kept as nearly as possible at the desired temperature, for a sufficient time to impart, as nearly as appreciable, the same to the instrument. It is then withdrawn, the screw loosened, the piston depressed a little to a regulated depth with a special tool, the screw tightened, and the piston rotated a few degrees, which completes the setting. The object of this last movement is to inscribe a transverse line on the stem, affording a starting point in measuring the length of the stroke.

Small changes of temperature after the instrument is set are of no consequence, as the oil will of course return to the same volume, and the piston stand at the same place, on returning to the same temperature. Before placing the piezometer in the hollow plug, a thin leather envelope, kept saturated with oil, is drawn upon it, (with the intention of affording protection against the shock of firing), and when inserted, the remaining space within the plug is filled with oil, which is retained by stopping the opening through the retaining ring (which forms the communication with the bore of the gun) with a loosely-fitted disk of cork or leather. One particular to be noted is the position of the eye of the piston with reference to the line in which the gun will recoil on firing. The metal surrounding the eye occupies a position at one side of the piston's axis of rotation in the barrel, thereby throwing the center of gyration out of that line; and if that center be so situated as to fall outside of a plane coincident with the line of recoil, it is evident that the piston will have a tendency to rotation when the gun is fired.

PIFFARD HEEL-PLATE.—This device consists of a soft rubber pad or cushion about half an inch in thickness. It is applied to the butt of the gun (after removal of the iron heel-plate), and is retained in position by a skeleton plate. The latter is attached to the stock by using one of the original screws, and in addition a small screw inserted near the toe of the heel-plate, as shown in the drawing. The stock of the gun is not altered in any manner, and the original butt-plate can be re-applied at will. Experience has shown that, when using this contrivance, the effect of recoil has been greatly modified, and a charge of as much as 110 grains of powder, with 420



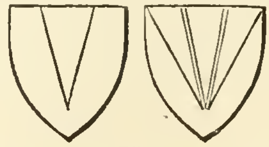
of lead, can be shot without discomfort. The benefits accruing from the lessened recoil are: Recruits and beginners will not become "gun-shy," and contract the habit of flinching; increased accuracy from absence of flinching; target practice can be more continuously and efficiently carried on than is practicable without the elastic-plate, owing to the bruising and other injuries attendant on the use of the service cartridge; and, the powder charge for service ammunition could be materially increased, thereby flattening the trajectory, and in other respects rendering the weapon more effective.

It is evident that the use of this description of heel-plate insures greater safety and increased accuracy. The dropping of a loaded gun (cocked or half-cocked), butt downwards, on a stone or hard ground may result in breaking the point of the sear or one of the notches of the tumbler, causing a premature discharge. This heel-plate would diminish the force of the concussion and lessen the liability to accident. In repeating rifles, in which the cartridges are arranged in the magazine with the bullet of one pressing on the primer of the one in front of it, the dropping of the gun might cause an explosion in the magazine. The liability to this accident would be diminished by the use of the plate. Practical marksmen have found that when using this heel-plate the butt of the rifle is retained in proper position against the arm with less exertion, the rubber not slipping from the arm as readily as the iron butt-plate. On drill, *Order Arms* is accompanied with less noise, and less jar to the mechanism of the weapon. By a recent resolution of the Directors of the National Rifle Association, the use of this heel-plate is permitted in all military and other competitions held under their auspices.

PIKE.—Previously to the use of the bayonet, infantry of the line of battle—that is, the heavy-armed troops—were from the earliest times armed with pikes or spears. The Macedonians carried pikes 24 feet long; those of modern warfare averaged 12 or 14 feet. They were of stout wood, and tipped with a flat iron spearhead, which sometimes had cutting edges. As a defense against cavalry, the pike, from its length and rigidity, was of great value; but though it long survived the introduction of gunpowder, that event was really fatal to it. For success with the pike, especially in offensive war, a depth of several men was essential, and this depth rendered the fire of artillery peculiarly fatal. The pike is now superseded by the bayonet on the end of the musket.

PIKEMEN.—Men who were armed with the pike. From the reign of Henry VIII. to that of William III. the greater part of the English Army was formed of Pikemen.

PILE.—1. In Heraldry, an ordinary, or, according to some Heralds, a subordinary, in the form of a wedge, issuing generally from the middle chief, and extending towards the middle base of the shield. It is said that a pile should occupy one-third of the breadth of the chief, or, if charged, double that breadth. When a pile is borne issuing, not from the



Pile.

middle chief, but from some other part of the bounding-line of the shield, this must be specified in the blazon. Three piles are sometimes borne conjoined in point. A pile *transposed* is one whose point is upward.

2. A round or squared log of wood used in engineering operations, such as dams, bridges, roads, etc. They are sharpened at the point, and, if necessary, protected with iron points, to enable them to cut through the strata they encounter as they are driven into the ground. When used for coffer-dams, or such temporary purposes, they are placed close together, and driven firmly into the earth; the water is then pumped out, and the piles form a dam, to enable workmen to lay foundations of piers, etc. When the force of the water round the dam is great, two rows of piles are driven in all round, and the space between the rows filled with clay, and puddled. Piles are also used for permanent works, when they are driven through loose soil till they reach a firm bottom, and thus form a foundation on which buildings, roads, etc., may be placed. Cast-iron is frequently used for piles, which are cast hollow. Wharf-walls are sometimes built of piles; they are then cast with grooves on the sides, into which cast-iron plates (forming the walls) are fitted. A kind of pile has been invented by Mr. Mitchell, which is of great use in very loose and shifting substances. It is called the screw-pile, and consists of a long shaft (of wrought iron), with a broad cast-iron disc, of a screw form, at the lower end. These piles are especially useful for light-houses, beacons, etc., which have to be placed on sands. They are fixed by means of capstans, which give them a rotatory motion. In 1843 Dr. L. H. Potts obtained a patent for a new kind of pile, which consists of hollow tubes of iron, from which the sand, etc., within them is removed by means of an air-pump, and the pipes are then sunk. In recent railway bridges, cylinders have been much used to form both piles and piers. They are of cast-iron, and made in pieces (of about 6 feet in height), which are applied one on top of another. The sand or gravel is removed from the inside of the first laid, which thus sinks down; another cylinder is placed above it, and the same process continued till it also has sunk sufficiently; and so on, cylinder over cylinder, till a solid foundation is reached. The requisite number of cylinders is then piled up to form the pier above ground.

PILE ARMS.—To place three muskets, with bayonets fixed or unfixed, in such a relative position that they shall mutually support each other. This is done when men stand from their arms either on parade, on the march, or in camp. See *Stack Arms*.

PILE BRIDGE.—A form of bridge much used in military operations, having the piers built with piles. These may be either temporary wooden structures, in which wooden piles, driven into the ground, serve also as piers, or they may be permanent bridges, with iron cylinders forming the piles below the surface, and piers above.

PILE-DRIVER.—A machine having a rising and falling weight to drive a pile into the bed. Nearly forty years ago an eminent Scotch Engineer, James Nasmyth, the inventor of the steam-hammer, constructed the first steam pile driver which, although a great improvement on the ordinary drop-hammer in many respects, never came into general use for several reasons. Principal among which were the liability of the machines through complication of parts to get out of order, and the fact that the end of each separate pile required to be accurately fitted and banded before it could be driven. Subsequent

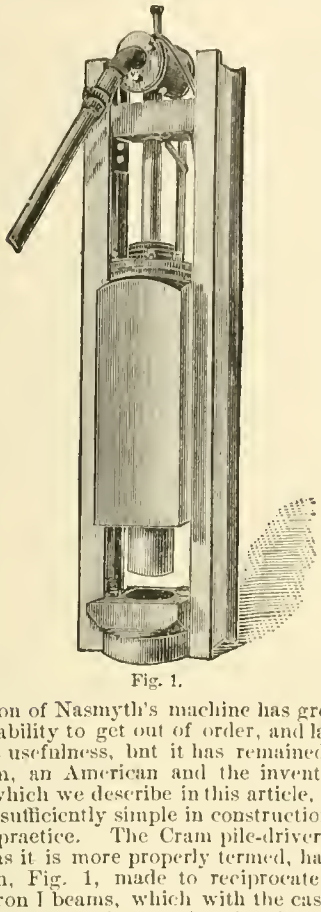


Fig. 1.

modification of Nasmyth's machine has greatly lessened its liability to get out of order, and largely increased its usefulness, but it has remained for Mr. R. J. Cram, an American and the inventor of the machine which we describe in this article, to devise an engine sufficiently simple in construction and effective in practice. The Cram pile-driver, or pile-hammer, as it is more properly termed, has a cylindrical ram, Fig. 1, made to reciprocate between wrought-iron I beams, which with the casting connecting the upper ends, carrying the piston rod and valve and the *bonnet casting*, holding the head of the pile, and connecting the bottom ends, make the frame which guides the machine while being hoisted between the leaders, or when following a pile which is being driven. These pile-hammers may be readily applied to any machine of the ordinary patterns without any alteration excepting such as may be necessary to accommodate the width of the hammer, and afford an opportunity for connecting the flexible pipe which conveys steam from the boiler to operate the hammer. The hammer being hoisted to a rest at a convenient height, the pile to be driven is placed in position and the hammer lowered until the bonnet casting, which forms the bottom of the frame, receives the head in the conical aperture through which the pintle-like projection on the bottom face of the hammer strikes, when a blow is delivered. The weight of the hammer being on the pile, the clutch on the winding drum or other device controlling its descent, is cast adrift and the valve thrown open to admit the passage of steam through the flexible pipe and the hollow piston rod sufficient to operate the hammer at any desired speed.

On the admission of steam the hammer immediately rises in its frame or cage, to the full extent of the stroke at which it may be set, ordinarily about four inches, and on reaching the end of its stroke the steam is exhausted and the cylinder falling delivers its blow, and thereafter continues to rain blows upon the pile with a speed at the will of the operator until the pile be down, or the supply of the steam cut off, when the machine is hoisted to the rest at the top of the leaders ready for a repetition of the performance just described. In this connection it may be stated that light or heavy blows may be struck at the will of the operator, as a reverse motion of the valve lever, which, in the hands of the operator, admits steam to the hammer, causes the steam to be exhausted at any desired point in the stroke, and a blow corresponding to the height from which the ram falls delivered; making it possible, if desired by the operator, to test the pile by one or more light blows before the machine is permitted to work automatically at full stroke, or if it is desired to drive the pile in position under the hammer to any desired point. It is possible, when the pile is found to be nearly home, to stop the automatic working of the hammer and deliver the remaining blows required to bring the pile to its proper position by hand. This feature in the working of this hammer is particularly advantageous, because since the heads of the piles driven with this hammer are neither bruised nor shattered, the ability to drive to any desired level with accuracy and expedition precludes, in many cases, the necessity of cutting off the piles to gain a common level. In the use of this machine, whether on land or mounted on a float, it is found that with the point of the pile in position, and the head held by the bonnet casting, no other guides of any sort are required to insure accuracy of position when driven. The bonnet casting referred to in this machine is so constructed that no preparation of the heads of the piles is necessary

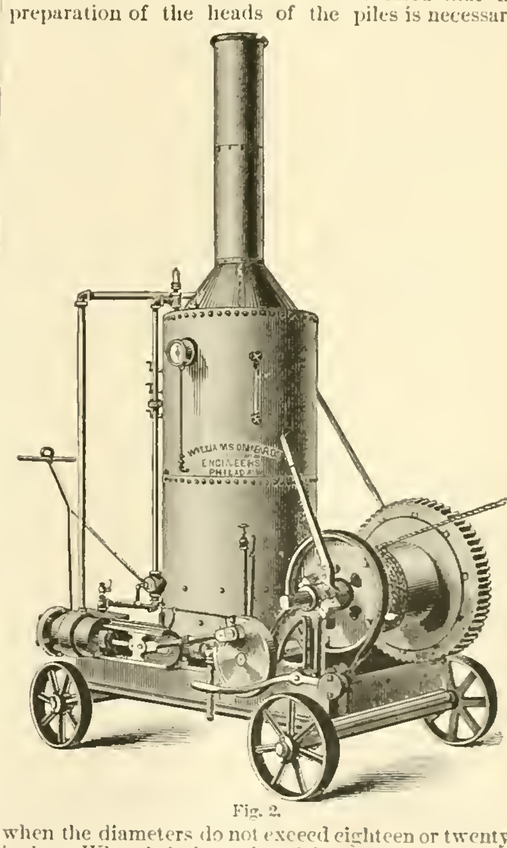


Fig. 2.

when the diameters do not exceed eighteen or twenty inches. When it is desired to drive piles of a greater diameter the heads are roughly chamfered with a chopping axe. It is an exceedingly difficult matter to compare the work done by this simple machine with that of the ordinary drop-hammer, because this steam-hammer will so readily do work that the ordinary drop-hammer will not do at all, for instance, after a pile has been driven with an ordinary drop hammer until it has become necessary to remove the ring and cut a section off the pile to form a new and solid head, by experiment it has been found that the steam-hammer experiences no difficulty in forcing the pile until the point reaches hard pan or rock, and it will, perhaps, be sufficient to state that in the machine here illustrated, the ram weighing 5,500 lbs., when working under a pressure of 75 lbs. of steam delivers upwards of 100 blows per minute, more than sufficient to force a pile through hard sand or clay to the depth usually desired.

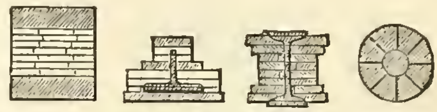
The fact that the ram, when the blow is delivered, is free, unattached to piston rod, valve gear, or any other part, will recommend the machine to practical men, as will also the fact that the valve is a perfectly balanced, positive action valve, with a travel of but $\frac{5}{8}$ of an inch in a steam jacketed chest, and that the attachments of the hose at either end are flexible, thus avoiding any cramping, or twisting which otherwise would occur. The tappit or trip operating the valve is adjustable, permitting the operator to control the length of stroke when the machine is working automatically, thereby making the force of the blows suit the work in hand. Spiral percussion springs are fitted in pockets in the "bonnet casting" to receive any chance blow, and in practice are found to effectually prevent any loosening of the fastenings connecting the bonnet casting with the I beams. Fig 2 shows a portable spur-geared pile-driver engine, having a cone friction single drum. The engine is designed for either portable or stationary purposes, and is constructed either with or without wheels. The drum is loose on the shaft, having a conical friction clutch which is thrown into or out of contact with the large gear wheel by means of a hand lever operating a spiral sleeve on the drum shaft. The drum, in lowering, revolves back free of the gear, and is controlled by a strap brake lined with wood, operated by a foot lever. A relief valve is also fitted to the engine, which allows it to back down with the load. This style of engine is the favorite in the United States for land pile driving machines. It is also well adapted for other kinds of work where speed in lowering is required. The engine may be made either vertical or horizontal, single or double cylinder, either connected or independent of each other, and with single or double drums. The foregoing table shows the power required for a specified duty. See *Gunpowder-hammer*.

Style of Engine.	Power.	Cylinder. Bore.	Cylinder. Stroke	Boiler. Dia.	Boiler. H'ight	Tubes. No.	Tubes. Dia.	Tubes. L'ngth	Dia. of Drum.	Duty of Engine lbs.
Horizontal or Vertical. Single Engines. One Drum.	6	6	8	32	63	41	2	39	10	1800
	10	7	10	34	72	49	2	48	12	3000
	12	7	10	36	72	55	2	48	12	3000
Horizontal or Vertical. Double Engines connected to same crank shaft. One Drum.	12	6	8	36	78	55	2	54	12	3600
	20	7	10	40	90	85	2	60	12	6000
Horizontal or Vertical. Double Engines connected to same crank shaft. Two Drums.	12	6	8	36	78	55	2	54	12	1800
	20	7	10	40	90	85	2	60	12	3000
Double Vertical Independent Engines.	6	6	8	36	78	55	2	54	10	1800
	10	7	10	40	90	85	2	60	12	3000

Dia. of Drum can be varied to suit the work.

PILETUS.—A kind of armor formerly used, having a knob upon the shaft, near the head, to prevent it from penetrating the object aimed at too deeply.

PILING.—In iron-working, the process of building up piles of iron bars, to be charged into the balling-furnace. The amount of work put into bar-iron varies with the quality. For the common kinds, puddled bars, or No 1 iron, cut into lengths, are piled, and when brought to a welding-heat are rolled off, either with or without first being worked into a bloom under the hammer. More usually, however, the iron of second-rolling, No. 2, is employed at the top and bot-



tom plates of the piles when making finished No 3. or best iron. Beyond this, if further piled and welded, the iron is distinguished as *best-best* and *treble-best* according to the number of heatings and weldings to which it has been subjected. The drawing shows samples of piling for plate, T, girder and bar-iron; the deeper shaded inner outlines representing finished sections. The harder and more granular kinds of iron are worked almost exclusively under the hammer, the rolling-mill being only used in giving the proper figure to the bar at the finishing stage.

The great improvement in the strength of malleable iron by the processes of piling and rolling has been more satisfactorily established by experience than explained by theory. One obvious effect of the violent compression between the rollers is the squeezing out of slag, which is liable to become entangled in the iron during hammering and rolling of the balls taken from the puddling-furnace. The occurrence of small masses of slag in malleable iron is not an uncommon cause of weakness, each particle of slag giving rise to a flaw in the metal. In the process of reheating the bars this slag is melted, and may then be squeezed out by the action of the rollers.

A marked diminution in the proportions of carbon and silicon present in the iron is also effected during the process, as shown by the following results of chemical analysis:

In 100 parts	Carbon.	Silicon.
Puddled bar...............	0.296	0.120
Best bar....................	0.111	0.088

This may be explained by the action of the oxide of iron formed upon the surface of the bar during exposure to air at a welding-heat. The rolling of several bars into one single bar would render the structure of the metal uniform, so that the bar would be equally strong throughout.

During the operation of fagoting, or piling and rolling, the iron acquires a remarkable fibrous structure, so that if a bar of the best iron be notched with a chisel, and broken across by a steady pressure, the fracture will present a stringy appearance, resembling that of a green stick; whilst a puddled bar thus treated would exhibit a crystalline, shining fracture, not unlike that of cast-iron. That this *nerve*, or reed, as the fibrous structure is sometimes called, should materially increase the resistance of a bar to any transverse strain, can readily be believed, for such a bar resembles a bundle of wires firmly bound together, whilst a crystalline bar must be regarded as composed of a number of particles of iron stuck together in a confused manner. See *Iron*.

PILING OF BALLS.—Balls are piled according to kind and caliber, under cover if practicable, in a place where there is a free circulation of air, to facilitate which the piles should be made narrow, if the locality permits; the width of the bottom tier may be from 12 to 14 balls, according to the caliber. Prepare the ground for the base of the pile by raising it above the surrounding ground so as to throw off the water; level it, ram it well, and cover it with a layer of screened sand. Make the bottom of the pile with a tier of unserviceable balls, buried about two-thirds of their diameter in the sand; this base may be made permanent; clean the base well and form the pile, putting the fuse-holes of shells downwards, in the intervals, and not resting on the shells below. Each pile is marked with the number of serviceable balls it contains. The base may be made of bricks, concrete, stone, or with borders and braces of iron. Good and imperfect balls should not be used in the same base; and, to avoid confusion, the unserviceable should be left unpainted, or painted of a different color from the serviceable.

To find the number of balls in a pile: Multiply the sum of the three parallel edges by one-third of the number of balls in a triangular face. In a square pile one of the parallel edges contains but one ball; in a triangular pile two of the edges have but one ball in each. The number of balls in a triangular face is $\frac{n\,(n+1)}{2}$; n being the number in the bottom row. The sum of the three parallel edges in a triangular pile is $n + 2$; in a square pile, $2n + 1$; in an oblong pile, $3N + 2n - 2$, N being the length of the top row, and n the width of the bottom tier; or $3m - n + 1$, m being the length, and n the width of the bottom tier. If a pile consists of two piles joined at a right angle, calculate the contents of one as a common oblong line, and of the other as a pile of which the three parallel edges are equal.

To find the length of a pile which shall hold a given number of balls, the width of the base being fixed: A = the number of balls to be piled. n = the number in the width of the base of the pile. m = the number of balls in the length of the base of the pile; then

$$m = \frac{6A + n\,(n+1)\,(n+1)}{3n\,(n+1)}$$

In the table of the number of balls in a pile, on page 526, the second line shows the number in a triangular pile, the base of which is the corresponding number in the first line. The other numbers show the contents of square and oblong piles; the length and width of the base being in the upper line and in the left-hand column, respectively.

For rifle projectiles: Divide the number of projectiles to be piled by the number in the triangular face decided upon, and multiply this number by the caliber in feet of the particular projectile to be piled. The dimensions provisionally adopted for service rifle projectiles are as follows, viz: Total length, $2\frac{1}{2}$ calibers. Radius of head, $1\frac{1}{2}$ diameter of projectile. Windage, 0″.05. The cavity for cored shot and for shells is of a somewhat similar form to the exterior of the projectile, except that the bottom is rounded, and its size is so proportioned as to secure the proper weight to the projectile.

The following formulas are useful in connection with this subject:

For an ogival head of 1 diameter radius: Volume of head $= D^3 \times 0''.395592$.

For an ogival head of $1\frac{1}{4}$ diameter radius: Volume of head $= D^3 \times 0''.44765$.

For an ogival head of $1\frac{1}{2}$ diameter radius: Volume of head $= D^3 \times 0''.49425$

(D = diameter of shot.)

Center of gravity of ogival head; Distance from

$$\text{base} = \frac{\frac{1}{2}(r^2 + a^2)\,g^2 - \frac{1}{4}\,g^4 + a\,(\frac{2}{3}\,a^3 - r^2,}{(r^2 + a^2)\,g - \frac{1}{3}g^3 + 2a\,s}.$$

in which g = length of head, r = radius of head, a = radius of head — radius of projectile.

Weight of cored shot; Small calibers $\frac{(\text{Diam.})^3}{3}$ · large calibers $(\text{radius})^3 \times 2.8$.

PILING OF BARRELS.—The following formulæ refer to the usual manner of piling barrels in magazines.

Case 1.—Pyramid pile.

$$S = 1+2+3. \ldots + n\cdot$$

where S = number of barrels,

n = number in bottom row.

$$\therefore S = \frac{n\,(n+1)}{2} \;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\; (1)$$

In an incomplete pyramid pile,

$$S = \frac{n\,(n+1)}{2} - \frac{(m-1)\,m}{2}$$

$$= \frac{n^2 - m^2 + n + m}{2}$$

$$= \frac{(n+m)\,(n-m\times 1)}{2};\;.\;.\;.\;.\;.\;.\;.\;.\;.\; (2)$$

where m = number in top row.

Case 2.—Where *one* end of the pile rests against an upright, and *the top row does not touch* the upright.

$$S = n^2 - m^2;$$

where n = number in bottom row, and m number in top row.

Suppose the pile continued till $m = 1$. Then,

$S = 2\,(1+2+3. \ldots +n) - n - 1$

$= n\,(n+1) - (n+1)$

$= (n+1)\,(n-1) = n^2 - 1; \ldots \ldots \; (3)$

and in an incomplete pile,

$S = (n^2 - 1) - (m^2 - 1) = n^2 - m^2 \;.\;.\;.\;.\; (4)$

Case 3.—If the top row touch the upright.

$S = n^2 - m^2 + m \;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\; (5)$

Case 4.—Where the barrels are piled *between two uprights* so that if bottom row $= n$, second $= n-1$, third $= n$, and so on.

If top row $= n - 1$, *i.e.* if top row do not touch the uprights,

$$S = mn - \frac{m}{2} = \frac{m}{2}\,(2n - 1);\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\; (6)$$

where m = number of courses.

When top row $= n$, *i.e.* when top row touches uprights,

$S = mn - \frac{1}{2}\,(m - 1)$

$$= \frac{m\,(2n - 1) + 1}{2}\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\; (7)$$

These results, being only calculated for piles of one barrel in depth, must of course be multiplied by the number of barrels in the *depth* of the piles.

PILLAGE.—The act of plundering; that which is taken from another by open force, particularly and chiefly from enemies in war.

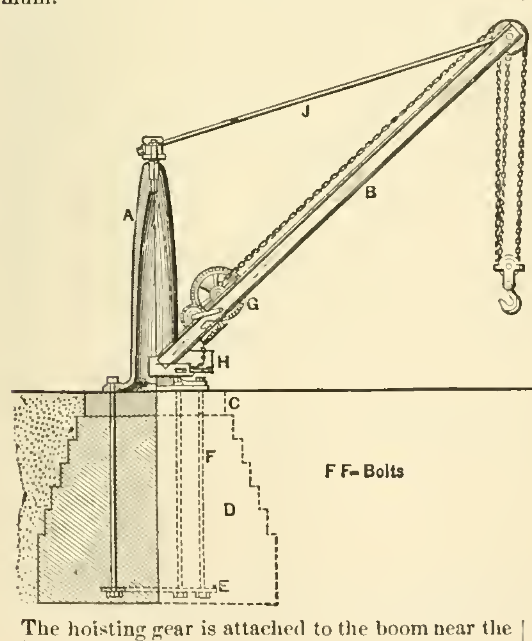
PILLAR CRANE.—A crane of this class is entirely supported from below, and the masonry which forms the foundation must have sufficient stability

Table of the number of balls in a pile.

	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21
Triangle	4	10	20	35	56	84	120	165	220	286	264	455	560	680	816	969	1,140	1,330	1,540	1,771
2	5																			
3	8	14																		
4	11	20	30																	
5	14	26	40	55																
6	17	32	50	70	91															
7	20	38	60	85	112	140														
8	23	44	70	100	133	168	204													
9	26	50	80	115	154	196	240	285												
10	29	56	90	130	175	224	276	330	385											
11	32	62	100	145	196	252	312	375	440	506										
12	35	68	110	160	217	280	348	420	495	572	650									
13	38	74	120	175	238	308	384	465	550	638	728	819								
14	41	80	130	190	259	336	420	510	605	704	806	910	1,015							
15	44	86	140	205	280	364	456	555	660	770	884	1,001	1,120	1,240						
16	47	92	150	220	301	392	492	600	715	836	962	1,092	1,225	1,360	1,496					
17	50	98	160	235	322	420	528	645	770	902	1,040	1,183	1,330	1,480	1,632	1,785				
18	53	104	170	250	343	448	564	690	825	968	1,118	1,274	1,435	1,600	1,768	1,938	2,109			
19	56	110	180	265	364	476	600	735	880	1,034	1,196	1,365	1,540	1,720	1,904	2,091	2,280	2,470		
20	59	116	190	280	385	504	636	780	935	1,100	1,274	1,456	1,645	1,840	2,040	2,244	2,451	2,660	2,870	
21	62	122	200	295	406	532	672	825	990	1,166	1,352	1,547	1,750	1,960	2,176	2,397	2,622	2,850	3,080	3,311
22	65	128	210	310	427	560	708	870	1,045	1,232	1,430	1,638	1,855	2,080	2,312	2,550	2,793	3,040	3,290	3,542
23	68	134	220	325	448	588	744	915	1,100	1,298	1,508	1,729	1,960	2,200	2,448	2,703	2,964	3,230	3,500	3,773
24	71	140	230	340	469	616	780	960	1,155	1,364	1,586	1,820	2,065	2,320	2,584	2,856	3,135	3,420	3,710	4,004
25	74	146	240	355	490	644	816	1,005	1,210	1,430	1,664	1,911	2,170	2,440	2,720	3,009	3,306	3,610	3,920	4,235
26	77	152	250	370	511	672	852	1,050	1,265	1,496	1,742	2,002	2,275	2,560	2,856	3,162	3,477	3,800	4,130	4,466
27	80	158	260	385	532	700	888	1,095	1,320	1,562	1,820	2,093	2,380	2,680	2,992	3,315	3,648	3,990	4,340	4,697
28	83	164	270	400	553	728	924	1,140	1,375	1,628	1,898	2,184	2,485	2,800	3,128	3,468	3,819	4,180	4,550	4,928
29	86	170	280	415	574	756	960	1,185	1,430	1,694	1,976	2,275	2,590	2,920	3,264	3,621	3,990	4,370	4,760	5,159
30	89	176	290	430	595	784	996	1,230	1,485	1,760	2,054	2,366	2,695	3,040	3,400	3,774	4,161	4,560	4,970	5,390
31	92	182	300	445	616	812	1,032	1,275	1,540	1,826	2,132	2,457	2,800	3,160	3,536	3,927	4,332	4,750	5,180	5,621
32	95	188	310	460	637	840	1,068	1,320	1,595	1,892	2,210	2,548	2,905	3,280	3,672	4,080	4,503	4,940	5,390	5,852
33	98	194	320	475	658	868	1,104	1,365	1,650	1,958	2,288	2,639	3,010	3,400	3,808	4,233	4,674	5,130	5,600	6,083
34	101	200	330	490	679	896	1,140	1,410	1,705	2,024	2,366	2,730	3,115	3,520	3,944	4,386	4,845	5,320	5,810	6,314
35	104	206	340	505	700	924	1,176	1,455	1,760	2,090	2,444	2,821	3,220	3,640	4,080	4,539	5,016	5,510	6,020	6,545
36	107	212	350	520	721	952	1,212	1,500	1,815	2,156	2,522	2,912	3,325	3,760	4,216	4,692	5,187	5,700	6,230	6,776
37	110	218	360	535	742	980	1,248	1,545	1,870	2,222	2,600	3,003	3,430	3,880	4,352	4,845	5,358	5,890	6,440	7,007
38	113	224	370	550	763	1,008	1,284	1,590	1,925	2,288	2,678	3,091	3,535	4,000	4,488	4,998	5,529	6,080	6,650	7,238
9	116	230	380	565	784	1,036	1,320	1,635	1,980	2,354	2,756	3,185	3,640	4,120	4,624	5,151	5,700	6,270	6,860	7,469
0.	119	236	390	580	805	1,064	1,356	1,680	2,035	2,420	2,834	3,276	3,745	4,240	4,760	5,304	5,871	6,460	7,070	7,700

to resist the overturning tendency caused by the load hanging from the outer end of the boom. Where the surrounding ground is sufficiently firm the proportions of this foundation are about as represented in the drawing. On filled ground, piling or a timber platform beneath the masonry, or both, may be necessary. These questions can only be properly determined by a consideration of the fact in each case. Referring to the drawing, A is the column of the crane, and B the boom carrying the upper block and revolving around the fixed mast or column, A; D is the masonry foundation; E,a heavy iron plate or ring embedded in the masonry near its bottom; FF foun ation-bolts passing through this ring and also through the base of the pillar, A, thus securely fastening the latter to the foundation. The foundation, D, may consist of ordinary rubble masonry, covered with a cap stone, C, the upper surface of which should be dressed smooth to receive the base of the pillar, A. After the completion of the foundation the ground surrounding it should be refilled and thoroughly packed by ramming or puddling, so as to assist the foundation in resisting the strains caused by the crane.

The pillar or column of the crane is of cast-iron, and of simple but symmetrical design, its form being proportioned to the strains it has to resist. It has a broad base, thus giving it a good footing on the foundation and spreading the holding down bolts well apart. Fixed in the head of the column is a steel pin or pivot upon which rests the cross head or yoke. The latter is bushed with bronze and has proper provision for lubrication, so that the cross-head shall always turn freely on the pin. The boom or strut consists of two wrought-iron channel beams, well braced together and united at the upper end by a head casting carrying the upper chain sheaves over which the chain passes to the running-block. The foot of the boom is supported vertically by two suspension rods, hung from the ends of the cross-head, and its upper end or head is held by two guy rods, also extending back to the cross-head. The horizontal thrust at the foot of the boom is transmitted to two turned rollers, placed within the foot casting of the boom and traveling upon a turned path around the base of the column. The weight, both of the boom and load, is entirely carried by a steel pin at the top of the column, and the friction of rotation is thus reduced to a minimum.



The hoisting gear is attached to the boom near the column and rotates with the former. It consists of a train of spur gearing provided with an automatic safety ratchet and with the Weston disc-brake for lowering, substantially as in the jib-crane, so that the load is always self-sustained and cannot run down, nor the handles recoil on the operator. Lowering is effected by turning the cranks backward, the load descending easily and smoothly so long as this motion is continued, but coming to rest if the backward motion be discontinued or the handles let go. Two changes of speed are provided. Swinging or rotation of the crane is effected by pushing or pulling the suspended load, and the construction is such that the maximum load can be easily swung by one man.

This type of crane is designed for yard use where there is no roof or ceiling to support the top of crane, and where guy rods are objectionable. It is particularly adapted to railroad and wharf use, for loading and unloading heavy ordnance from cars or boats, and is a useful addition to the yard appliances of any large foundries. They are constructed for operation by hand, by power, or by direct steam, according to the requirements of the case. See *Cranes*.

PILLENLICHTE. Short cylindrical tubes of laboratory paper, filled with a composition resembling that used in port-fires. A countersink is formed in one end, at the bottom of which is placed a small disk of fulminate covered with a water-proof cap. The entire exterior is varnished. These are used to light the fuses of the life-saving and anchor rockets of the Germans. They are put up in packages of twenty each. The following are the dimensions and weight:

	Inches.	Centimeters.
Total length	1.55	3.93
Exterior diameter	0.625	1.58
Depth of countersink in end	0.1	0.25
Time of burning	Seconds. 45	....
Weight	Grains. 230	....

See *German Life-saving Rocket*.

PILLES.—A name given to arrows in the twelfth century, according to the chronicles of Saint Denis.

PILON.—A half-pike, 7 feet long exclusive of the iron, which was 18 inches. It consisted of a fir tube covered with parchment and varnished. Marshal Saxe proposed to draw up an army four deep, the two front ranks armed with muskets, and the two rear with both pilons and muskets.

PILUM.—A formidable spear used by the Romans. It bore no resemblance to any other weapon of the same class, either lance, pike, or javelin. Each soldier of the legions carried two pila. The weight of the pilum caused it to be regarded rather as a spear than as a dart.

PIN.—A short piece of wood or metal, generally with a head and hole at the other end to receive a key. There are many sorts used in army material. See *Bolt*, and *Linch-pin*.

PINCH.—To *pinch* a gun or other object is to move it by small heaves with a pinch-bar or handspike, without allowing it to turn on its axis. A piece is pinched one end at a time, the other end being chocked. The bar or handspike is placed as a lever, with the beveled side down, and the power applied at the other end by bearing down.

PINCH-BAR.—A stout handspike, of iron, with a round-beveled butt, turned up into a blunt edge for the purpose of catching under a gun or other similar object. It is used as a lever, by pressing down, thus *jumping* the gun forward a very short distance at a time. The butt end is of steel. The length of the bar is from five to seven feet. Those used with the 15-inch gun are of the largest size, and weigh 53 pounds; the shorter size weigh 26 pounds. See *Mechanical Maneuvers*.

PINCHBECK.—An alloy of zinc and copper, in which the proportions slightly differ from those which constitute brass; 3 parts zinc to 16 of copper constitute this material, instead of 1 part of the former to 2 of the latter as in common brass. Pinchbeck, when new, has a color resembling red gold.

PINDAREES.—In the East Indies, plunderers and marauders who accompany a Mahratta army. The name is properly that of persons who travel with grain and merchandise; but war affording so many opportunities and creating so many necessities, the merchants, as it is all over the world, become plunderers and the worst of enemies.

PING.—The whistle of a shot, especially the rifle-bullet in its flight.

PINTLE.—The vertical bolt around which the chassis is traversed. In the center-pintle carriage it is in the center of the chassis, but in the front-pintle carriage it is in the center of the front transom. It is a stout cylinder of wrought-iron inserted in a block of stone, if the battery be a fixed one; or it is secured to cross pieces of timber bolted to a platform firmly embedded in the ground, if it be of a temporary nature. In casemate batteries the pintle is placed immediately under the throat of the embrasure, and the chassis is connected with it by a stout strap of iron, called the *tongue*. Casemate carriages differ from barbette carriages in being much lower, but their mode of construction is essentially the same.

PINTLE-HOLE.—An oval-shaped aperture made in the trail transom of a field-carriage, wider above than below, to leave room for the pintle to play in.

PINTLE-HOOK.—In ordnance, a hook attached to the rear of the limber axle-tree bed of a light field carriage to enable the gun or ammunition carriage to be limbered up to it. In this position the gun forms a counterpoise to the weight that would otherwise rest on the shafts. In heavy howitzers and siege carriages formed with bracket sides, the pintle-hook is either a stiff or movable iron perch, attached to the top of the limber axle-tree, to which the gun carriage is limbered up by a hole passing through the rear transom.

PINTLE-PLATE—A flat iron, nailed to both sides of the bolster, and through which the pintle passes.

PINTLE WASHER.—An iron ring, through which the pintle passes, placed close to the bolster for the trail to move upon.

PIONEER.—A military laborer employed to form roads, dig trenches, and make bridges as an army advances, and to preserve cleanliness in the camp when it halts. Formerly, the pioneers were ordinary laborers of the country in which the army was, impressed for military purposes; but now such persons are only brought in as auxiliaries, a few men being attached to every Corps as a permanent body of pioneers. In the British Army one man is selected, for his intelligence, from every company. These pioneers march at the head of the regiment, and the senior among them commands as Corporal. Instead of a musket each man carries a saw-backed sword, which is at once tool and weapon. Each bears also an axe and two gun-spikes, other necessary tools being distributed among them. There is something rather conflicting between the functions of the pioneers and those of the engineer force.

PIONEER SERGEANT.—In the British service, the Non-commissioned Officer who commands the pioneers.

PIPE BOX.—The cylindrical box in the nave of a wheel in which the axle-tree arm works, and in which is a recess for holding grease. A hard alloy, technically known as "metal," composed of copper, tin, and zinc, is now used as the material for pipe-boxes in preference to cast-iron, on account of the less development of friction between it and the iron arm.

PIPE-CLAY.—A fine clay, free from iron and other impurities, having a grayish-white color, a greasy feel, and an earthy fracture. It adheres strongly to the tongue, and is very plastic, tenacious, and infusible. The localities where it is chiefly obtained are Devonshire, and the Trough of Poole in Dorsetshire. It is also found in various places in France, Belgium, and Germany. This substance is much used by soldiers for the purpose of keeping their buff belts, etc., clean.

PIPER GIN.—In this gin, the windlass is attached by placing it in windlass seats of peculiar construction, and is secured in position by *keepers* attached to the legs. The keepers are placed under the axles of the windlass. Two stay chains connect the pry-pole and legs at the upper brace-bands, and prevent them from spreading. They also serve to connect the parts for transportation. Two braces (upper and lower) connect and secure the legs when the gin is put together, and serve to distinguish the right from the left leg—the long brace being permanently attached to the right and the short brace to the left leg. The clevis and clevis bolt are attached to the head of the pry-pole with keyes which secure the clevis bolt when the gin is assembled; double and single blocks, with fall, are used. This gin was designed by the late Captain J. W. Piper, Fifth artillery.

Length of legs	13 feet 8 inches.
Length of pry-pole	13 feet 8 inches.
Weight of gin	365 pounds.
Weight of windlass	88 pounds.
Weight of block and fall	100 pounds.
Weight of bail and dowels	41 pounds.

The parts are estimated to be sufficiently strong to bear a weight of of 5,000 pounds. The advantages of this gin are, its superior lightness and portability, and its great facility of being assembled, taken apart packed up, and transported. See *Gin*, and *Mechanical Maneuvers*.

PIQUICHINS.—Irregular and ill-armed soldiers, of which mention is made in the history of the reign of Philip Augustus. They were attached to the infantry.

PIRACY.—Robbery on the high seas, and is an offense against the Law of Nations. It is a crime not against any particular State, but against all mankind, and may be punished in the competent tribunal of any country where the offender may be found, or into which he may be carried, although committed on board a foreign vessel on the high seas. It is of the essence of piracy that the pirate has no commission from a Foreign State, or from one belligerent State at war with another. Pirates being the common enemies of all mankind, and all Nations having an equal interest in their apprehension and punishment, they may be lawfully captured on the high seas by the armed vessels of any particular State, and brought within its territorial jurisdiction for trial in its tribunals. The African slave-trade was not considered piracy by the Law of Nations; but the municipal laws of the United Kingdom and of the United States by statute declared it to be so; and since the treaty of 1841 with Great Britain, it is also declared to be so by Austria, Prussia, and Russia.

PIRAMETER.—An instrument for measuring the power required to draw a gun carriage, etc., upon a road or track. See *Dynamometer*.

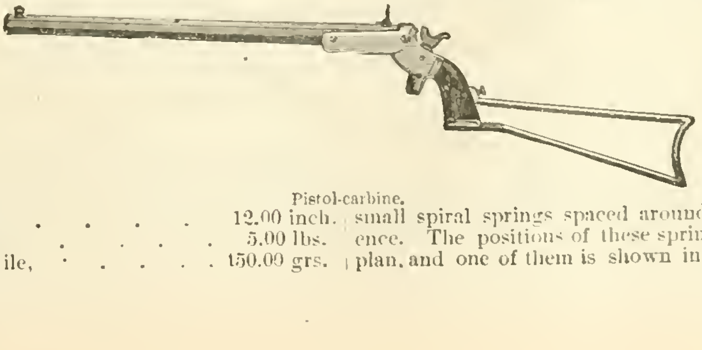
PIRATES.—Men, or squads of men, who commit hostilities, whether by fighting or inroads for destruction or plunder, or by raids of any kind, without commission, without being part and portion of the organized hostile army, and without sharing continuously in the war, but who do so with intermitting returns to their homes and avocations, or with the occasional assumption of the semblance of peaceful pursuits, divesting themselves of the character or appearance of soldiers—such men, or squads of men, are not public enemies, and, therefore, if captured, are not entitled to the privileges of prisoners of war, but shall be treated summarily as highway robbers or pirates.

PIRSCHER SYSTEM OF FORTIFICATION. In this system, the enceinte is circular, and the ditch is occupied by two lines of works mutually flanking each other. The covered way and glacis are replaced by advanced works.

PISA REVETMENT.—A wall of clay built against a slope in the following manner: Common earth, mixed with clay and moistened with water, is kneaded until the particles will adhere when pressed or squeezed together. Sometimes chopped straw is mixed in the mass. A row of pickets, with the proper inclination given to them, is driven along the foot of the interior slope, the tops extending a short distance above the height marked for the interior crest. A shallow trench about twelve inches wide is dug in the parapet, behind the line of pickets, and a board laid horizontally on edge on the side next to and supported by the pickets. The tempered clay is then placed in the trench and rammed. Successive layers are placed in until the clay reaches the top of the board, the earth of the parapet being carried up simultaneously with the revetment. A second board is then placed upon the first, and the clay rammed in, rising simultaneously with the parapet as in the first course; and this process is continued until the top layer is on the same level with the interior crest. When the clay has dried, the boards and pickets are removed.—See *Revetment*.

PISTOL.—The smallest description of fire-arm, and is intended to be used with one hand only. Pistols vary in size from the delicate saloon-pistol, often not six inches long, to the horse-pistol, which may measure eighteen inches and sometimes even two feet. They are carried in holsters at the saddle-bow, in the belt, or in the pocket. Every cavalry soldier should have pistols, for a fire-arm is often of great service for personal defense, and almost indispensable for giving an alarm or signal. Sailors, when boarding an enemy's ship, carry each two in their waist-belts. As early as the reign of Henry VIII. the English cavalry carried clumsy pistols called "Dags." The latest improvement on the pistol is the revolver. The *pistol* probably derives its name from the word *pistallo*, which means "pommel," and not from the word *Pistoja*, for it appears not to have been first made at Pistoja, but at Perugia.

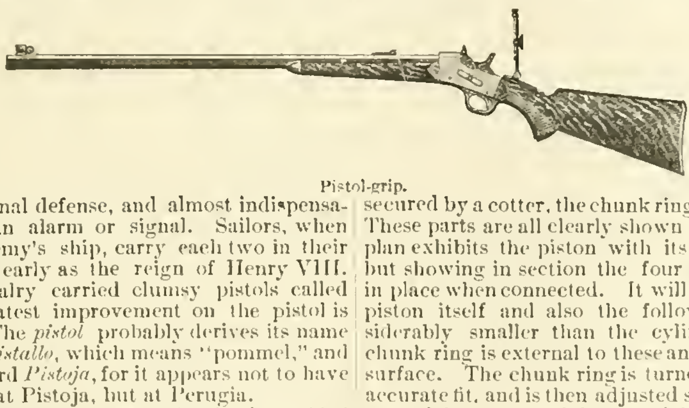
PISTOL CARBINE.—A horseman's pistol provided with a removable butt-piece, which may be secured to its stock by a spring-catch, or detached, so that the weapon may be fired either from the hand or the shoulder. The pistol-carbine used in the United States, and particularly suited to the service of light artillery, has the following particulars:



Pistol-carbine.

Length of barrel,	12.00 inch.
Weight complete,	5.00 lbs.
Weight of projectile,	150.00 grs.
Weight of powder,	40.00 grs.
Initial velocity,	603.00 feet.

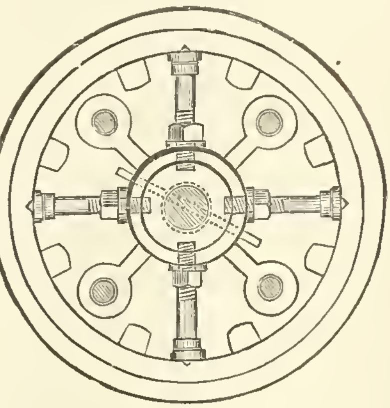
PISTOL GRIP.—A shape given to the small of the stock in shot-guns and rifles, to give a better hold for the hand. The pistol-grip has of late become quite popular and nearly all the recent models of sporting arms embody it. See *Pistol-carbine*.



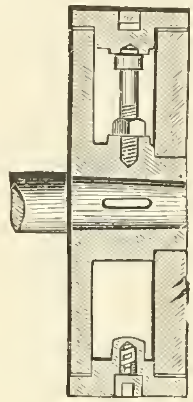
Pistol-grip.

PISTON. A device so fitted as to occupy the sectional area of a tube, and be capable of reciprocation by pressure on either of its sides. It may be of any shape corresponding accurately to the bore of the tube; but the cylindrical form is almost exclusively employed for both, as in the common pump and steam-engine. One of its sides is fitted to a rod, to which it either imparts reciprocatory motion, as in the steam-engine, or by which it is itself reciprocated, as in the pump. In the former case it is termed solid, though generally not really so; but in the latter, an aperture controlled by a valve permits the passage of the fluid from one side to the other during its downward movement. The piston usually requires "packing" to cause it to fit closely within its cylinder, and at the same time allow its free backward and forward motion. For this purpose its ends are usually formed by two connected discs, or have a deep annular groove between them for receiving the packing material, which may be hempen cord wound around it, or other somewhat expansible substance, which will not wear too rapidly nor cause excessive friction. In modern practice, metallic rings, cut through at one side, so that their expansion may compensate for any wear, are largely employed in the steam-engine.

The cut on page 530 shows the plan and section of the Cummer piston. It is made large enough to give ample wearing surface, and with sufficient weight and careful distribution of metal, to secure strength, no extra weight being given for any other purpose. The piston consists of three parts, the piston proper, to which is fitted the tapered end of the piston rod secured by a cotter, the chunk ring, and the follower. These parts are all clearly shown in the section. The plan exhibits the piston with its follower removed but showing in section the four bolts which hold it in place when connected. It will be noticed that the piston itself and also the follower are made considerably smaller than the cylinder, and that the chunk ring is external to these and forms the bearing surface. The chunk ring is turned up so as to be an accurate fit, and is then adjusted so as to be perfectly central by means of four stud bolts, which appear in the plan and section; their outer ends have a conical point which bears against the chunk ring, while the other ends are tapped into the boss of the piston and are provided with jam nuts. The center of the chunk ring is grooved to receive the cast-iron piston ring which is pressed well outwards by several small spiral springs spaced around the circumference. The positions of these springs appear in the plan, and one of them is shown in the section. An additional packing is provided by turning two small grooves in the chunk ring on either side of the central piston ring. The advantage of using a chunk ring is, that we can make a very exact fit, and by using the central adjustment, secure perfect alignment, and we obtain a greater wearing surface for the same thickness of piston because the chunk ring is the same width as the piston itself and bears over its whole surface, whereas in the ordinary form a



Plan.



Section.

part of the piston, and the follower also, are turned down below size and do not bear at all. By this arrangement, also, whenever after long wear it becomes necessary to rebore the cylinder, we have only to turn up a new chunk ring instead of fitting up a whole new piston. See *Steam-engine.*

PISTOS.—Broad, short, double-edged swords of the fifteenth century, which do not differ materially from the *anelaces.*

PIT.—The pit, in gun-casting, is usually a circular well, nineteen feet deep, and twelve feet in diameter; the walls are of brick, and the bottom, an iron tank of one-half inch sheet-iron, extending upwards eight feet. The mouth of the pit is provided with iron covers, made to fit closely to prevent escaping of heat from the fire built around the flask. During the casting, the gas which is generated and passed out through the holes in the flask is ignited by dropping small quantities of molten metal into the pit, and as soon after "cast" as possible, a fire is built in the pit, about the bottom of the flask—wood and bituminous coal being used in sufficient quantities to burn four or five days; the mouth of the pit being covered, after the mass is thoroughly ignited. See *Molding.*

PITAUX.—This term, sometimes written *Petaux,* was formerly used to distinguish those peasants who were pressed into the service, in contradistinction to soldiers who were regularly enlisted.

PIT-BURNED CHARCOAL.—This description of charcoal is used in the manufacture of what is known as "pit gunpowder," and is found to be more suitable for filling fuses, port-fires, etc., than that made from retort-burned charcoal; it is also used for pyrotechnic compositions and other purposes of a similar kind. Charring the wood in a pile covered up with straw and sods is found to produce a charcoal which will give to the gunpowder the peculiar qualities required for the before-mentioned purposes; the process employed is as follows: The wood is built up in a cone about 10′ in diameter at the base and from 5′ to 7′ in height, a vertical hole being left in the center of the pile or cone reaching from the bottom to the top, so as to act as a chimney. The wood is then entirely covered over with a layer of straw from 4″ to 5″ in thickness, then a covering of charcoal refuse or sweepings from the store, if such can be obtained, and over all a covering of sods with the grass side inwards. The pile is now fired by a few pieces of lighted charcoal being dropped to the bottom of the vertical hole or chimney (which is afterwards closed at the top), and the process of charring commences, beginning at the center and spreading all round until the whole pile is charred. A shifting screen is generally employed so as to regulate the draught on the windward side, and small holes are made through the sods with a half-inch iron rod, these allow the vapor to escape and draw the fire to any side of the pile that may be desired. From seventy to eighty hours are required to char the whole mass, and as the charcoal produced by this process contains more of the woody fiber than the cylinder retort-burned charcoal, it consequently burns more slowly, is heavier, has a reddish tinge, is not so brittle, and has a more metallic sound when dropped. See *Charcoal.*

PITCH.—A thick substance obtained by boiling down tar to the requisite consistency, either by itself or combined with a portion of rosin; it becomes solid on cooling, but is soon softened by the heat of the hand, in which state it is very adhesive. When of good quality, it is clear and hard. It is used in making carcasses, light-balls, kit, and smoke-balls.

The term is also used in wheel-work, signifying the distance between the centers of two contiguous teeth. *Pitch-line* is the circle concentric with the circumference which passes through all the centres of the teeth.

What is known as the *pitch of a screw* is the interval between the points of starting and of arrival of a complete revolution of a screw, and consequently of the thread of a screw, which is traversed by the screw, or its thread, when it has completed an entire revolution. The pitch is therefore independent of the diameter of the screw.

In rifling, the *pitch* is described as term resistance of the direct progressive motion of the projectile through the bore. This resistance varies according to the incline as well as the pattern of rifling; for as the more defined the pattern the more the resistance, so the sharper the pitch the greater the rotation of projectile around the axis of progression, and consequently the more difficult its initial and the slower its direct forward motion There are two natures of pitch, an increasing and decreasing pitch. See *Twist.*

PITCHED BATTLE.—A battle in which the hostile forces have firm or fixed positions, in distinction from a skirmish. See *Battle.*

PITCHED FASCINE.—Pitched fascines are fagots of dry twigs, covered over with an incendiary composition, and used to set fire to buildings or to light up a work. The following materials and utensils are required to make pitched fascines: *Dry branches,* about .5 inch diameter, or other light, combustible wood; *iron wire,* about .05 inch diameter; *four pickets,* about 40 inches long and $1\frac{1}{4}$ inch diameter; *cylindrical sticks,* 20 inches long, $1\frac{1}{4}$ inch diameter; 2 *trace-ropes;* 1 *rope* for a capstan; 2 *levers;* 1 *small* *cord*; 1 *flat punch*; 1 *saw*, or *bill-hook*; 1 *block*. To make the fascines, form two crotches, 1 foot apart, with the 40-inch pickets; cut the branches 20 inches long, and tie them in the middle of their length, and about 2 inches from their ends, with annealed wire, and place in the axis a cylindrical stick, intended to preserve a vacant space; draw the branches tightly together, that they may hold the composition better, and cut off the ends square.

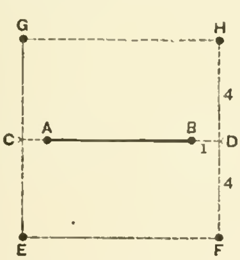
The fascines receive two coats of composition, when pitched. For the first coat, melt 20 parts of pitch and one of tallow in the pots, filling them not more than half full. Having first well oiled the cylindrical stick, plunge the fascine into the liquid with the fork, first one end and then the other, each time pouring on the upper end two ladlefuls of the composition. Let the composition harden, holding the fascine over the pot, turning it slowly and then immerse it in the tub of water. The assistant, with his hands covered with oil, fashions the fascine, rolling it on the bottom of the tub, and places it on the planks.

The second coat is put on 24 hours after the first; it is composed of equal parts of pitch and rosin melted and mixed together in the pot. The cylindrical stick is taken out, and the fascine immersed in the composition, as with the first coat; it is permitted to drip, and is then laid in saw-dust and powdered all over with it. A fascine requires about 1.1 pound of each composition. Fascines should be primed only a short time before being used. For this purpose, dip each end, for a distance of half an inch, into a kettle holding melted rock-fire.

When used for incendiary purposes, fascines are placed in piles, and pieces of quick-match and portfire scattered over them, to make the whole mass take fire at once. See *Fireworks*.

PITCHING FIRE.—Fire is pitching when the shot is projected against an object, covered in front by a work or obstacle, the ordnance being fired at full charge.

PITCHING TENTS.—There is an art in pitching a tent, and the men of a regiment should be instructed from time to time how to pitch their tents and to strike them ready for a march; but they will soon come to know how to do so, even if they have had no previous experience, when once they enter on camp life. The following is the proper method of pitching the ordinary wall tent: After selecting a suitable spot, place the ridge pole, *A B*, upon the ground, approximately beneath its place when in position. Drive pins at *A* and *B*. From *A* and *B*



continue *A B* to *C* and *D*, by stepping one pace from each end. From *C* and *D* make four paces at right angles with *C D* on each side, and determine the points *E*, *F*, *G*, *H*. At these points drive the corner tent pegs. By following these directions the tent may be promptly pitched and will make a beautiful appearance, every portion of canvas being in proper position and free from wrinkles. An important point to be observed in pitching a tent is not to dig inside but outside of it, viz., to use such means, in case of rain, that water shall not flood the tent. This, however, cannot always be prevented, but a drain dug all round the tent to the lowest ground may save a flooding. Then, again, to secure a tent from being blown down, the corner ropes should be bushed.

PITS.—Military pits, whether round or square, should be so arranged as to cause an advancing enemy as much delay and annoyance as possible. They are usually made about six feet in diameter at top, and about one foot at the bottom, and are placed so that the centers shall be about ten feet apart. They shall be placed in rows, at least three in number, the pits being in quincunx order. The earth obtained by the excavation, should be heaped up on the ground between the pits. Shallow pits should not be deeper than about two feet, so that the enemy could not obtain shelter by getting in them. They should cover the ground in zig-zag arrangement, the upper bases being made square or rectangular in form, and in contact with each other. The side of the upper base should be made about equal to the depth of the pit. The earth obtained from the holes is thrown in front of the arrangement, making a glacis. See *Trous-de-loup*.

PIVOT.—The soldier or guide upon whom a line of troops wheels,or partly wheels. The pivot is either *fixed* or *movable*.

In a wheel on a movable pivot the radius is:

For a column of files	2 yards.
For a column of twos, fours, or double column of fours	3 "
For a platoon	6 "
For a company	12 "

PIVOT BOLT.—The axis of horizontal oscillation. A traversing platform passing through the pivot transom and the front sleeper of the platform.

PIVOT FLANK.—When a regiment is drawn up in column right in front that is, when the company which stood on the right, when in line, is in front the left-hand man will be the pivot flank of each company. When the column is left in front, the right-hand man will be the pivot flank of each company.

PIVOT GUN.—A cannon which turns on a pivot in any direction.

PLACAGE.—In fortification, a kind of revetment, which is made of thick, plastic earth laid along the talus of such parapets as have no mason-work, and which is covered with turf.

PLACATES.—In ancient armor, small plates placed in front of the shoulders.

PLACE DU MOMENT.—When the operations of an army render it necessary that a position should be fortified and occupied for the whole campaign, the works assume more importance, and many consist of forts having five or six bastioned fronts. Such a fort is called a *place du moment*.

PLACES-OF-ARMS.—The covered-way, from the direction given to the counter-scarps of the enceinte and outworks, forms a line of communication with salient and re-entering parts. The salient portions are termed *salient places-of-arms*; and the re-entering parts the *re-entering places-of-arms*.

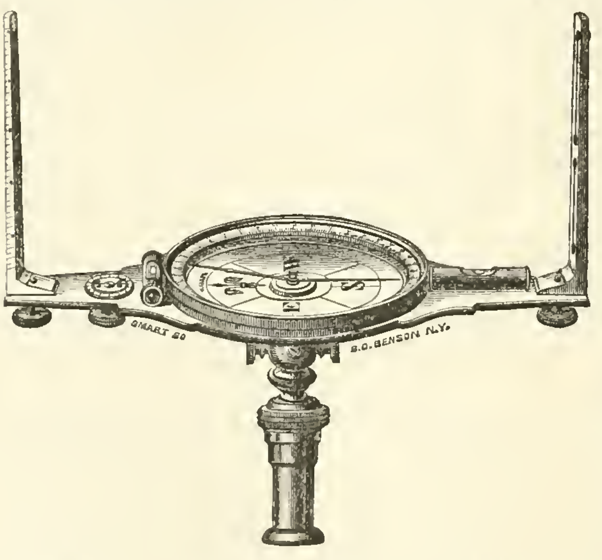
The salient places-of-arms result from the general plan of the covered way; but the re-entering places-of-arms are formed by changing the directions of the two branches where they form the re-enterings, so as to make a salient within the re-enterings; thus enlarging the covered-way at these points, and producing a flanking arrangement, by which the glacis can be swept, and a cross-fire be brought to bear on the ground in advance of the salients. See *Outworks*.

PLAID.—A woolen shawl of a tartan pattern, worn over the shoulder by the Scotch Highlanders, and still worn by Highland regiments.

PLAIN.—In geography, an extensive tract of country which, on the whole, preserves a nearly uniform elevation. When referred to the level of the sea, plains may be distinguished into low plains or low-lands, and elevated plains called plateaux or *table-lands*. Plains differ much in appearance, according to the nature of their soil and the climate, from the frightful sandy wastes of Africa, to the luxuriant fertility of the South American silvas. They are occasionally crossed by hills of moderate altitude, which, however, are generally detached, and exhibit no connection with any neighboring mountain system. These hills often, as in the North American Plains degenerate into mere undulations, quite uniform in structure. The term "Plains" is, in a limited sense, confined to the Plains of Western Europe; those of other parts of the world receiving special designations, and differing from each other in many important points thus we have the *Steppes* of Eastern Europe and Asia: the *Deserts* of Arabia and Africa; the *Savannahs* and *Prairies* of North America; and the *Llanos, Pampas* and *Silvas* of South America. The chief Plains of Europe are, the country stretching from the foot of the Carpathians in Galicia to the Ural Mountains, including Poland and Russia, the drainage area of the Danube in Hungary, and the portion of Europe which is bounded by the Elbe, the Hartz mountains, France, and the sea. Plains of comparatively small extent, but presenting the necessary characteristics in perfection, are found in almost all countries.

PLAIN CLOTHES.—A citizen's every-day dress, as applied to an officer not in uniform; this dress is also known by the familiar name of *mufti.* It is left to the discretion of General Officers Commanding, to permit the use of plain clothes for the purpose of recreation; otherwise all Officers must appear in uniform in camp or quarters, or when attending public balls within the district in which they are quartered.

PLAIN COMPASS.—The plain compass, as shown in the drawing, has a 6-inch needle, and is furnished with levels, sight-vanes, socket, etc. The compass-box is in the same piece with the main plate, and the



instrument is used mainly in the surveys of new lines, or in the preparation of maps, where the variation of the needle is not required. To adjust the compass, first bring the bubbles into the center, by the pressure of the hand on different parts of the plate, and then turn the compass half-way around; should the bubbles run to the end of the tubes, it would indicate that those ends were the highest; lower them by tightening the screws immediately under, and loosening those under the lowest ends until, by estimation, the error is half removed; level the plate again, and repeat the first operation until the bubbles will remain in the center, during an entire revolution of the compass. The sights may next be tested by observing through the slits a fine hair or thread, made exactly vertical by a plumb. Should the hair appear on one side of the slit, the sight must be adjusted by filing off its under surface on that side which seems the highest. The needle is adjusted in the following manner: Having the eye nearly in the same plane with the graduated rim of the compass-circle, with a small splinter of wood or a slender iron wire, bring one end of the needle in line with any prominent division of the circle, as the zero, or ninety degree-mark, and notice if the other end corresponds with the degree on the opposite side; if it does, the needle is said to "cut" opposite degrees; if not, bend the center-pin by applying a small brass wrench, furnished with the compasses, about one-eighth of an inch below the point of the pin, until the ends of the needle are brought into line with the opposite degrees. Then, holding the needle in the same position, turn the compass half-way around, and note whether it now cuts opposite degrees; if not, correct half the error by bending the needle, and the remainder by bending the center-pin. The operation should be repeated until perfect reversion is secured in the first position. This being obtained, it may be tried on another quarter of the circle; if any error is there manifested, the correction must be made in the center-pin only, the needle being already straightened by the previous operation. When again made to cut, it should be tried on the other quarters of the circle, and corrections made in the same manner until the error is entirely removed, and the needle will reverse in every point of the divided surface.

In using the compass, the Surveyor should keep the south end towards his person, and read the bearings from the north end of the needle. He will observe that the E and W letters on the face of the compass are reversed from their natural position, in order that the direction of the line of sight may be correctly read. The compass-circle being graduated to half-degrees, a little practice will enable the surveyor to read the bearings to quarters or even finer—estimating with his eye the space bisected by the point of the needle, and as this is as low as the traverse table is usually calculated, it is the general practice. Sometimes, however, a small vernier is placed upon the south end of the needle, and reads the circle to five minutes of a degree—the circle being in that case graduated to whole degrees. This contrivance, however, is quite objectionable on account of the additional weight imposed on the center-pin, and the difficulty of reading a vernier which is in constant vibration; it is therefore but little used.

To take angles of elevation.—Having first leveled the compass, bring the south end towards you, and place the eye at the little button, or eye-piece, on the right side of the south sight, and with the hand fix a card on the front surface of the north sight, so that its top edge will be at right angles to the divided edge, and coincide with the zero mark; then sighting over the top of the card, note upon a flagstaff the height cut by the line of sight; then move the staff up the elevation, and carry the card along the sight until the line of sight again cuts the same height on the staff, read off the degrees and half-degrees passed over by the card.

For angles of depression, proceed in the same manner, using the eye-piece and divisions on the opposite sides of the sights, and reading from the top of the sights. When the instrument is to be used in making new surveys, the vernier should be set at zero and securely clamped by screwing up the nut beneath the plate. In surveying old lines, the change of the variation of the needle should be ascertained by setting the compass on some one well-defined line of the tract, and making the bearing to agree with that of the old survey, by moving the circle as already described. Then the circle can be clamped, and the old lines retraced from the bearings given by the original Surveyor. When the variation of the needle is known,it can be easily set off by the vernier, and the compass used to run a true meridian by the needle.

A little caution is necessary in handling the compass, that the glass covering be not excited by the friction of cloth, silk, or the hand, so as to attract the needle to its under surface. When, however, the glass becomes electric, the fluid may be removed by breathing upon it, or touching different parts of its surface with the moistened finger. An ignorance of this apparently trifling matter has caused many errors and perplexities in the practice of the inexperienced Surveyor.

The railroad compass is an instrument of the highest grade, in which by the addition of a divided limb and verniers the Surveyor is enabled to take angles, and run lines unaffected by the imperfections of the magnetic needle.

The vernier compass has a neat compass-circle, to which is attached a "vernier," movable about a common center a short distance in either direction, thus enabling the Surveyor to set the zeros of the circle at any required angle with the line of sights; the number of degrees contained in this angle or the "variation of the needle" being read off by the vernier. See *Solar Compass*.

PLAN.—The representation on paper,on a reduced scale, by means of conventional signs and process, of any portion of the earth's surface. In fortification, a plan shows the tracing, also the horizontal lengths and breadths of the works, the thickness of the ramparts and parapet, the width of the ditches, etc. It exhibits the extent, division, and distribution of the works, but the depth of the ditches and the height of the works are not represented in the plan. See *Plan of Campaign*, and *Plan of Defense*.

PLANE.—1. A surface without curvature, and the test of it is, that any two points whatever being taken in the surface, the straight line which joins them lies wholly in the surface. When two planes cross or intersect one another, their common section is a straight line; and the inclination of the planes to each other is measured by taking any point in their common section, and drawing from it two straight lines, one in each plane, perpendicular to the common section: the angle contained by these lines is the angle of inclination of the planes. When the angle is a right angle, the planes are perpendicular to each other.

2. A tool used for rendering the surface of wood smooth and level. It consists of an oblong block of wood or metal (the latter has only recently come into use), with an opening through the center; this opening is square on the upper side, and is always large enough to admit the cutting instrument; it diminishes down to a mere slit on the under side, just wide enough to allow the cutting edge of the plane-iron and the shaving of wood which it cuts off to pass through. The essential part of the tool is the plane-iron, a piece of steel with a chisel-shaped edge, and a slot in its center for a large- headed screw to work and to attach to it a strengthening plate. They are held in place by the hard-wood wedge. By driving in the wedge, the irons are held very firmly in their place, and they are so adjusted that only the fine sharp chisel-edge of the cutting-tool projects through the slit in the bottom of the body of the plane, so that when the tool is pushed forward by the force of the hand, the cutting edge pares off all irregularities, until the wood is as smooth as the under surface of the plane. There are many modifications in this tool, which can have its cutting edge and under surface made to almost any contour, so that mouldings of all kinds may be made. The two commonest are the jack-plane for rough work, and the smoothing-plane for finishing off plane surfaces. See *Planing-machine*.

PLANE OF COMPARISON.—A plan of a fortress, and of the surrounding country, on which are expressed the distances of the principal points from a horizontal plane, imagined to pass through the highest or lowest points of ground, in the survey. This imaginary plane is called a plane of comparison.

PLANE OF DEFILEMENT. A plane, which containing the interior crest of a work, passes at least eight feet above those points to be sheltered, and at least five feet above the ground which can be occupied by an enemy within cannon range. The amount of space in rear of a parapet which is required to be defiladed, depends upon circumstances. In some cases, the entire space enclosed, and in others only a part, is to be protected from this fire from a commanding height. Thus, it is usual to require that the whole interior space of an enclosed work should be defiladed; that the interior as far as the gorge should be defiladed for a half-enclosed work; and that so much of the interior,or so much of the terreplein behind the parapet as may be necessary for the free movements of the defense, should be defiladed in open works or lines.

It is not convenient in practice to place the eye at a distance of eight feet from the ground, nor is it an easy thing to judge, from a distance, what should be the position of a point which shall be five feet above the ground. The method used is to place the eye at a convenient distance from the ground, observe the highest point of the top of the hill, and determine the position of a visual plane tangent to the hill. Knowing the position of this visual plane, a second plane is passed parallel to it and five feet above it. The tangent visual plane is known as the rampant plane, and the plane parallel to it is the plane of defilement. The position of the rampant plane and the plane of defilement may be fixed as follows: To illustrate the method, a redan is supposed to be the field work which is to be built, upon a position commanded by a neighboring height, and that the salient and extremities of the faces are marked by upright poles planted in the ground. The trace marked, the next step is to profile the work, and this requires the height of the interior crest to be determined. Two stakes, at a convenient distance apart, are erected upon the gorge line; if not too far apart, the poles already erected to mark the extremities of the faces may be used. A line, three feet from the gronnd, is marked by a strip of wood having a straight edge,or by a cord tightly stretched, and fastened to these uprights. An observer is placed in rear of this line; he sights along it and tangent to the hill, and determines where the visual plane containing this line cuts the pole placed at the salient. This point is carefully marked, and with the line joining the two uprights on the gorge line, fixes the position of a plane tangent to the hill and three feet above the ground at the gorge. If on the three posts, points be marked, five feet above the points of intersection of the posts by the rampant plane, these will be points of a plane which will pass eight feet above the gronnd at the gorge and five above the ground at the top of the hill. If the faces of the redan are held in this plane, the whole interior of the redan will be defiladed from this hill, and the last plane determined will be the plane of defilade, or defilement. The extremities of the faces at the gorge have parapets of the ordinary height, viz., eight feet; the parapets from these points, increase in height nntil the salient is reached, where the height is the greatest. The height of the interior crest can then be determined, at the points where the profiles are to be placed. The site being level, there is no reason why any one part of the interior crest should be higher than another. It is nevertheless the practice, even in this case, to give additional height to the parapet at a salient, not for the purposes of defilading the interior, but to lessen the effect of any enfilading fire which an enemy might obtain upon the faces, and to allow for the descent of the trajectory of a projectile which might graze the interior crest at the salient.

A slight deviation from the method just described is made when the work to be defiladed is a lunette, instead of a redan. Two uprights, about twelve feet apart, are planted upon, and near the center of, the gorge line. A third upright is placed in front of the gorge and ten or twelve feet from it upon the line joining the center of the gorge line with the salient. The points are then marked where the rampant plane, three feet above the ground, cuts these three uprights and the uprights planted at the salient, and at the shoulders. A distance of five feet is marked above the points just determined, and this will fix the position of the plane of defilade for the lunette. See *Defilement*, *Direct Defilement*, and *Reverse Defilement*.

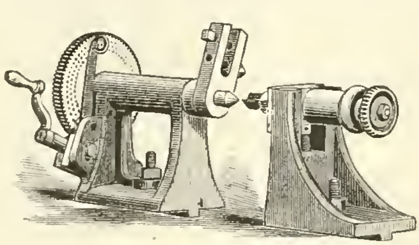
PLANE OF FIRE.—In Gunnery, a vertical plane through the line of fire. See *Pointing*.

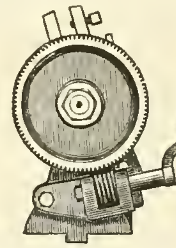
PLANE OF SIGHT.—In Gunnery, a vertical plane through the line of sight. See *Pointing*.

PLANE OF SITE.—The general level of the ground, or ground line, upon which the works are constructed, is called the plane of site, whether that plane be horizontal or oblique to the horizon.

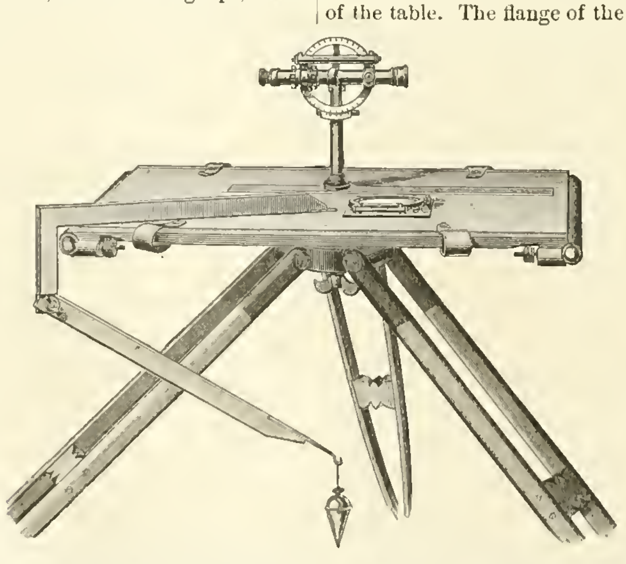
PLANE OF SYMMETRY.—In artillery, an imaginary plane everywhere bisecting the space between the two cheeks of a gun carriage.

PLANER-CENTERS.—Devices for supporting small work on the bed of a planing-machine. One of the two is provided with a worm and worm-wheel, by which the work may be rotated, so as to present each face in succession to the cutter; the other has





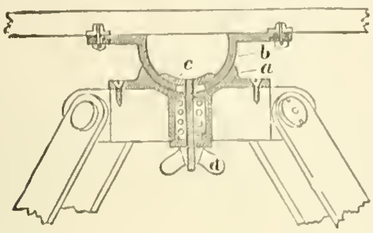
an inclined plane by which the slope of the work is regulated so as to give a taper, if required. The drawing shows an improvement in the device for dropping the worm out of gear, as in many cases it is not needed, thereby saving time. The dials are so drilled that they are calculated to plane any shape that is generally required, and for fluting taps, reamers, etc.



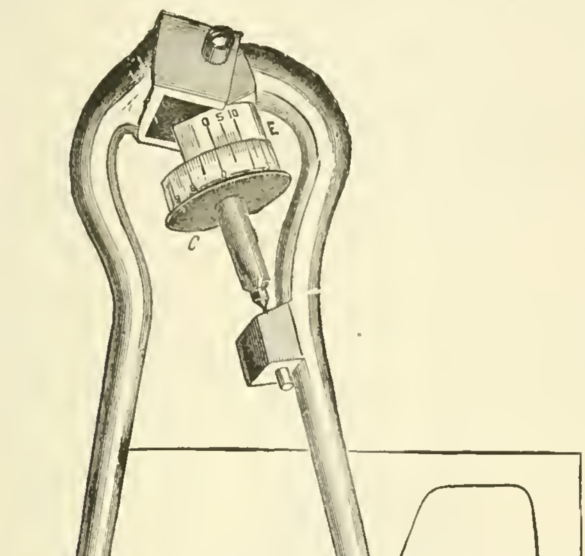
PLANE TABLE.—Plane tables may be used to determine distances and to note the fall of projectiles in target-practice or firing for ranges; also in topography and map drawing. As shown in the drawing, the plane table consists mainly of a drawing-board set upon a very firm tripod, and having upon its upper surface a movable straight edge or *alidade*, arranged either with sight-vanes or telescope, by which it may be directed to any given point, the line being then drawn on the paper along the edge of the alidade. A rectangular plate of brass to which is attached a small compass and two spirit-levels, is also shown, and serves both to level the table and when applied by the edges parallel to the zero points of the compass circle, to determine the magnetic bearing of the lines drawn on the paper, or the direction of the table itself. The table is made of wood arranged in sections so as to prevent warping, and has an adjustable wooden roller at each end by which the paper is brought down snugly to the board, or upon which a long sheet can be rolled and unrolled at will. In place of the rollers, sometimes, and often in combination with them, a number of brass clamps as shown are used in holding the paper firmly. The plumbing arm shown in the figure has its end brought to a point, that it may be set at any given point on the paper, the plummet hanging from the under arm determining the corresponding point on the ground; the lower arm moves upon a hinge, an index on the side showing when the ends of the two arms are plumb with each other as applied to the table.

The construction of the socket and tripod-head is shown in the drawing on page 535, in which *a* represents the hemispherical concave metal cup fastened by six screws to the wood top of the tripod, *b* the upper or convex part fitting nicely into the cup and clamped to it at will by the clamping piece *c* and nut *d*; a strong spiral-ring in the hollow cylinder between *c* and *d*, serves to hold the two spherical surfaces of the socket together, and allow of the easy movement of the one within the other in the leveling of the table. The flange of the socket *b* supports the table and is connected with its under surface by three segments of brass, two of which are shown at *e e*; these are brought down firmly upon the shoulder of the flange by capstan-head screws as shown, or released at will, thus allowing the plane table to be moved horizontally when desired. A set of three leveling-screws is sometimes added for more accurately leveling the table, but ordinarily the pressure of the hand upon it with the socket alone will be all that is required. When desired, a tangent movement in azimuth may also be added.

When estimating distance, if the target is on the water, a point along the shore, the distance of which



from the battery has been ascertained, is selected so that a line drawn from it towards the place where the first grazes are expected to occur will be at right angles to the line of fire, or nearly so: here one of the plane tables is placed. The other is situated as nearly in line with the target and battery as convenient; sufficiently removed, however, not to be in-



convenienced by the smoke. The two stations should be so situated that lines drawn from them to the target will be nearly at right angles to each other. Their distances from each other and from the battery are known. The table is adjusted with the small metal plate over the stake that marks the station, and leveled. The observer places his alidade on the pivot-pin, sights carefully on a given point at the battery, and marks on the paper affixed to the table the direction assigned by the beveled edge of the ruler. The direction of the other station is noted in the same way, as is also the target and any stakes which may be placed in the line of fire. When the cannon is ready to fire, a preparatory signal is hoisted at the battery; seeing this, the observer points the alidade in the expected direction of the first graze. The signal is lowered and the gun fired. The instant the jet takes place, the sights of the alidade are aligned upon it, and the direction indicated by the beveled edge of the ruler marked upon the paper. The line connecting the two stations is a base from which is determined the position of the point struck and of the battery. The projection of this base on any scale will enable one to ascertain in terms of that scale the distances desired. After the firing, the tables are returned, the observations made on one table transferred to the other, and the intersections of the lines locate the positions of the points struck. See *Alidade*.

PLANIMETER.—An instrument for ascertaining the contents of all irregular plane figures. More than thirty years ago, Oppikoffer, of Berne, invented an instrument of this description, which seemed to fulfill all the requirements of the case; but its cost and the practical difficulties attending its use prevented its general adoption. More recently, Amsler-Laffon, of Schoffhausen, devised a simpler and much less costly instrument of the kind, which was exhibited at the Paris Exposition of 1867. The principle of each is nearly the same, the area being measured by a roller of given surface, the number of revolutions of which are indicated by a disc. The drawing shows the Amsler polar planimeter, which, in addition to the ordinary requirements of the instrument, is well adapted for measuring the area of *indicator diagrams*. To use the instrument, press the point A slightly into the paper, not clear through, in such position that the tracer B will follow the desired line without bringing the roller C against any projection. The roller must move on a continuous flat surface. It is also well to fasten the diagram to a drawing-board, or some other flat surface, by means of pins or springs, to prevent it from slipping. Mark a starting point at any point on the outline of diagram D, set the tracer on that point, and place zero on the roller so it exactly coincides with zero on the vernier E. Now trace the line, moving in the direction traveled by the hands of a watch, stop at the starting point and take the reading. 1st. Find the highest figure on the roller that has passed the zero on the vernier, moving to the left, which we will assume to be 4; now the construction of the instrument is such, that each figure on the roller represents an equal number of square inches. 2d. Find the number of *completed* divisions between four on the roller and zero on the vernier, which we will assume to be 5. 3d. Find the number of the mark on the vernier which coincides with some mark on the roller, which in this case may be 6. We now have the exact reading, $4\frac{56}{100}$ inches area. In measuring diagrams of more than 10 inches area, add 10 to the result.

To those who are familiar with the instrument, it is not necessary to place the zeros together; but take the reading as it is, and subtract it from the result. Should the second reading be less than the first, add 10 to the second reading before making the subtraction. If the area to be measured is very large, divide it by lines into areas of less than 20 square inches, and take separate measurements. If the drawing is to a scale, multiply the result by the square of the ratio number of the scale. In using the Planimeter for indicator diagrams, and for which it is *specially* adapted, we find the area of the diagram, according to the foregoing directions, which we will assume to be 2.48; we now measure the length of the diagram parallel with the atmospheric line, which we will say is this case is 4 inches. Now divide the area by the length; the quotient is the mean, or average height of the diagram, in inches, which is .62 inches: this we multiply by the scale of the indicator, which we will assume to be 40; the product gives us 24.8 lbs. mean pressure on each square inch of the piston.

PLANING-MACHINE.—Planing-machines have recently been much in use, by which both wood and metal are planed. In the case of those intended for wood, the cutting instruments are moved forward over the wood by machinery in the same manner as in the hand-plane. The precision and rapidity with which these machines work have given great facilities for building, as one machine will do as much work as sixty men. The planing-machines used for metal are different in principle. A well-tempered, chisel-edged steel cutter is held in a fixed position, pressing downwards upon the metal plate, which is moved forward by powerful machinery. The action of this movement is that a groove is plowed into the metal of the size of the steel cutter; when the metal has traveled its full length, and has made the groove complete, the downward pressure of the tool is removed, and by the action of the double screw which has carried it forward, it is returned, and readjusted for another groove to be formed by the side of the first; and this is repeated until the whole surface of the plate is reduced to the required level. However tedious this process may appear, it offers such facilities for metal working as were previously unknown.

In its usual form, the metallic object is dogged to a traversing-table and is moved against a relatively fixed cutter. In practice, the cutter is adjusted in a stock, and is usually fed automatically between strokes. The machine is variously constructed, and in sizes to suit the work in hand. The drawings illustrate the Pond machines of the latest patterns, and including novel features. Fig. 1 shows a 26-inch machine which is intended for light work. Its bed has great depth and its length in proportion to the length of table is greatly in excess of usual practice. The uprights have sufficient metal and breadth of base to resist heavy cuts without jar when the tool is at the greatest height. The table is very thick, with three bolt-slots truly planed and pin-holes drilled and reamed, and receives back and forward motion from an open and cross belt through a powerful train of cut gears and rack. These gears are mounted on shafts having very large diameters and more than twice the usual length of the journal. These journals are carefully scraped together and straight surfaces scraped to surface plates. The automatic belt-shifter transfers but one belt at same time, thus obviating squealing of belts and jar of machine, it is entirely disconnected from feeding apparatus and is arranged to throw out to clear the reversing dogs on the table which can then be run backward to examine the work. The feeding device gives automatic

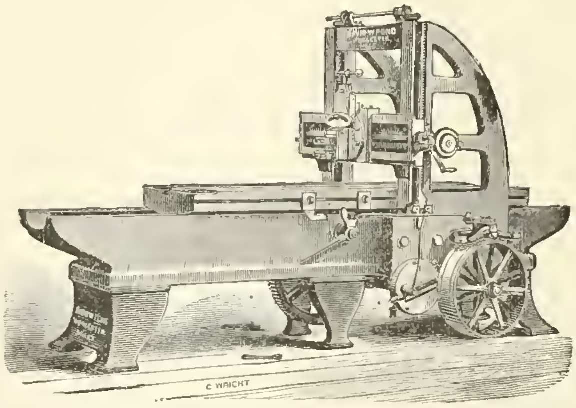


Fig. 1.

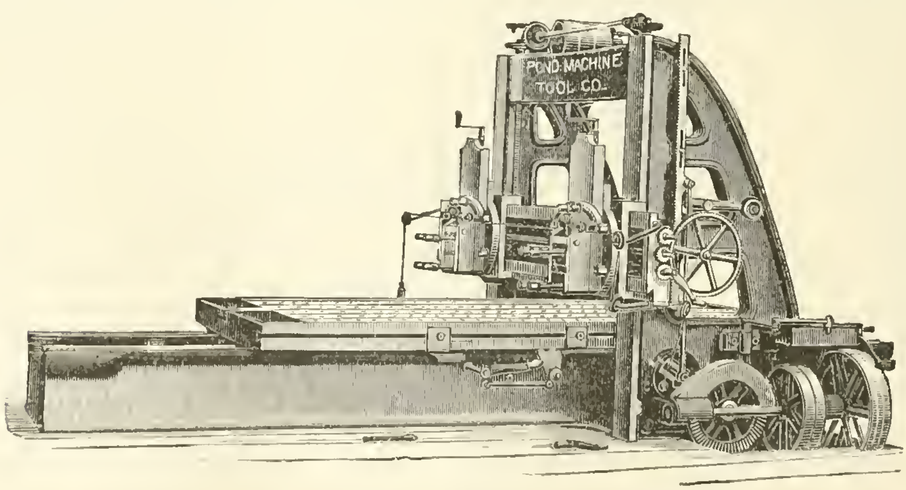


Fig. 2.

feed in all directions and is adjustable from 0 to ⅝ of an inch wide and takes no power except at the moment of feeding. The down and angular feeds can be operated by hand, if more convenient, from both ends of the cross-head as well as the top of the saddle. The countershaft has two pulleys, each 12 inches diameter, by 3 inches face for the 3-inch belt and should make 310 revolutions every minute. Weight 5,500 pounds.

Fig. 2 shows an 84-inch planer, designed for the heavier work. It possesses all the features above enumerated, the countershaft having two pulleys each 24 inches, by 5 inches face for 5-inch belt, and making 200 revolutions a minute. The weight of this machine is 56,000 pounds. See *Rotary Planer*, and *Shaping-machine*.

PLANK REVETMENT.—Plank is an excellent material for revetments where durability and very great strength are not required. The ease of working and convenience of handling are its great advantages. When it can be easily obtained and can be spared for the purpose, it will always be used in works of hurried construction.

Revetments may be made with it by driving posts or pieces of scantling into the earth, three or four feet apart, giving to them the same inclination as the interior slope. Boards, in a horizontal position, to retain the earth, are then nailed to these scantlings or posts. Or, the scantlings may be capped, and the boards having been cut into suitable lengths, placed in an upright position, similar to the posts in the timber revetments. The moisture of the earth soon produces rot in the boards, and renders the revetment a very perishable one. See *Revetment*.

PLAN OF CAMPAIGN.—Before undertaking any military operation, great or small, we should first settle down upon some decided end to be gained; determine upon beforehand, as far as practicable, the steps to be taken to attain our object. In one word, we should clearly see what we propose to accomplish, in order that we may not go blindly to work and leave anything to chance. The mental process by which all that is here supposed is elaborated is termed *The lay'ng out the Plan of Campa'gn.* In the first place, it stands to reason that this plan should be so limited as to comprise only the leading strategical dispositions, thus presenting only the outline features, within which the meshwork of the minor operations is to be confined; thus leaving ample latitude for all movements of detail and their execution. Nothing could be more absurd than to pretend to dictate to the Commanding General what he shall do from day to day; yet this has been done, and with but few exceptions, with disastrous results. Once within the sphere of the enemy's operations, a Commanding General is no longer at liberty to do what he wishes, but what he best can. Marches, maneuvers, combats depend on circumstances for the most part imperative; decisions arrived at are often sudden, and brought about by the attitude, resources, strength, and the *morale* of the enemy. The Commanding General should have *carte blanche* for carrying out the details of the campaign, the plan of which may have been decided upon by a council, but even this is far better left in the hands of him who has the whole responsibility of its execution on his shoulders, and has the greatest interest in its success. It is with the aid of the general maps of a country, made to a small scale, as embracing a wider territory, that the general plan of campaign is marked out. All that is wanted for this object is that the map should contain the exact positions of the places upon it; the water courses, the mountain crests, the principal lines of communication, and the political and geographical boundaries. The less detail on such maps the better they are for this purpose, as the mind is not distracted by them from the main features. For all points of detail topographical maps, on a large scale, are necessary. To these we have recourse when it is a question to choose an encampment; to decide upon a military position; to dispose an order of battle, etc. The plan of campaign lays down the points where the troops are to be assembled, the base and line of operations, and the strategical points to be attained. The choice of the positions where the troops are to be assembled is not only dictated by the facility of subsisting them, although this is a point of great importance; but by their suitableness to deceive the enemy as to the point on which we intend to make an advance, so that we may take the initiative and follow up our blow with the most crushing effect. The advance, where practicable, should be made over commodious roads rather than upon narrow and obstructed byways. The nature of towns or defiles to be traversed may force us to leave them on one side to take byways, although bad; for we overcome with less difficulty material obstacles on our line of march than we can towns and defiles well defended. When an army can, in its onward movement, rest one wing upon a natural obstacle to an enemy, it will be well for it to keep as near that obstacle as practicable; because it will be better covered by the army, the front of which during the march occupies always several miles in extent; at least so long as a battle is not imminent. When the two wings of the army are not supported in this way, the line of operations should cut the middle of the front of the army, in order that it may be equally well covered on each side. There is one general rule both on the march and for battle, which is, never to expose your line of operations; every disposition, on the contrary, should be taken to cover it and defend it in the best possible manner. The plan of campaign for the defensive is usually termed the *Defensive Plan.* It chiefly consists in deciding upon the character of the warfare to be adopted; one which will depend upon national traits, the resources, topography, and climate of the country. The French, for example, make a defensive warfare by assailing their enemies; the Germans, on the contrary, carry on patiently a methodical defensive behind their own frontiers; the Spaniards have been seen to carry on an exterminating war of detail; whilst the Russians, under like circumstances, have laid waste whole provinces, and destroyed by fire their capital city, to deprive their invaders of every material resource. A brave people, but not habituated to privations, will not drag out a war by patient endurance, but will endeavor to bring it speedily to a close by a few brilliant actions; its preferences will be for sledge-hammer blows, preferring the hazard of a great decisive battle, in which it may fall with glory, to a series of petty combats which only serve to exhaust the resources of the country without bringing about any decisive results. Carrying the war into the heart of the assailant's country, or that of his allies, is the surest plan of making him share its burdens and foiling his plans. The courage and conduct of troops are improved in this way, and the chances in their favor increased. But to be successful, the party adopting it must not be too inferior in strength, and the nature of the frontiers should favor it; as there would be too great a risk under less favorable circumstances, and in these even it would not be prudent to advance too far beyond our own frontier. The army will chiefly depend for the supply of its wants upon the zone of territory adjacent to the frontier, and this should be desperately disputed, by uniting all its forces against the enemy's invading corps. If this succeeds, from the defensive the army can assume the offensive. If unsuccessful, nothing remains to be done but to concentrate all the troops possible and fall back upon positions selected beforehand, either of very great natural or artificial strength, as rivers, mountain-passes, fortresses, etc. In this manner the enemy is drawn forward into a region the devastations of which are upon his shoulders. The skilful Montecuculi, in his memoirs, argues strongly for the adoption of such a plan of defensive measures; remarking that upon the territory of our enemy we arouse the discontented, whilst the fountains of men, money, and whatever else war calls for, are only disordered and fail in this portion in which the war rages.

PLAN OF DEFENSE.—The determination of the points on which resistance is to be made, those upon which we are to fall back in case of disaster, and the roads leading to these, in retreat; the dispositions of our forces at the outset so as to anticipate the enemy on every point; an indication of the points in rear of our frontier for concentration, so soon as the enemy has unmasked his projects; the mode of supporting our advanced corps and those of observation by central reserves; finally, the designation of the points to be fortified by art, bridges to be destroyed, roads to be repaired, etc., etc.: such are some of the objects upon which attention must be directed in any defensive plan. The suitable military dispositions in all such plans will be controlled by the local topography; it is, therefore, impracticable to lay down invariable rules on this point; the most that can be said is, that too great a dissemination of our force is always dangerous; therefore that, so far from attempting to defend every pass some must be abandoned to their fate, in order to effectually guard those which are most important and the more directly threatened by the enemy. If, instead of moving upon the latter, the enemy makes a show of gaining the former, he must be met by analogous movements, and our task should be to be in readiness to meet him by whatever route he may arrive; and also with the most troops he can concentrate. It is from this cause that the configuration of frontiers, and the direction and nature of the roads by which they are approached, have so great an influence upon the defensive measures against invasion. If these last are such as to permit our moving on right lines, from a center, upon the enemy maneuvering on the periphery, every advantage of mobility is on our side, and we ought to reach any point before the enemy. But, in any case, it is next to impossible to close every pass. To do so would require a continuous line of troops, which, from its extent alone, would be weak at all points, and which an enterprising enemy would easily pierce at any one. Instead of attempting any such impracticable plan it would be better to place a considerable force at some one favorable point in rear of our frontier, and, from there, take the chances of anticipating the enemy on any point he may threaten by moving on him promptly. In advance of this central force, and upon its front and flanks, small bodies can be thrown forward to occupy the principal passes momentarily and give warning of the enemy's movements. These detachments, by retiring slowly and holding the enemy in check, will give the main body time to make its dispositions, either to advance or to receive the enemy at any point further back. With these precautions the main body will be secured from surprise, and all the troops can be kept near enough to concentrate for battle. Such are the general defensive dispositions recommended by the highest military authority. It is readily seen that great discretion is necessarily left to the Commanding General, and that his measures should lend themselves to the local features of his line of defense. All that is requisite that these should be good is that they should be based upon the simple idea of concentration. This is always preferable to a feeble continuous line, with separated bodies that cannot afford mutual support; which are too far removed from the supervision of the Commanding General, who cannot be everywhere, and which, owing to the distances between them, cannot be rallied and concentrated in time when the line is pierced at any point. With the foregoing dispositions there should be combined some suitable system of signals, or other means of transmitting intelligence promptly from the interior line of detachments to the main body. No pains should be spared to have this system as perfect as practicable, and not liable to mistakes. A position chosen on the direct road that the enemy must follow is not always the best to check with advantage his onward march; flank positions can also often be found of superior advantage for this purpose from which the enemy's line of operations can be threatened if he persists in neglecting this position. This is particularly the case when the force thrown on the flank is of such strength that the enemy dare not to leave it in his rear, and therefore must attack and drive it back so that he may not expose himself to be separated from his base. In this simple manner the enemy is forced to give battle on a ground, of our own choice, and where we will have had time to make every defensive disposition. The searching out and establishing, on sound principles, flank positions for concentration of troops, forms an essential feature in laying down any plan of defense. Having decided upon the most advanced positions to be occupied, attention should next be directed to those of a secondary character, which will naturally be controlled by the water courses and mountain chains in rear of the first line. These will demand in their selection very careful study. The best of this class are those which have their wings or extremities resting upon natural obstacles that an enemy cannot turn—as the sea, lakes, unfordable rivers, which, in some respects, overlook the lines of approach on them; are accessible from the front only by a few practicable roads which can be easily guarded; the general outline of the position being convex towards the enemy, and in rear having good roads leading to all points of it, along which troops can be rapidly moved to any point in danger. Fortified places on a frontier will, of course, play an important part in any defensive plan; even open towns, by properly covering them with field works, may give the means of effective resistance to any usual mode of attack. When these places lie upon a river, which is itself a line of defense, particularly when they occupy both banks of it, they afford great facilities for the operation of an army which can maneuver on either shore with safety, so long as the place itself is not invested. Fortifications so placed completely prevent the enemy from using the river as a means of transportation, whilst they assist us in so using them; and, in most cases, they would therefore force an enemy to take all the known measures for gaining possession of them before he would dare to pass beyond them. In whatever way a river may lie, which has fortified points on it, the disadvantages to an invading force are necessarily great. If parallel to our line of frontier an enemy cannot cross the river, leaving these occupied in his rear, without running the risk of a great disaster. When perpendicular, he cannot with safety divide his forces to operate on both banks at once, as we have, by means of the fortified points, the ready facility of concentrating on either side at our pleasure. Without such strong points on it, a river, on the contrary, might be a positive advantage to the enemy, by allowing him to secure one of his own wings from attack by resting it upon the river, whilst he would also thus facilitate his own means of transportation. As to military positions, properly so called, that is localities favorable to accepting battle, great care should be taken in designating them on the plan of defense, and in preparing them beforehand for every eventuality, by field works, lines of retreat, the removal of all obstructions between the points of the position, etc. In every plan of defense, particular care should be taken in pointing out what roads should be carefully preserved, and which, in any emergency, may be broken up, or otherwise obstructed. These measures of destruction are almost always put off so late as to become impracticable at the moment of need.

PLANT.—In a military sense, to place or to fix; as *to plant a standard.* It likewise signifies to arrange different pieces of ordnance for the purpose of doing execution against an enemy or his works; hence, *to plant a battery*. Some authors apply this word to the act of directing a cannon properly.

PLANTATIONS.—Trees which are sometimes planted on the glacis of fortresses. When judiciously placed, they form a valuable aid to the defense. First, in the wood being used for timber, as they would be cut down when the place was about to be attacked. Secondly, in the roots of the trees which run under the glacis forming a considerable obstacle to the besieger's saps. Care should be taken to leave a space of about 20 feet clear in front of the crest. This part will be of no use to the besieger, as the sap of his lodgment will probably be excavated outside of it; and the defenders may have occasion during the siege to cut ramps in it ascending from the covered way to facilitate sorties, or to construct lodgments thereon for riflemen. For the same reason it would be advisable to avoid planting any parts of the glacis where it is likely the defenders will have to excavate counter-approaches.

PLASH.—A term commonly used to signify the interweaving of branches, as for gabions, dikes, weirs, hurdles, etc.

PLASTRON.—1. A stuffed pad or cushion, formerly worn at the shoulder to sustain the recoil of heavy muskets and other fire-arms, and still used

by fencers upon the right side. 2. A breast-plate or half cuirass. In the old French service, the Gens d'Armes, the heavy cavalry, the light horse, etc., were obliged to wear them on all occasions, at reviews, etc. Sometimes written *Plaston*.

PLATE.—1. In Heraldry, a roundle argent. It is represented flat, and in the Heraldry of Scotland is known as a *bezant argent*. 2. Metallic armor composed of broad pieces, and thus distinguished from mail.

PLATE-ARMOR.—The employment of thick slabs of iron to protect the sides of ships of war and the fronts of fortifications, is quite a recent invention; or rather, the modern system is the practical realization of plans suggested long ago by Mersenne and others. In 1842, Mr. Balmano, of New York, proposed that war-ships should be clad with several thicknesses of iron plate, riveted one upon another, the plates being individually ¾th inch thick. Soon afterwards, Mr. Stevens, an American ship-builder, made further suggestions on the subject, and other practical men kept the matter before the attention of the authorities in various countries. In 1854, the French sent several floating-batteries to the Black Sea, clad with iron plates; and the English Admiralty hastily imitated this example, producing eight very slow and unmanageable batteries in 1855-56. Then came in a flood of suggestions for arming regular ships of war in a similar way. The Admiralty, dismayed at the thought of dismantling the existing fleet, which had cost so much, delayed the subject as long as they could, but without abandoning it. In 1860, the French sent to sea *La Gloire*, a timber-built ship of war, altered from a 90-gun three decker to a 40-gun corvette, clad with 4½-inch iron plates having a burden of 3,000 tons. This proceeding at once set the English Government on the alert they saw that further delay would be imprudent, and they set about the creation of an armor-clad navy. Many problems had to be solved—whether to case old wooden ships with armor; to build and case new wooden ships; or to build new vessels, of which the hull as well as the armor should be of iron. Then arose further problems—how near the bulwarks should the armor-plates come, how near the bottom of the vessel, how near the stem and stern; also, what thickness of iron, and whether the same thickness in every part.

From 1861 to 1876, the British Admiralty were engaged on a series of costly constructions and reconstructions, intended to afford eventually solutions to the above problems. Several of the ships built have cost from £300,000 to £450,000 each; several half-finished timber three-deckers have been cut down and converted into iron-clads; and variations of detail almost innumerable have been introduced. The following is a list of English vessels which in 1876 formed the Iron-clad Navy. Those which are wholly clad—*i. e.* covered with armor plates in all parts of the hull needing protection—are the *Minotaur*, *Agincourt*, *Northumberland*, *Royal Oak*, *Prince Consort*, *Caledonia*, *Ocean*, *Lord Clyde*, *Lord Warden*, *Audacious*, *Invincible*, *Prince Albert*, *Scorpion*, *Wyvern*, *Monarch*, *Iron Duke*, *Sultan*, *Glatton*, *Cyclops*, *Hecate*, *Hydra*, *Gorgon*, *Dreadnought*, *Devastation*, *Thunderer*, *Swiftsure*, *Triumph*, *Rupert*, *Hotspur*, *Hercules*, *Inflexible*, *Alexander*, and *Shannon*. Those which are only partially clad—*i. e.* covered with armor-plates only in the more exposed portions—comprise the *Black Prince*, *Warrior*, *Defense*, *Resistance*, *Achilles*, *Hector*, *Valiant*, *Royal Alfred*, *Bellerophon*, *Zealous*, *Pallas*, *Favorite*, *Research Enterprise*, *Viper*, *Vixen*, *Water-witch*, *Penelope*. Regarded as to the material of which the hulls are mostly built, and on which the armor-plates are laid, the following are timber-built: *Royal Oak*, *Prince Consort*, *Caledonia*, *Ocean*, *Royal Alfred*, *Zealous*, *Lord Clyde*, *Lord Warden*, *Pallas*, *Favorite*, *Research*, and *Enterprise*. The *Vixen* is wood and iron; the *Swiftsure* and *Triumph* are iron sheathed with wood; all the rest are iron. The dimensions and weight of these ships, laden with armor-plates from 3 to 24 inches thick, are enormous. The load displacement of five of them exceeds 10,000 tons each; six, 9,000 to 10,000; four, 7,000 to 9,000; twelve, 6,000 to 7,000; seven, 4,000 to 6,000. Some of the steam engines for these ponderous ships, nominally of 1200 horse-power, work up to (indicated) 8000 horse-power. Whatever the thickness of the armor, the plates are nicely tongued and grooved to fit closely together edgewise. The bolts which fasten them to the ship are generally 2 to 2½ inches thick, expanded at one end to form a head, and having a screw-thread at the other to receive a nut.

It is not yet known whether the thickest armor will resist any shot that can be hurled against it; whether, in other words, the thickest practical armor will overcome, or be overcome by, the heaviest practicable shot. Experiments at enormous cost have been conducted for some years to determine this important question: a natural result has been that cannon are made larger and larger, and armor-plates thicker and thicker, in the struggle between artillery and ship-building. The experiments (so far as England is concerned) have been conducted principally at Shoeburyness. The usual mode is, to construct a target resembling the armed side of one of the iron-clads, and then to try to pierce it with shot fired from guns at various distances. A *Warrior* target, for instance, consists of a 4½-in. armor-plate, backed by 18 in. of teak, and an inner skin of ¾-in. iron; while a *Lord Warden* target has 4½ in. plate, 30 in. teak, and 1½ in. skin. A few examples will serve to illustrate the method of proceeding. In August, 1866, a *Warrior* target was built up at Shoeburyness—*i. e.*, a target similar in strength and construction to the side of that ship. Alderson's steel shell, Armstrong's conicle shell, and Palliser's chilled-iron shell were fired at it from a 7-in. gun at 200 yards: the Palliser shot excelled the others, going clean through the target, armor and all, and bursting behind. On another occasion, a Palliser 115-lb. shot went through the target even at an angle of 30° from the perpendicular. The *Lord Warden* target has been pierced by 9½ and 10-in. shot at a distance of 1,000 yards; while the thinner *Warrior* target was pierced at 2000 yards. The *Bellerophon* and *Hercules* targets were more ponderous. At the end of 1878, the British navy consisted of 64 ships, afloat or building, of which 46 were efficient. They were divided into five classes, the first two of which contain only the formidable turret-ships. The armor of the first class comprising 4 ships, ranged from 12 to 24 in. in thickness: the *Inflexible* has armor from 16 to 24 in. The second class, of 9 ships, has armor from 8 to 14 in. thick. The third, of 16 ships, from 5 to 12 in. The fourth, of 4 ships, from 6 to 10 in. In the fifth class, 13 ships, the armor is from 4½ to 5½ in. The last class comprises the two old iron-clads, the *Warrior*, *Black Prince*, and others.

Armor-clad forts are also attracting attention. Iron has been used largely in the defenses of Plymouth and Portsmouth. In 1864, a line of iron-clad fort was built up at Shoeburyness, to test several modes of construction. In the same year, the Russian Government employed the Millwall Company to build a wrought-iron shield, as an experiment for the defenses of Cronstadt. The front was made of 12 in. thick of iron in horizontal bars; this was backed by 14 in. of thickness in upright bars; and the whole strengthened with enormous struts, brackets, ribs, and dovetails of iron. The shield was to form the facing or armor for a battery of three of Krupp's 600-pounder steel guns, and measured 43 ft. by 10. The shield, with its foundation-plate, weighed 140 tons. In one experiment at Shoeburyness, a plate 13 in. thick was placed in front of a mass of granite 14 ft. thick, and fired at with 200-pounders; four shots cracked the granite, although the plate was not pierced. The

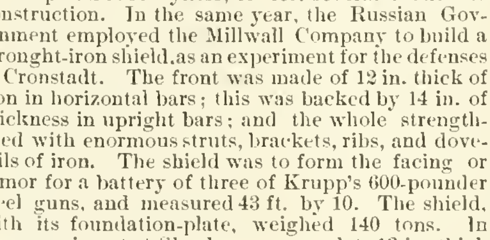


Fig. 1.—Front View of "Warrior" target, after practice with 600-pounder Armstrong Gun.

Americans made an experiment in Chesapeake Bay, in September, 1866, on a temporary fortification, made of enormous granite blocks faced with 10-in. armor; shots of 430 and 620 lbs. were fired from the Rodman guns, at a range of about 350 yards, and eleven such shots destroyed the whole fabric. The *Thunderer* was fitted up as a target-ship at Portsmouth, partly to test very thick plates at very short distances. The plates were fastened to an enormous bulkhead near one end of the ship, and the guns placed near the other end. On one special occasion, a Palliser 115-lb. chilled shot, with an extra charge of powder fired at 25 ft. off, went clean through a 7-in. plate and 45 in. of teak bulkhead. On another occasion soon afterwards, a *Hercules* target, with a 9-in. plate, was fired at with an 8-in. spherical shot at 30 ft.; the shot made a dent 2½ in. deep, but did not further disturb the plate. The 24-in. armor of the *Inflexible* is divided into two 12-in. plates, with 9 in. of teak between—the theory of this arrangement being that the outer plate, even if pierced, will shatter the shot, which will then be stopped by the inner armor. Dr. Collis Brown has suggested a system of sloping armored sides which would give a ship armor of 36 in. at any given point in a displacement not exceeding that of existing iron-clads. In the trial of the 100-ton Armstrong gun at Spezzia, a steel armor-plate was fired at, and the shot, though it penetrated the plate, was stopped in the backing.

Regarded as articles of manufacture, armor-plates were first produced mainly by hammering, several thicknesses of iron being welded one upon another,

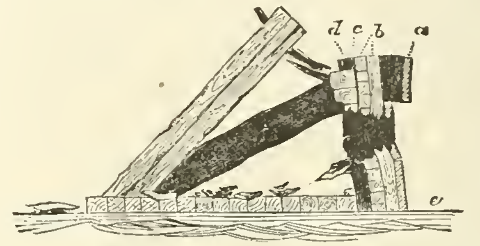


Fig. 2.—Section of "Warrior" Target, showing the hole made by the 600-pound Shell, and displacement of the upper plate. a, armor plating, 4½ in. thick (displaced); b, teak backing, 18 in. thick; c, boiler plate skip, ⅝ in. thick; d, wrought-iron beams; e, platform.

at a white heat, by blows of a ponderous steam-hammer; but it is now more customary to produce them by rolling than by hammering—pressure being considered to produce more satisfactory results than percussion. Whatever the thickness of the slab is to be, operations are commenced with plates about an inch thick; these are heated, rolled, cut, piled up, heated and rolled over and over again, until the required thickness is produced. The rollers are placed further and further apart, as the slab becomes thicker and thicker. Some of them are truly enormous masses of metal, solid cylinders 8 ft. long by 32 in. diameter. At the Atlas works of Messrs. Brown & Co., Sheffield (the chief manufactory for armor-plates), there has been produced a rolled slab 17 ft. long, 7 ft. wide, and 14 in. thick, weighing 30 tons. At Grüser, in Germany, some excellent armor-plates of chilled (cast) iron have been manufactured. For armor-plates, the metal is very scrupulously selected, and every part of the processes conducted with great caution.

PLATFORM-BOARD.—A side-board on an ammunition carriage for forage.

PLATFORM-WAGON.—A carriage on four wheels; having no sides, and used for the transport of guns, mortars, traversing platforms, and for every description of heavy stores.

PLATFORMS.—To insure accuracy of fire with heavy guns and mortars, it is absolutely necessary to have solid and substantial platforms. For casemate and barbette batteries in fortifications, fixed platforms are constructed with the works. The barbette platform consists essentially of the pintle block, which is of granite firmly imbedded in concrete; in the block is inserted the pintle, of iron, and around this is the friction plate for the pintle transom of the chassis to rest upon. Traverse circles, of iron, form level and smooth tracks, upon which the traverse-wheels run. The pintle of a casemate carriage is inserted in a hole in the sole of the embrasure, and is lifted out when the chassis is to be removed. The chassis is attached to it by a tongue, and is provided with a front set of traverse-wheels. Platforms for siege pieces accompany troops in the field, and it is desirable to have them as light as is compatible with sufficient strength to endure the shock of firing. Those used in the United States Service combine, in a high degree, the essential qualities of strength and portability. All the pieces composing them are of the same dimensions, and, as the weight of each piece is only fifty pounds, a soldier can carry one from the depot to the batteries, or any moderate distance, in addition to his arms and equipments. Another platform for mortars is described, which is very simple, strong, and well suited to positions where trees or timber can be easily procured. This is designated the *rail platform*. When a siege gun or howitzer is to be fired constantly in one direction, it is best to give the platform an inclination to the rear. This prevents excessive recoil, and also serves to carry off water from rain. The degree of inclination is not absolute. When the piece is to be traversed over a wide field of fire, the platform should be perfectly level; the recoil is then checked by placing a bag of earth or a pile of sods at a proper distance (about five feet) behind each wheel. The following is the method of laying the platform when it has an inclination. To lay it horizontally, simply omit what is said with reference to the slope: The direction in which the piece is to fire is established by stretching a cord over the center of the place where the platform is to be laid. This line is the directrix

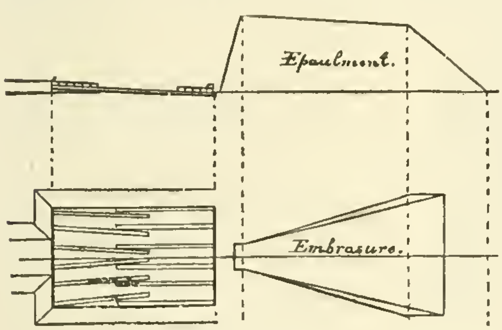


Fig. 1.

of the platform. Prepare a bed for the platform by excavating the earth so that it will have the proper inclination to the rear and be perfectly level across. The earth, if not already firm, should be well rammed. Lay the outside sleepers parallel to the directrix, their outside edges being fifty-four inches distant from it. The four other sleepers are laid parallel to these, the edge of each fifteen and a half inches from the edge of the next. The upper surface of the front ends of these sleepers is fifty inches below the sole of the embrasure, and they are laid with an elevation to the rear of one and a half inches to the yard, or four and a half inches in their whole length. This elevation is determined by placing a block four and a half inches high on the front end of the sleeper, and laying a straight-edge, with a level on it, from this block to the rear end; the earth is then arranged so as to bring the level true in this position. The next set of sleepers are laid against and inside of the first, overlapping them three feet, having the rear ends inclined outwards, so that the outer edges of the exterior ones shall each be fifty-four inches from the directrix, and the space between the rear edges of the others the same as in the first set, viz., fifteen and a half inches from the edge of one to the edge of the next; all having an elevation to the rear of one and a half inches to the yard, and perfectly level across. The earth is then rammed firmly around the sleepers and made even with their upper surface. The first deck-plank, with a hole through each end for the eye-bolts, is laid in place, perpendicular to the directrix, its holes corresponding with those in the sleepers. The hurter is placed on it, and the bolts driven through the corresponding holes in these pieces. The hurter should be so placed as to prevent the wheels from striking against the epaulement when the piece is in battery. If the interior slope has a base of two-sevenths of its height, the inner edge of the hurter should be two and a half inches from the foot of the slope. The other planks are laid, each being forced against the preceding, with the dowels fitting into their respective holes; the last plank has holes for the eye-bolts. By drawing out or driving in the outside sleepers, the holes through their rear ends are made to correspond with those in the last deck-plank. The bolts are then driven. Drive stakes in rear of each sleeper, leaving their tops level with the upper surface of the platform. Raise, ram, and level the earth in rear of the platform, so as to have a plain, hard surface to support the trail when the recoil is great. The earth should be raised nearly as high as the platform along the sides, and well rammed, giving it a slight inclination outward to allow water to run off. The platform is fifteen feet long and nine feet wide. Instead of twelve sleepers, each nine feet long, it is preferable to use six, each fifteen feet long. See Fig. 1.

The field platform is for siege guns and howitzers when serving with an army in the field, and the method of constructing it indicates the way in which platforms may be extemporized from such material as may be at hand. To lay this platform, level off the ground and mark the directrix; dig trenches for the sleepers; place the latter in the trenches so that the holes for the eye-bolts will correspond in place to those in the wheel-planks; place the wheel-planks in position, and drive in the eye-bolts. The front eye-bolts pass through and secure the hurter; apply the level and make the structure perfectly level; secure the front sleeper with stakes; it is well to secure also the rear ends of the wheel-planks with stakes; lay on the trail-plank and secure it with an eye-bolt to the third sleeper; ram the dirt well in around the sleepers. Fig. 2. To check recoil, place

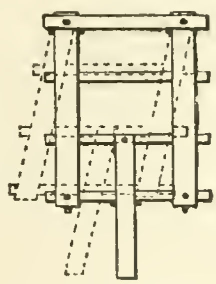


Fig. 2.

sacks of earth or piles of sods over the eye-bolts of the third sleeper, or a stick of timber, similar to a sleeper, laid across will effect the same object. This platform admits a change of direction of about ten degrees on each side of the directrix, thus covering as much of a field of fire as is ordinarily required. To make this change of direction, slightly loosen or remove the earth about the three rear sleepers, and heave the rear ends of the wheel-planks over with handspikes. The platform then has the position indicated by the dotted lines in the figure.

The siege mortar platform is composed of six sleepers and twenty-one deck-planks. It is laid level, and the front and rear deck-planks are connected by eye-bolts to each sleeper. A bed for the platform is first prepared by leveling off the ground, and, if not already solid, the earth should be well rammed. This bed should be sunk only so deep as to allow the upper surface of the platform to be slightly above the surrounding ground, for drainage. The sleepers are laid parallel to the directrix or plane of fire, three on each side of it, at equal distances apart, so that the holes in their ends shall correspond to the holes in the front and rear deck-planks. The front deck-plank is laid first, and the eye-bolts driven to secure it; the remaining planks are driven up against it, and the last secured, like the first, with eye-bolts. At the rear end of each sleeper a securing stake is driven. Fig. 3. The earth. on all sides, should be raised nearly as high as the platform, and well rammed. giving it a slight inclination outwards to allow the water to run off. It

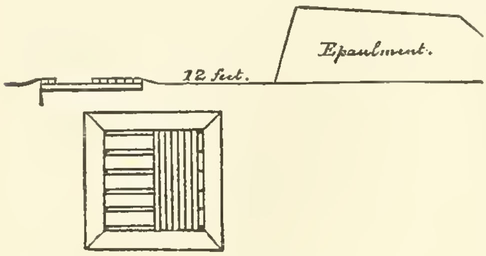


Fig. 3.

is of the first importance that the upper surface of the platform should be level and true.

The rail platform for siege mortars consists of three sleepers and two rails for the shoes of the mortar to rest on. It is very strong, and easily constructed and laid. The rails and sleepers are notched and fitted together as represented in Fig. 4. The distance between the center lines of the rails is equal to that be-

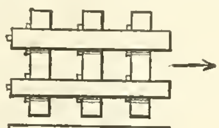


Fig. 4.

tween the center lines of the cheeks of the mortar carriage. The pieces are put together at the battery, and the earth is excavated eight inches in depth, and of suitable length and width to receive the platform. The bottom of this excavation is made perfectly level. The directrix being accurately marked by stakes, the platform is placed in position, its center line coinciding with a cord stretched between the stakes marking the directrix. The earth is filled in as high as the upper surface of the sleepers and firmly rammed; stakes are driven in the rear angles formed by the sleepers and the rails, and one at the rear end of each rail.

The platform for sea-coast mortars is 15 feet by 15 feet by 2 feet 2 inches. To lay it, a pit is dug 2 feet deep and about 18 feet square on the bottom. The earth on the bottom is well rammed and leveled. The two inch-planking is laid level on the rammed earth, perpendicular to the directrix. The cylindrical bolts are put in the sleepers, and the sleepers, with bolt-heads down, are laid compactly on, and perpendicular to the planking and parallel to the directrix. As the deck-timbers are laid the bolts pass through the holes in them. These timbers are laid compactly upon the sleepers, perpendicular to the directrix. The nuts are put on the bolts and screwed down. Both the nut and bolt-heads are countersunk. The iron plates are laid parallel to the directrix, and secured firmly with screws to the deck-timbers, covering nine feet in the center of the platform and leaving three feet on each side uncovered. The earth is then filled in, and rammed compactly around the platform, with a slight inclination outwards, so as to shed water. The platform for the center-pintle classis is 17 feet square; the bottom of the pit must therefore be 20 feet square.

The 10-inch sea-coast mortar platform is 12 feet by 12 feet by a 1 foot 8 inches. To lay it, a pit is dug 1 foot 6 inches deep by 15 feet square; the remainder of the operation is similar to that for the 13-inch mortar. See *Mortar Carriages*, and *Siege Carriages*.

PLATINUM FUSE.—A fuse of great value introduced by the Laflin and Rand Powder Company, and used with their *magneto* machines. These fuses have become noted for their surety, regularity, and perfect safety. They cannot be fired by a spark or by the effects of free electricity, but need a current of sufficient strength and persistence that in its passage through the circuit it shall heat to redness a small bridge of fine platinum wire in the body of the fuse. The drawing shows, in section, one of these fuses nearly of actual size. The following are its parts: A, the shell, of copper, having a corrugation, thrown out from the inside, which holds the sulphur cement more firmly in place. B, chamber containing the charge of explosive, composed mainly of fulminate of mercury—very powerful. C, the fuse wires, of copper, entering the shell, having a covering which is a partial insulator sufficient for all ordinary purposes. D, the bare ends of the copper fuse wires, projecting above the sulphur cement and into the charge. E, the small platinum wire, or bridge, soldered to and connecting the two ends of the fuse wires: this is heated to redness or combustion by the passage of the electric current. F, the sulphur cement holding the fuse wires firmly in place. These fuses are of cotton-covered wires; the nicety of insulation by gutta percha not being needed for general work, but only where blasting is to be done in deep water, and not then unless several fuses are to be fired simultaneously through a great length of submerged wire.

In March, 1880, these fuses were submitted to a rigid and careful testing at Willet's Point, N. Y., and were found to be remarkably uniform both in resistance and in the current required to explode them. The blasting machine with which they are intended to be used is a small magneto-electric instrument, weighing only about sixteen pounds, and occupying considerably less than one-half of a cubic foot of space. The capacity of this machine is for about twelve or fifteen holes, though under entirely favorable circumstances many more can be fired. As to durability, the construction is such that one should last as long as a clock. No uncertainty exists. In the deep mining of the Territories, especially in Colorado, many of them have been used in very wet shafts, and have been found invaluable. The patent self-discharging arrangement, a remarkable invention, has made them far superior, for practical use, to any instrument ever made. See *Blasting*.

PLATOON.—A subdivision of a company. This term (probably from the French *ploton*) was formerly used to designate a body of troops who fired together. A battalion was commonly divided into 16 platoons, and each company into 2 platoons, the platoon thus corresponding to the present subdivision. The word is obsolete in this its original sense; but it survives in the expression "platoon exercise," which is the course of motions in connection with handling, loading, and firing the musket or rifle.

PLEA.—A technical term in law. In England it had a very restricted meaning, being confined to the pleading of a defendant to an action at common law. Now in all actions in the High Court it is called the "Statement of Defense." In Scotland it is not used in the same sense, but denotes the short legal ground on which a party, whether pursuer or defender, bases his case or pleading. Hence the pleas in law are only short propositions of law. Pleas are subdivided according to their subject-matter, into pleas dilatory and peremptory, pleas of abatement, pleas to the jurisdiction. Pleas in bar are the same as peremptory pleas; but in criminal cases in England, special pleas in bar are pleas stating some ground for not proceeding with the indictment, such as a plea of formal acquittal or autrefois acquit; or of conviction, or autrefois convict; or a plea of pardon. In Scotland a "Plea of Panel" means a plea of guilty or not guilty. "Pleas of the Crown" was an expression anciently used to denote the divisions of criminal offenses generally, as in the well-known work called *Pleas of the Crown*, by Sir Matthew Hale, and other writers. The phrase was so used because the Sovereign was supposed in law to be the person injured by every wrong done to the community, and therefore was the prosecutor for every such offense.

PLOMBEE.—An ancient war-club, whose head was loaded with lead.

PLONGEE.—In artillery and fortification, a slope toward the front. Thus, in speaking of the course of a shell through the air, its plongée is from the point of greatest altitude to the point at which it strikes the earth. So, in fortification, the plongée is the top of the parapet sloping gently toward the front. This slope is ordinarily 1 in 6; but a deviation is permissible of from 1 in 9 to 1 in 4; the sharper the slope, however, the more liable is the crest of the parapet to be destroyed by an enemy's fire. Moreover, as flat a plongée as possible is desirable, that sandbags may, when required, be laid upon it to form cover for riflemen.

PLOUGH.—A wooden wedge ,or a shoe, shod with leather. It is attached to a gunpowder incorporating mill, for confining the charge under the path of the runner. There are two attached to each pair of runners.

PLOYMENTS.—A general term for all tactical movements by which column is formed from line upon a designated subdivision. The following points are general:

If *right* is to be in front, heads of companies incline to the *right*.

If *left* is to be in front, heads of companies incline to the *left*.

Always wheel by fours *away from* the file-closers.

In all ployments (except to or on the right or left) the designated company, unless it is to be the *rear* company of the close column, moves forward 19 yards, if from line, and 15 yards, if from column.

In ploying on a flank, or leading company, dress on side which company enters the column.

In ploying on an *interior* company, if { *right* companies ploy in front, dress to *left*. / *left* companies ploy in front, dress to *right*. }

In ployments *to* or *on* the right or left, the companies clear the columns by 30 yards before forming line.

PLUMACHER PERCUSSION-FUSE.—This fuse consists of a tube, the interior of which has three peculiar-shaped communicating chambers of different sizes, a screw cap, a screw-bottom, a winged needle-discharging plunger in the upper chamber, and a charged plunger in the lower chamber, the two plungers being kept apart by the third smaller or intervening chamber, as will be shown by reference to the drawing. Fig. 1 is a vertical section of the charged fuse in repose, top end up. Fig. 2 is a vertical section of the charged fuse at the point of striking, after having been discharged from the gun, top end down. Fig. 3 is a vertical section of the empty fuse-case. In external appearance the fuse-tube, A, is an ordinary cylinder, having a screw-thread, *t*, cut to a proper depth at one end on the periphery of the projectile. It is made of the size usual for percussion-fuses, so that it may be used in any pattern of elongated shell. The cavity of this cylinder is tapped at both top and bottom at *v v'*, and is provided with a screw-cap, D, and a screw-bottom, E, and the interior is divided, by abutting shoulders, *o o*, into three different-sized chambers, *f*, *g*, and *h*, in which the sliding plungers operate. The screw-cap, D, has a groove, *r*, that it may be handled by a screw-driver, and an indent, *s*, on the lower side, to admit the point of a needle, should it be deemed necessary to reverse the discharge-plunger when shipping the projectile. The screw-bottom, E, has keyholes, *u u*, by which it is screwed, etc., and an escape-hole, *e'*, through its axis, to permit the passage of fire into the magazine of the shell. The discharging-plunger, B, is a cone-crowned piece of metal, smaller in diameter than either of the chambers, with a tapped hole, *c*, in the apex, into which a pointed steel needle is screwed, holding in place by a shoulder on the needle a many-pointed steel spring, *k*. The steel spring, *k*, is just sufficiently stiff to hold the plunger in place and to prevent it from being forced into the center or chamber, *g*, by any power less than the impact produced by the discharge of the projectile from the gun. The plunger is contained, needle-point down, in the chamber, *f*, but by the impact produced by the discharge of the gun it is thrown forward and secured by the flaring springs in the chamber, *g*. The sliding plunger, C, incased in the chamber, *h*, larger and heavier than the plunger, B, is of cylindrical shape—a body of metal with a cone-shaped crown, having through its axis a hole, *e*, in which is secured by a drop of varnish or other suitable material, the fulminating powder or pill. Through this hole also passes the fire into the magazine of

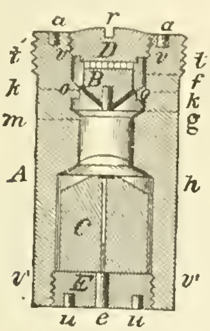


Fig. 1.

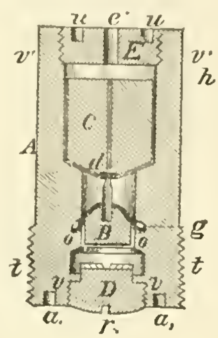


Fig. 2.

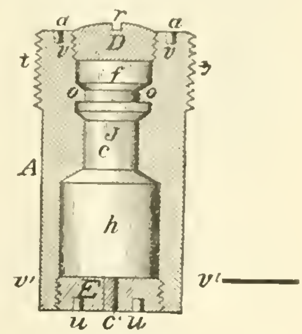


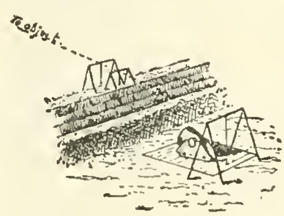
Fig. 3.

the shell Extra security in transportation may be obtained by unscrewing the cap, D, and taking out and reversing the needle-plunger, B, securing the point of the needle in the indent in the lower side of the cap. When fired, the impact produced upon the projectile by discharging the gun from which it was thrown forces the plunger, B, from its normal position into the center chamber, *g*, where it is held, at the bottom, by the narrow entrance to the lower chamber, and from the top by the ends of the many-pointed spring coming in contact with projecting shoulder, *o o*, dividing chamber, *f*, from *g*, the point of the needle protruding into the larger chamber, *h*. Then, by the check on the projectile when striking, the plunger, C, is thrown violently forward on to the plunger, B, the point of the needle entering and discharging the pill or fulminating-powder, thereby exploding the shell. See *Fuse*.

PLUMES.—Large and handsome feathers knots of buffalo-hair, etc., worn as ornaments on helmets, chapeaux, military hats, etc. In the United States, the General-in-chief wears three black ostrich feathers. All other general officers, officers of the General Staff and Staff Corps, except the Signal Corps, wear two black ostrich feathers. See *Helmet*.

PLUMMET.—A lead or iron weight suspended by a string, used by artificers to sound the depth of water, or to regulate the perpendicular direction of any building. Pendulums, called also plummets, which vibrate the required times of march in a minute, are of great utility. The different lengths of these plummets are as follows: For common time, 90 steps in a minute, 17.37 inches; quick time, 110 steps in a minute, 11.6 inches; double time, 165 steps in a minute, 5.17 inches.

The plane of sight is established by plummets; one suspended in front and another in the rear of the mortar. A convenient method of suspending the plummets is by means of trestles, made light and easy to handle. The one in rear of the mortar should be about six feet high, to permit the gunner to sight without stooping. The one in front being on the parapet, need not be more than eighteen inches high. They should have their upper edges scored with fine saw-cuts, close together, to secure the plummets when adjusted in position. The plummet-cord should be of fine thread or silk, and if affected by wind when suspended, the bob should swing in a bucket of water. A third trestle and plummet is required temporarily for placing the first two in position. To establish the plummets in position, the Instructor commands: 1, PLACE THE PLUMMETS.—The gunner, assisted by No. 2, places a trestle upon the parapet near the interior crest, and suspends from it a plummet in such position that it will be approximately in the line passing through the center of the platform and the object to be fired at. No. 3 brings up another trestle, which the gunner causes him to place a few feet in advance of the first, and in line with it and the object; sighting by the plummet first established, he causes the second plummet to be accurately adjusted on the line to the object; then, going to the front plummet and sighting back, he causes, No. 4 to place in position the trestle in rear of the mortar, and suspend from it the plummet, being careful to have it in exact line with the two on the parapet. The front trestle is then removed by No. 3. The trestle in rear of the mortar should be about three yards from the platform. Should the fire from the enemy endanger the plummet on the parapet, a priming-wire may be stuck there in its place to mark the line. When, owing to the interposition of an intermediate obstacle, the object to be fired at cannot be seen from the mortar, a point must be interpolated on the required line in such position that it can be seen from the mortar. This is most readily effected by using the Paddock interpolater. See *Bob*, *Mortar*, and *Paddock Interpolater*.



PLUNDER.—That which is taken from an enemy by pillage or open force. In the United States the Articles of War declare that every officer or soldier, who shall quit his post or colors to plunder and pillage, shall suffer death, or such other punishment as may be ordered by a General Court-Martial.

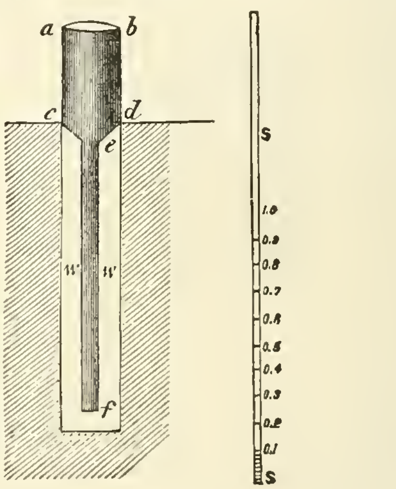
PLUNGER.—A form of striker used in some breech-loading fire-arms. See *Firing-pin*.

PLUNGING FIRE.—When a battery is raised considerably above the object, so that the shot impinges at a great angle, and is buried without grazing, the fire is termed "Plunging Fire."*

PLUNGING RICOCHET.—The description of *ricochet* fire, when the *angle of fall* is comprised between 6° and 10°. In this fire, the ball is given a small velocity, and the curve described is short and high.

PLUTEUS.—A kind of wicker helmet covered with raw ox-hide, worn by the ancient Greeks when engaged in sapping walls. Others were made of hurdles, covered in the same way, running upon three wheels, and affording cover to 7 or 8 miners.

PLUVIOMETER.—An instrument to measure the quantity of rain that falls. It usually consists of a metal funnel from 5 to 7 inches in diameter, the rain being collected in a glass bottle. This bottle should be placed in a small stand near the surface of the ground, to protect the bottle from the action of the sun. The amount of rain fallen in a given time is measured in a graduated glass-jar, one-tenth the area of the funnel, and so divided that every inch in depth of the tube shall indicate $\frac{1}{10}$ inch falling in the funnel. The amount of rain which has fallen can be measured by such an instrument to $\frac{1}{5000}$ part of an inch, or even less.



Another kind of rain-gauge may also be adopted. It consists of a cylinder of copper or other metal, from 5 to 7 inches in diameter, and 30 inches long. A float, just so much smaller as to allow it to rise freely, is placed within the cylinder, and to the center of the float an upright staff is attached, marked in inches and tenths of an inch, which, rising through a hole in the bottom of the funnel, indicates the depth of rain received into the guage. The drawing shows this instrument as employed in the United States Signal Service. See *Rain-guage*.

PNEUMATIC BUFFER.—A device for checking recoil through the agency of atmospheric air. At present, only the 15-inch gun is thus provided. Between the front ends of the chassis-rails are attached two cast-iron cylinders each 110 inches long, with an interior diameter of 14.25 inches. The ends of the cylinders are closed with tight-fitting heads secured with screw bolts. A piston works in each cylinder. The rods of the pistons pass out through the rear cylinder heads and are attached, by nuts, to a heavy transom on the rear end of the top-carriage. The cylinders have the same inclination as the chassis-rails, and are secured to the latter by three cylinder transoms. When the piece recoils the piston-rod is withdrawn, and the air contained in the cylinder compressed between the piston and the rear head of the cylinder. A small hole in the front head admits air to supply the vacuum in front of the piston. The air in rear of the piston thus forms an elastic cushion, offering but slight resistance to the first movement of recoil, but gradually increasing in resisting force as the carriage moves back, until finally the force of recoil is overcome and the top-carriage is brought to a state of rest. The shock of recoil is to a great extent absorbed without sudden strain to the carriage. The top-carriage must be *out of gear* whenever the piece is discharged; it then moves on the chassis with sliding friction. This, together with the inclination of the chassis-rails, assists in checking the recoil. When the carriage is in good running order, it generally runs forward a short distance by the reaction of the compressed air after recoil. To run the piece *in battery*, the top-carriage is thrown *into gear;* it then moves forward, the air is compressed in front of the pistons, and, escaping gradually through the small holes in the heads of the cylinders, allows the carriage to move forward with a gentle motion. The weight of the air-cylinders with attachments is about 5000 pounds. See *Hydraulic Buffer*.

PNEUMATIC DISPATCH.—This name is given to a mode of sending parcels, mail-bags, or telegram pa-

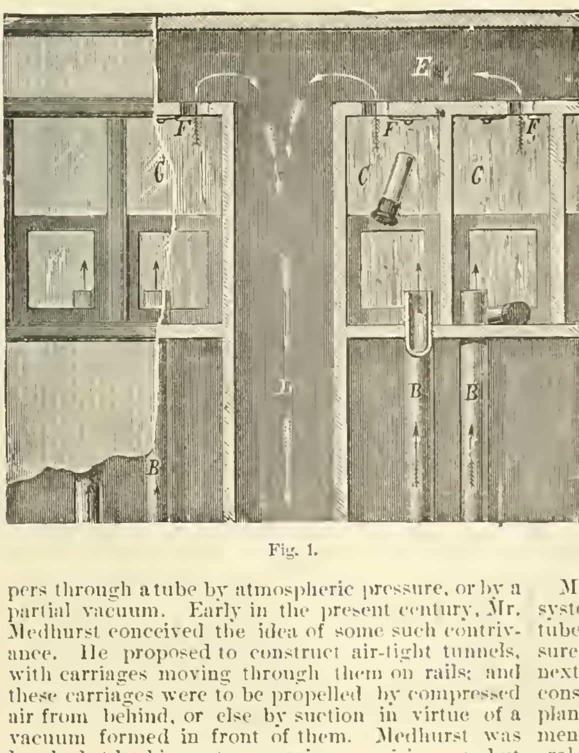


Fig. 1.

pers through a tube by atmospheric pressure, or by a partial vacuum. Early in the present century, Mr. Medhurst conceived the idea of some such contrivance. He proposed to construct air-tight tunnels, with carriages moving through them on rails; and these carriages were to be propelled by compressed air from behind, or else by suction in virtue of a vacuum formed in front of them. Medhurst was laughed at by his contemporaries as a visionary; but his speculations were called to mind in later years, and led to the establishment of ATMOSPHERIC RAILWAYS. In 1861 was announced a *Pneumatic Dispatch* project, based on a reconsideration of the causes of failure in the earlier schemes. The conveyance of passengers and of bulky goods was not here contemplated; parcels and mail-bags were the articles held chiefly in view. To test the theory, a quarter of a mile of iron tube was experimentally laid down near Battersea, with a very fair average of gradients and curves purposely given to it. The tube was about 30 inches in diameter; and it was found easy to propel a train through the tube consisting of two iron-carriages of 7 cwt. each, at a rate of 30 miles an hour. After many financial discouragements, a *Pneumatic Dispatch Company* obtained capital in 1862, and began operations in 1863. The experimental tube was removed to London, and laid down beneath the roadway of Seymour Street, Euston Square—a distance of one-third of a mile. Mail-bags being successfully transmitted in this way, the Company commenced in 1861 the construction of a tube on a larger scale, and this has since been completed. The tube has been laid down from Euston Square to St. Martin's-le-Grand, by way of Tottenham Court Road, Holborn, and Newgate Street—over a distance of 2¾ miles. The tube is of large size, nearly 4½ feet in diameter, laid down at as small a depth beneath the carriage-way of the several streets as the water and gas pipes will permit. It is chiefly of cast-iron; but some portions on a sharp curve are of brick. There is a large engine-house on the south side of Holborn, near Lincoln's Inn Fields, to supply all the power for working the whole tube in both directions. Rarefied air in one-half of the tube draws a train of iron carriages, laden with parcels and mail-bags, from Euston Station to Holborn; and compressed air drives them through the other length of tube from Holborn to the General Post-Office—there being a suction in the one case and pressure in the other. A reverse action brings trains in the other direction. The necessary amount of rarefaction in the one case, and of compression in the other was determined by experiment; but both are produced by means of a revolving fan of peculiar construction and large dimensions worked by a powerful steam-engine at the Holborn Station. If this mode of transmission were to come into general use, there would be great saving of time in the delivery of letters and parcels, and a material lessening of the number of parcels and mail-vans and carts in the overcrowded streets of cities. It is to be regretted that a work so successful in a scientific and engineering point of view should still remain undeveloped in a commercial sense. The Postmaster General, the Railway Companies, and the great Carriers, have made no practical working engagements with the Pneumatic Dispatch Company; and this costly tube, with the engine-house in Holborn, has now remained silent and unused for several years. This of course has checked any extension of the system into other districts. We cannot resist the conviction that a better result will present itself sooner or later. The problem of *passenger* conveyance with a pneumatic tube was shown to be practicable by Mr. Rammell, in an experiment tried at the Crystal Palace in 1864; but nothing further has been done in the matter.

More success has attended the introduction of a system for transmitting small rolls of paper through tubes of a few inches diameter, by pneumatic pressure. Mr. Siemens introduced it at Berlin; it was next tried with success at Paris; Mr. Latimer Clark constructed similar apparatus in London; and the plan is now in regular use in the telegraph department of the new buildings connected with the General Post Office in St. Martin's-le-Grand, while it is also used in some of the chief provincial cities and towns. In 1875 the number of tubes in London was 24, with an aggregate length of nearly 18 miles; there were 4 tubes in Liverpool; 3 in Dublin; 5 in Manchester; 3 in Birmingham; and 1 in Glasgow. Small tubes, two or three inches in diameter, are arranged for the reception of telegraph forms or papers, made up into a roll, and put into a felt cylinder. The purpose is to economize time and expense in conducting the Government Postal Telegraph business by *blowing* along the telegraph forms at a rate of 30 miles an hour, instead of sending them by street conveyance. Two parallel tubes have been laid down beneath the pavements of the streets from the General Post Office to various parts of London, and also in some of the large provincial cities and towns; additions being made to the length of tube according as the system becomes practically developed. One tube in each pair may be called the down line, the other the up; the two are placed in connection at each end, and one steam-engine works them both. The felt cylinder very nearly fills up the tube,

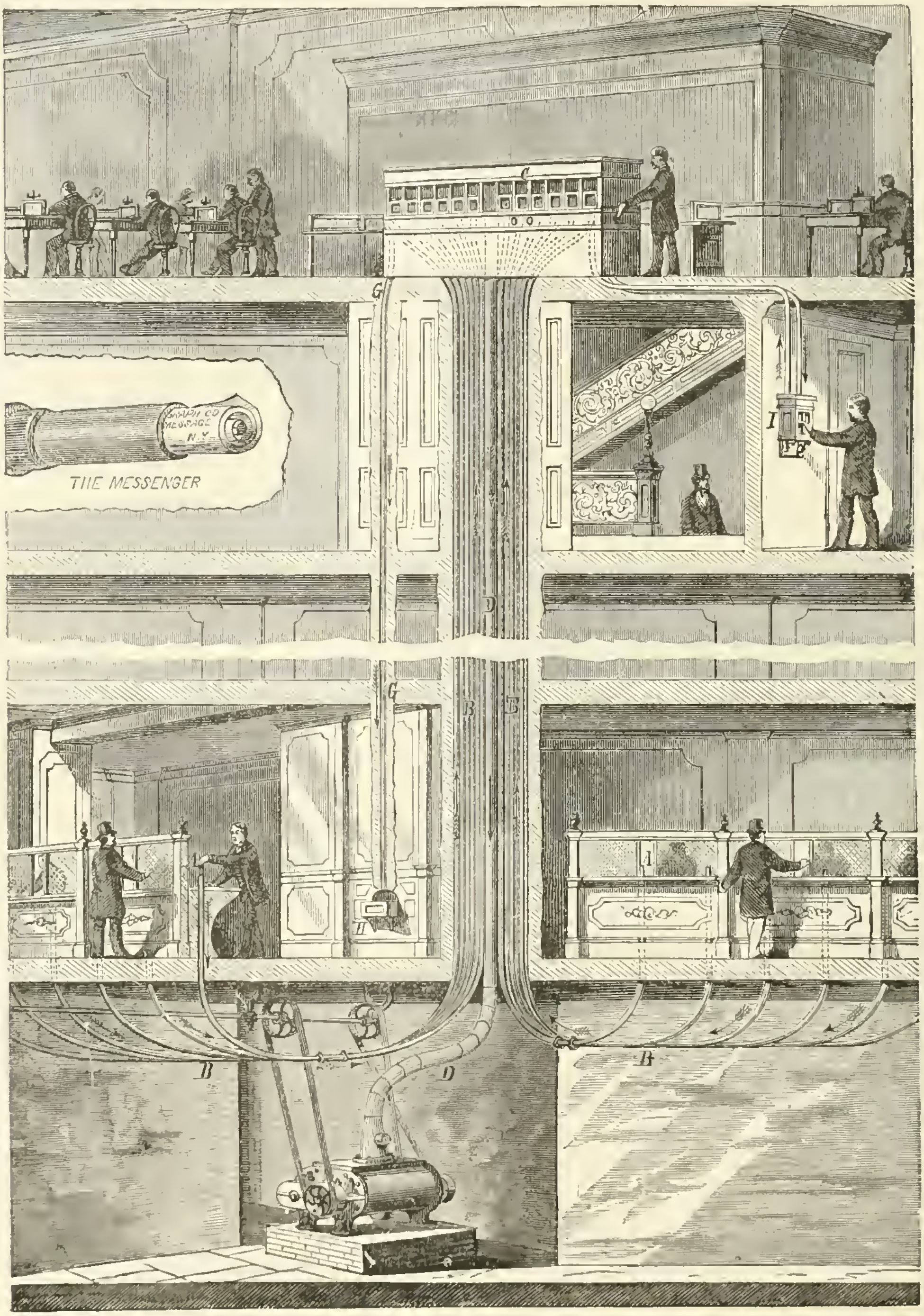


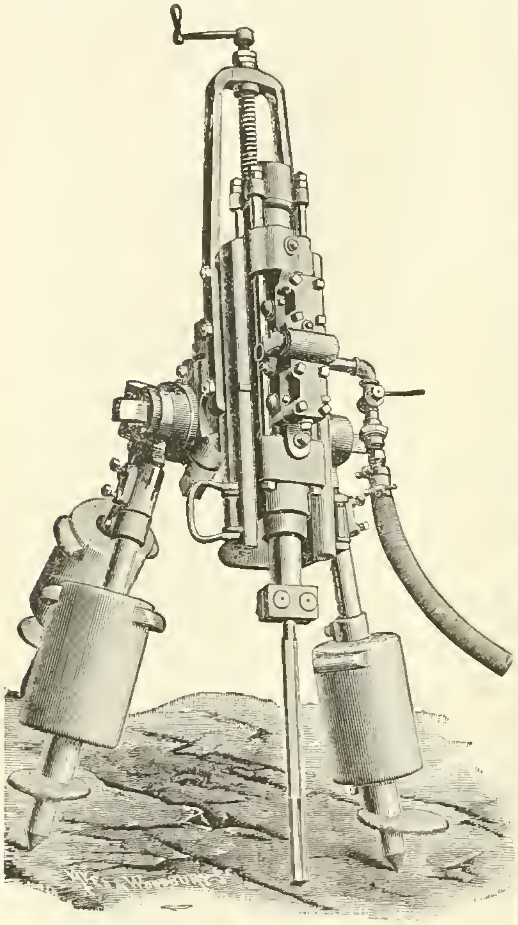
Fig. 2.

but still moves easily along it; this movement is brought about either by the formation of a partial vacuum in front of the cylinder, or by compressing the air behind it; and the steam power is so applied as to produce either or both of these two results, according as convenience may suggest. An ingenious plan is adopted for accommodating one or more intermediate offices, just as local stations are accommodated between the two termini of a railway. The cylinder or *carrier* travels from end to end of the tube, unless a block or check action is purposely put in force at an intermediate station; and the mode of effecting this is one of the most beautiful of Mr. Siemen's inventions relating to the subject. Two pieces of pipe, the *receiver* and the *transmitter*, are made exactly alike, and are so pivoted together that either may be adjusted into a cavity cut in the tube, and made temporarily to form part of it. The carrier, we will suppose, is intended to stop at the intermediate stations, to admit of the removal of some telegram papers and the introduction of others. A click is heard, the carrier strikes against an obstruction in the receiver; the cavity is opened; the exchange of papers is made; the carrier is re-introduced, but into the transmitter instead of the receiver; the cavity is closed again, and the carrier resumes its journey. All this is the work of a few seconds merely. If the intermediate station has nothing to send and nothing to receive, the transmitter alone is used, and the carrier travels on without stopping. The up-tube and the down-tube have each its apparatus of receiver and transmitter. The felt cylinder and its contents being very light, a slight rarefaction of the air in front of it, or condensation of the air behind it, is sufficient to produce a speed equal to twenty or thirty miles an hour. Practically, there is a *current* of air maintained, circulating through the two tubes and their terminal connections; wherever a carrier is placed in this current it is blown along, and there may be two or more carriers traveling at the same time.

We have recently examined, with considerable interest, the pneumatic system of transmitting telegraphic messages between the operating and receiving rooms in the newly constructed building of the Western Union Telegraph Company, in New York. In such an immense edifice, comprising eleven stories, it would obviously involve great delay to maintain the necessary communication by means of messenger boys, and consequently the apparatus which we describe and illustrate herewith has been introduced, with remarkably successful results. In the large engraving, Fig. 2, sections of several of the stories are represented, showing the numerous tubes through which the necessary current of air which propels the packages, are maintained. Those of our readers who have had occasion to send a telegram at the Central Office above named, may remember that, after they had delivered the writing to the clerk, that functionary rolled the paper in a little parcel and inserted it in a wood and leather case, of the manner and form shown in the upper portion of the illustration, Fig. 2. He then dropped the case into an open tube, leading up through his desk, at A, and perhaps announced that the packet had reached the operating room, in the seventh story, almost before the curious watcher of his proceedings had had time to draw a second breath. The packet appeared to be sucked into the tube, and so in fact it is, and in about two seconds it is drawn up almost to the top of the great building. After leaving the clerk's hand it passes down through the wide curve in its conduit, at B, and thence ascends the straight portion of the same, until it jumps forth from the end of the tube i none of the compartments of the receptacle, C, in the operating room. A section of a good portion of this receptacle is also well represented in Fig. 1, in one compartment of which a packet is seen emerging from its tube. The compartments, C, are entirely cut off from the main portion of the case, being constructed within the same, so that above them and extending over all is a large empty chamber, E. With the latter, however, each compartment communicates by an orifice, F, which is provided with a cover opened or closed at pleasure, thus, as will be seen further on, throwing any tube into or out of action, or moderating the air current therein as is desired. In the center of the receptacle and opening into the upper chamber, E, is a large tube, D, which extends down beside the pipes, B, and connects with a blower in the cellar. It is a positive blast rotary blower, invented and constructed by the well known firm of P. H. & F. M. Roots, of Connersville, Ind. The machine has long been in use in iron founderies, machine and blacksmith shops, and other establishments, and, besides, has met with extensive employment for ventilating purposes in buildings, ships, mines, and other localities. It will be understood that, in the present instance, the blower forces the air out beneath, so that the current is drawn down the tube, D, through the chamber, E, in the receptacle above, thence through the orifices, F, and compartments, C, and finally up through the pipes, B. Thus used as an exhauster, and at the slow speed of 120 revolutions per minute, it draws down five cubic feet of air per revolution, or 36,000 cubic feet per hour, thus propelling the packets, and at the same time (by removing the last mentioned aggregate quantity of air from the atmospheres of the rooms with which the pipe orifices communicate) serving as an excellent and efficient ventilating apparatus.

After a packet arrives in the upper story, the person stationed at the receptacle lifts a little window in the compartment which it enters, takes out the case, extracts the paper therefrom, and passes the message at once to the proper operator, who immediately telegraphs its contents to their destination. The case is then returned to the first story by dropping it into the open tubes, G, through which it falls by its own gravity, landing in the box, H, whence it is again taken out to be filled and started back on its journey. The general adoption of this system by all Military Headquarters, allowing that it will operate through tubes of half a mile length as effectively as it does at the Western Union Office, would expedite the collection and distribution of official matter, and greatly promote the public service and convenience.

PNEUMATIC DRILL.—A drilling-machine operated by compresseed air admittted alternately above and below a piston connected with gear-wheels which rotate the drill. The air-reservoir and force-pump may be placed at any required distance from the cylinder, and connected therewith by a flexible pipe. The introduction of the first Burleigh drill into the Hoosac Tunnel ten years ago marked a new era, not only in that great engineering enterprise, but in the history of rock work throughout the world. Up to that date many had been the attempts to produce a machine that would supersede the severe manual labor of the sledge and hand drill, but all proved failures. Eventually Mr. Burleigh took up the matter and solved the problem by producing the machine which bears his name,and which is a monument to his genius. The main elements of the drill, shown in the drawing, are the cage, the cylinder, and the piston. The cage is merely a trough, with ways on either side, in which the cylinder,by means of a feed-screw and an automatic feed-lever, is moved forward as the drill cuts away the rock. The piston moves back and forth in the cylinder, propelled and operated either by steam or compressed air, like the piston of an ordinary steam-engine. The drill point is attached to the end of the piston,which is a solid bar of steel. The piston is rotated as it moves back and forth by ingenious and simple mechanism. The forward motion of the cylinder in the trough is regulated by an automatic feed as the rock is cut away, the advance being more or less rapid, as by the variation in the nature of the rock the cutting is fast or slow. It will thus be seen that the drill-point and solid steel piston alone receive the shock of the blow; and it also should be stated, that the piston-rod, arranged with a double annular cam and spiral grooves, in its movements performs three important functions. First. The movement of the valve admitting the steam or compressed air to the cylinder. Second. By the operation of the annular cam acting upon the feeding device, the cylinder is moved forward (as the rock is penetrated) in the cage or slide. Third. By the spiral grooves and a spline in the ratchet, the piston bar is automatically rotated, a partial revolution taking place at each upward movement of the piston, the ratchet remaining perfectly stationary while the rotating movement occurs, and moving only as the piston again descends. When the cylinder has been fed forward the entire length of the feed-screw, it may be run back, and a longer drill-point inserted in the end of the piston.



By an ingenious peculiarity in the form of the cutting-edge of the drill-point, perfectly round holes are ensured; thus giving a greater area to the hole, and a larger percentage of the powder near its bottom. The regular rotation of the drill insures the delivery of each blow at the point of greatest efficiency; each wing of the drill-point striking the rock at a point just far enough in advance of the cut of the preceding blow to chip away the rock lying between. The yielding of the chip saves the edge of the drill-point; and thus the advance of the drill-point in the rock, without sharpening, is *ten times greater* than is possible in hand-drilling, where the hole is formed by the crushing and pulverising of the rock. The drilling-machine is attached to a clamp by means of a circular plate, with a beveled edge cast upon the bottom of the cage near its center. This plate fits a corresponding cavity in one side of the clamp, and is held there firmly in any required position by the tightening of screws. The clamp is clasped about a bar of iron to which it may be quite tightly held by screws.

By the motions—upon one plane, of the plate in its cavity, and upon another, at a right angle to the first, of the clamp upon the bar, and the sliding endwise of the clamp upon the bar—it will be seen at once that any position and direction of the drill is attainable. It only remains to securely attach the bar, of any reasonable length, to a convenient carriage or suitable frame, and the machinery is ready for operation. These machines are applicable to all kinds of rock work, whether in mining, quarrying, cutting, tunneling, or in sub-marine drilling. They combine simplicity, strength, lightness and compactness, are easily handled, and require but few repairs. With them, holes may be drilled from three-fourths of an inch to five inches diameter, and to a depth not exceeding thirty to thirty-five feet, at the rate of from two to ten inches per minute, according to the nature of the rock. They are driven by either steam or compressed air as a motor, and, under a pressure of fifty pounds to the inch, work at two hundred to three hundred blows per minute, according to the size of the machine.

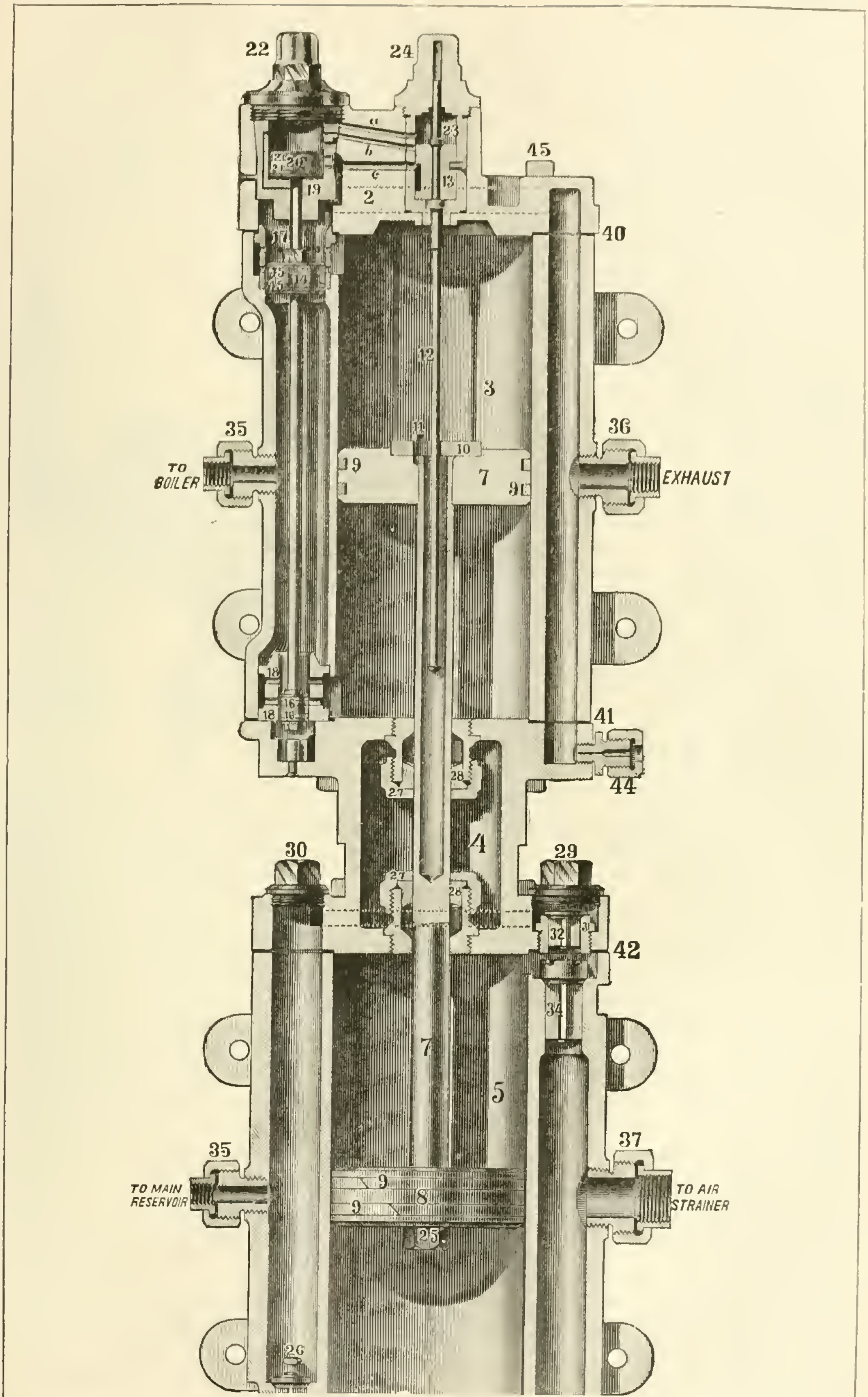
PNEUMATIC GUN-CARRIAGE.—Facility of maneuver is of the greatest importance, after strength and stability, in a gun-carriage, and the training and running of heavy carriages, and the elevating and depressing of the gun, are now generally accomplished by means of toothed-gear. Modern guns should be trained very quickly and smoothly, and facility in that respect is of inestimable advantage in combat, hence a simple carriage that will return a B. L. gun, automatically to battery after each discharge is greatly to be desired.

Simplicity of construction also is a very important quality in a gun-carriage for sea-service, where the liability to rust, deterioration and damage from shot is very great, and the facilities for repair limited. Unfortunately, the modern carriages are entirely too elaborate in construction, and the aim in the design should be always to make the working parts as accessible as possible, and as simple as is consistent with the object in view.

The endurance of a carriage is greatly enhanced by a real judicious application of the recoil check. Though it is desirable, on general principles, to allow the carriage free recoil, it is not usually possible to do so in practice, and, in fact, since the introduction of B. L. cannon, it has been an object to limit the recoil as much as possible, with a view to return the gun quickly to battery. Any device that will give an increasing check is much the easier on the carriage.

A comparison of the foregoing will demonstrate the advantages of the pneumatic carriage in rapidity of maneuver, simplicity of construction, certainty of action in any climate, protection of the vital parts, and endurance. The use of water as a recoil check makes a summer gun-carriage; other fluids are liable to cake or clog the cylinders at an important moment. Any misadjustment or accident to the valves of any hydraulic check would cause an instant splitting of the cylinders, thereby disabling the gun—an impossible occurrence when using an elastic gas.

As a familiar example of the application of pneumatic force, the Westinghouse air-brake may be here cited. The introduction of this appliance was baffled for six years by the adverse opinion of eminent Engineers as to its practical utility. It never freezes clogs or splits the pipes, and one man controls with ease a great train of cars. In this connection it may be remarked that the use of hand-gearing in modern gun-carriages is comparable to the old style "brakes" on a railway train. The operating of the gun-carriages, either in the forts or on ships, by means of com-


22
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b
c
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TO BOILER
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EXHAUST
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TO MAIN RESERVOIR
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TO AIR STRAINER
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26

pressed air supplied to the working parts from the pipe led to the breast of the carriage, and controlled by simple levers, for rapid training, for rapidly raising or lowering the gun to aim, for checking the recoil without shock, and for running in and out when desired, is absolutely practical, certain in its action, and the least liable to accident.

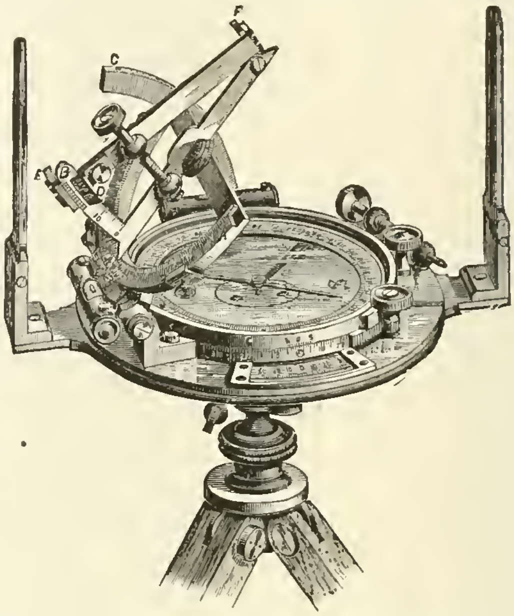
A section of the Westinghouse air-pump is shown in the drawing. The parts are numbered as follows: Steam-cylinder Head (with reversing-cylinder, piston, and valve bushes),2; Steam-cylinder (with the main valve and bushes,) 3; Center-piece, 4; Air-cylinder (with lower discharging-valve), 5; Steam-piston and Rod, 7; Air-piston, 8; Main Piston Packing-ring, 9; the Reversing-valve, the Reversing-valve Plate, the Plate Bolt and Stem, 13, 10, 11, 12, Main Steam-valve, 14; Packing-rings for the Upper and Lower Piston-valves, 15, 16; the Upper and Lower Main Steam-valve Bushes, 17, 18; Reversing-cylinder and Cap, 19, 22; Reversing-piston and Packing-ring, 20, 21; Reversing-valve Bush and Cap, 23, 24; Piston-rod Nut, 25; Discharge-valve Stop-bolt, 26; Piston-packing Nut and Gland, 27, 28; Right and Left Chamber Caps, 29, 30; Upper Discharge-valve and Seat, 32, 31; Receiving-valve, 34; Half-inch Union, 35; Three-quarter-inch Union, 36; One-inch Union, 37; Top and Bottom Steam-cylinder Gaskets, 40, 41; Top Air-cylinder Gasket, 42. The steam from the boiler enters the top cylinder between two pistons forming the main valve, 14. The upper piston being of greater diameter than the lower, the tendency of the pressure is to raise the valve, unless it is held down by the pressure of a third piston, 20, of still greater diameter, working in a cylinder directly above the main valve.

The pressure on this third piston is regulated by the small slide-valve, 13, working in the central chamber on the top head. This valve receives its motions from a rod, 12, extending into the hollow piston, which, as shown in the drawing, has a knob at its lower end and a shoulder just below the top head. This valve chamber in the top head, by a suitable steam-port, is constantly in communication with the steam space between the two pistons of the main valve. The steam acting on the third piston, 20, and holding the main valve down, enters below the main piston; as the main piston approaches the upper head, the reversing-valve rod, 12, and its valve, 13, are raised until the slide-valve exhausts the steam from the space above the third or reversing piston, when the main valve is raised by the steam pressure on the greater area of its upper piston, which movement of the main valve admits the steam to the upper end of the main cylinder.

When the main valve is moved up to admit steam to the upper end of the cylinder, it opens an exhaust-port at the lower end, just below the lower steam-port, which latter is closed by the lower piston of the main valve; and when the main piston is on its upward stroke, the upper exhaust-port is similarly opened. The air-valves of the pump are similar to those used in all pumps. The lift of a discharge valve should not exceed one sixteenth of an inch. See *Powlett Gun-carriage*.

POCKET LEDGER.—A small account-book with which a soldier in the British service is provided, and in which is inserted the monthly settlement of his accounts, having reference to his pay, the state of his savings-bank account, date of enlistment, etc. Commanding Officers are to see that these books are kept with the utmost regularity, the officer commanding the company of the soldier being responsible that the book is kept correctly, his signature being a voucher for the same. This book is familiarly termed by the soldier his "Tommy Atkins."

POCKET SOLAR COMPASS.—This instrument has a needle 3 inches long, and a limb of 4½ inches diameter, divided to half degrees and reading by its one double vernier horizontal angles to single minutes. The arrangement of the plates is similar to that of the large solar compass, the under plate carrying the sights revolving around the upper or compass-plate to which are attached the solar apparatus, levels, etc.; there is also a clamp with tangent-screw between the two plates, and another to the whole instrument about its spindle. The distance between the sights is nearly 7 inches, the sights themselves are 4½ inches high, and have a slot and hair in half their heights; they are hinged so as to fold down in packing. The compass-circle is arranged with pinion and movable part so as to set off the variation of the needle to five minutes; the needle has a lifting-lever, as usual, by which it is raised against the glass. The solar ap-



paratus is attached to the flange of the upper plate, and consists of the usual *hour*, *latitude*, and *declination arcs*, marked respectively, A, C, and B, in the drawing, with an arm, F F, to the last named, carrying the solar lenses and lines as in the larger instruments. The latitude and declination arcs are each divided to half degrees, and read by verniers, the latitude arc to five minutes, and the declination arc to single minutes of a degree; the hour arc is divided on its inner edge into hours and twelfths, or spaces of five minutes each, the index of the declination arc above easily enabling one to read the time to single minutes.

The hour arc is made movable on its supporting segment to either side, its outer edge being also divided on the middle portion to spaces of five minutes of time, and read by a vernier upon the segments to single minutes; in this way the *equation of time* for any given day is set off at once, and the time given by the index of the hour arc thus made to agree with mean time or that given by the ordinary clock.

The solar lenses and lines are placed as in the larger instruments, the declination arc being also reversible, as the sun changes from north to south of the equator.

When packed in the case the declination arc with its arm is detached from the hour arc; and this itself, together with the latitude arc, folds very closely to the compass box.

The pocket solar is set up for use either upon the ball spindle, with staff mountings, or upon a light tripod like the other pocket compasses, and very often with small leveling-head with clamp and tangent screws.

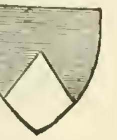
Sometimes a side telescope with counterpoise is substituted for the sight-vanes.

When about to use the instrument, it is set upon its tripod or staff, and carefully leveled; the declination of the sun for the given day and hour is obtained from the Ephemeris supplied with this and other solar instruments, and set off upon its arc, and the hour arc is raised until its vernier marks the latitude of the place upon the latitude arc. The equation of time for the day is also set off as before described, the zero of the hour circle being moved to the right when the equation is to be added, and to the left when it is to be subtracted from apparent time. The index of the declination arc being then set to the proper division on the hour arc, and the declination arm directed to the sun, the limb being also set at zero, and the sun's image brought between the hour lines of the silver plate by turning the whole instrument upon its spindle, the sights will indicate the *true meridian* precisely as with the larger solar compass. The compass-circle being now turned by the pinion until the needle points to zero, the needle also will be set to the true meridian, and the variation of the needle can be read off upon the outside divisions of the compass-box.

The adjustments and the use of this solar arc substantially the same as those of the solar compass, and its indications so accurate that after repeated trials it will give the true meridian within an error of less than three minutes of a degree, which taken in connection with the deflection of the magnetic needle will indicate with certainty the presence and direction of veins of magnetic iron ore.

Indeed, we have the assurance of competent Surveyors that while it is much more portable it is also very nearly or quite as accurate in all its indications as the large solar compass. Its weight, excluding box and tripod, is $4\frac{3}{4}$ lbs. See *Solar Compass*.

POINT.—In Heraldry, a triangular figure issuing from the dexter and sinister base of the shield. It is common in French and German Heraldry, and occurs in the shield of Hanover, which was a part of the royal arms of Great Britain from the accession of George I. till that of the present Sovereign. A shield charged with a point is in heraldic drawing hardly distinguishable from one parted per cheveron. See *Points*.



Point.

POINT-BLANK.—With all small-arms, the second point in which the natural line of sight (when horizontal) cuts the trajectory. With artillery, it is the point where the projectile first strikes the horizontal plane on which the gun stands, the axis of the piece being horizontal.

Usually, the object aimed at has a certain height; hence, it will not only be struck when at *point-blank*, but also when at points in rear or in front of the point-blank where the vertical distances of the trajectory from such points shall be equal to or less than the height of the object. This distance between these two points, known as the dangerous space, is greater as the trajectory is flattened or as the height of the object is greater.

In the drawing, A F, is the line of fire; A′ F P, is the natural line of sight; and A″ F P′, is an artificial

line of sight. It will be seen that the object P P′, beyond the *point-blank*, is struck at the bottom, P′. If it were at *point-blank*, it would be struck at P. Were the object increased in height, above P, it would also be struck when placed between *point-blank* and the piece. The sum of the distances in front and rear of the point-blank, at which the object could be struck at its bottom and top, is the dangerous space. This permits us to make slight errors in estimating distances; we can either over or under estimate them so long as the errors do not exceed the limits of the dangerous space. See *Artificial Point-blank*.

POINT BLANK RANGE.—The distance from the muzzle of the piece to that point in the projectile's trajectory where it cuts the prolongation of the natural line of sight, a second time, the natural line of sight being horizontal. The British define *point-blank range* as, the distance from the muzzle to the first graze when the axis of the piece is parallel to the horizontal plane upon which the carriage stands; but this is really nothing more than the range due to the *angle of elevation* equal to the angle subtended by the height of the gun from the point struck. See *Point-blank*.

POINT BLANK SHOT.—The shot of a gun pointed directly toward the object to be hit.

POINT D'APPUI. A fixed point of support in rear of the operations of an army, or on its flanks, such as a fortress or some convenient locality to resort to in case of necessity. A *Point d'Appui* is of great importance in military tactics. Few battles have been fought without making use of villages, hills, and even trees as *Points d'Appui*. In changes of front, one flank, or part of the force, should be held securely appuyed. Artillery massed in batteries have also served as *Points d'Appui*, as instanced at the battles of Borodino, Ramilies, Hohenkirch, etc.

POINTED STAKES.—A form of impediment used on the berm, at the bottom of the ditch and beyond the counterscarp. They are placed about one foot in the ground, and stand about one foot above it.

POINTING.—To point or aim a fire-arm, is to give it such direction and elevation that the projectile shall strike the object. To do this properly, it is necessary to understand the relations which exist between the line of sight, the line of fire, the trajectory, etc. The *line of sight* is the right line containing the guiding points of the sights. The sights are two pieces, *A* and *B*, on the upper surface of the gun, the situation of which with regard to the axis of the bore is known. The *front* sight is situated near the muzzle, or on the right rimbase, and is generally fixed; the *rear* sight is placed near the breech, and is movable in a vertical, and sometimes in a horizontal direction. The *natural line of sight* is the line of sight nearest the axis of the piece; the others are called artificial lines of sight. The *line of fire* is the axis of the bore prolonged in the direction of the muzzle, or *C D*. The *angle of fire* is the angle included between the line of fire and horizon; on account of the balloting of the projectile, the angle of fire is not always equal to the angle of departure, or projection. This is evident. The *angle of sight* is the angle included between the line of sight and line of fire; angles of sight are divided into natural and artificial angles of sight, corresponding to the natural and artificial lines of sight which enclose them. The *plane of fire* is the vertical plane containing the line of fire. The *plane of sight* is the vertical plane containing the line of sight. The *point-blank* is the point at which the line of sight intersects the trajectory, or *P*. Strictly speaking, the line of sight intersects the trajectory at two points, *C* and *P*; but, in practice, the latter point *P* is only considered. The distance, *B P*, is called the point-blank distance. The *natural point-blank* corresponds to the natural line of sight; all other point-blanks are called *artificial point-blanks*. In speaking of the point-blank of a piece, the natural line of sight is supposed to be horizontal. In the British service, the point-blank distance is the distance at which the projectile strikes the level ground on which the carriage stands, the axis of the piece being horizontal. It is evident that this definition of point-blank distance conveys a better idea of the power of the piece than the former, which makes it depend on the form of the piece, as well as on the charge. As the angle of sight *A C C′*

is increased, the point-blank distance is increased; as it is diminished, the intersections of the line of sight and trajectory approach each other until they unite, when the line of sight and trajectory are tangent to each other; beyond this, the point-blank is imaginary. As the angle of fire increases, the force of gravity acts more in opposition to the force of projection, and the point-blank distance is diminished, until at 90° it becomes zero. Under an angle of depression, the force of projection acts more nearly in the direction of gravity, and the point-blank distance is increased, becoming infinite when the angle of depression is equal to 90° minus the

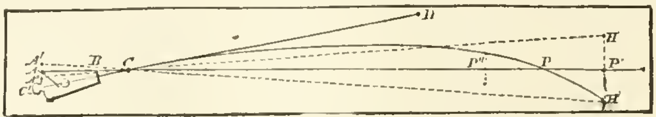


Fig. 1.

angle of sight. In ordinary firing, it is not considered that the trajectory changes its position with reference to the line of sight and line of fire, for any angles of elevation and depression, less than 15°. In aiming at an object, therefore, the *angle of elevation* of which is less than 15°, aim exactly as though it were in the same horizontal plane with the piece. For the same piece, the point-blank distance increases with the charge of powder; for the same initial velocity, a large projectile has a greater point-blank distance than a small one; a solid shot than a hollow one; an oblong projectile than a round one; or, in other words, it varies with the value of *c*, before referred to. *Range* is the distance at which a projectile first strikes the ground on which the carriage is situated; *extreme range* is the distance to the point at which the projectile is brought to rest.

In pointing guns and howitzers under ordinary angles of elevation, the piece is first directed toward the object, and then elevated to suit the distance. The accuracy of the aim depends—1st. On the fact that the object is situated in the plane of sight; 2d. That the projectile moves in the plane of fire, and that the planes of sight and fire coincide, or are parallel and near to each other; and 3d. On the accuracy of the elevation. The first of these conditions depends on the eye of the gunner, and the accuracy and delicacy of the sights; the errors under this head are of but little practical importance. When the trunnions of the piece are horizontal, and the sights are properly placed on the surface of the piece, the planes of sight and fire will coincide; but when the axis of the trunnions is inclined, and the natural line

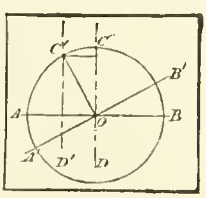


Fig. 2.

of sight is oblique to the axis of the bore, the planes are neither parallel nor coincident, and the aim will be incorrect. If the natural line of sight be made parallel to the line of fire, by making the height of the front sight equal to the dispart of the piece, the planes of sight and fire will be parallel, and at a distance from each other equal to the radius of the breech multiplied by the sine of the angle which the axletree makes with the horizon. To show this, let the circle $A\ C\ B\ D$, in Fig. 2, represent the section of the breech taken at right angles to the axis, and C the projection of the natural line of sight upon this plane; let $A'\ B'$ be the inclined position of the axletree, or trunnions, C'' marks the revolved position of the natural line of sight, and $C''\ D'$ the trace of the plane of sight, which is parallel to $C\ D$, the trace of the plane of fire. As the lines of sight and fire are parallel in their revolved position, the planes of sight and fire must also be parallel. The angle $COC'' = BOB'$, therefore $CC'' = OC'$ sin. BOB'. It is easily seen that with this arrangement of the front sight, the error of pointing can never exceed the radius of the breech. By an inspection of the figure, it will also be seen, that in the revolved position of the line of sight, the elevation is diminished by a small quantity, which is equal to the versed sine of the arc CC''.

If the natural line of sight be not parallel to the axis of the piece, the planes of sight and fire intersect at a short distance from the muzzle; hence, it follows, that as the object is situated in the plane of sight, the projectile will deviate from the object to the side on which the lower wheel is situated, and at a distance from it, which is proportional to the distance of the object from the piece; to correct for this source of error, the line of sight should be pointed to the side of the higher wheel, and at a distance from the object, which is proportional to the distance of the object from the piece. Siege and sea-coast cannon are generally fired from fixed platforms, which renders the axis of the trunnions horizontal; they are, therefore, not furnished with pendulum sights. In case the axis of the trunnions is not horizontal, and the piece has not a pendulum hausse, the highest points of metal at the breech and muzzle may be determined by the gunner's level and marked with chalk; the center line of the tangent scale, or breech-sight, is placed on the mark at the breech, the slider is placed at the proper elevation, and the aim is taken along the notch of the slider and the mark on the muzzle. This method, however, does not give a perfectly accurate aim. In the absence of a breech-sight, the piece can be pointed with the natural line of sight so as to strike objects not situated at point-blank distance if the object be within point-blank range, as at P'', Fig. 1, the natural line of sight should be depressed below the object as much as the trajectory is above it; if it be beyond point-blank, as at P', the natural line of sight should be directed to a point H, which is as much above the object, as the point H', of the trajectory, is below it. Owing to the shape and size of the reinforce of sea-coast cannon, the natural line of sight is formed by affixing a front sight to the muzzle, or to a projection cast on the piece between the trunnions. Although the latter arrangement does not give quite so long a distance between the sights as is desirable, it permits the use of a shorter breech-sight, and the front sight does not interfere with the roof of the embrasure, when the piece is fired under high elevation.

In pointing small-arms and mortars, the piece is first given the elevation, and then the direction necessary to attain the object. Mortars are generally fired from behind epaulements, which screen the object from the eye of the gunner. The elevation is first given by a gunner's quadrant; and the direction is given by moving the mortar-bed with a handspike, so as to bring the line of sight into the plane of sight, which, by construction, passes through the object and the center of the platform. The plane of sight may be determined in several ways; the method prescribed is to plant two stakes, one on the crest of the epaulement, and the other a little in advance of the first, so that the two shall be in a line with the object, and the gunner standing in the middle of the rear-edge of the platform; a cord is attached to the second stake, and carefully held so as to touch the first stake; a third stake is driven in a line with the cord, in rear of the platform, and a plummet is attached to this cord so as to fall a little in rear of the mortar. It is evident that the cord and plummet determine the required plane of sight into which the line of sight of the mortar must be brought. The usual angle of fire of mortars is 45°, which corresponds nearly with the maximum range. The advantages of the angle of greatest range are: 1st. Economy of powder; 2d. Diminished recoil, and strain on the piece, bed, and platform; 3d. More uniform ranges. When the distance is not great and the object is to penetrate the roofs of magazines, buildings, etc., the force of fall may be increased by firing under an angle of 60°. The ranges obtained under an angle of 60° are about *one tenth* less than those obtained with an angle of 45°. If the object be to produce effect by the bursting of the projectile, the penetration should be diminished by firing under an angle of 30°. When the object is not on a level with the piece, the angle of greatest range is considered in practice to be $45° + \frac{1}{2}A$, or $45 - \frac{1}{2}A$, A being the angle of elevation or depression of the object. Thus, to attain a magazine, for instance, situated on a hill, for which $A = 15°$, the angle of greatest range is $52\frac{1}{2}°$ instead of 45°. The angle of fire being fixed at 45° for objects on the same level with the piece, the range is varied by varying the charge of powder. The practical rule is founded on the knowledge of the amount of powder necessary to diminish or increase the range 10 yards. For the French 8 and 10 inch siege mortars, this amount is about 60 grains for the former, and 125 grains for the latter. A practical rule for finding the time of flight by which the length of the fuse is regulated, is to take the square root of the range in feet, and divide it by four; the quotient is the approximate time in seconds. Stone-mortars are pointed in the same manner as common mortars: the angle of fire for stones is from 60° to 75°, in order that they may have great force in falling; the angle for grenades is about 33°, in order that their bursting effect may not be destroyed by their penetration into the earth. Cannon are pointed at night by means of certain marks, or measurements, on the carriage and platform, which are accurately determined during the day. See *Cannon* and *Firing*.

POINTING-BOARD.—In gunnery, a piece of board 1 foot long, 2 or 3 inches wide, and 1 inch thick, having a notch cut in the middle of one side to fit on the stake, and graduated into equal divisions from its middle. When not in use the pointing cord may be wound on it. This board is used for pointing mortars.

POINTING-CORD.—A cord used in pointing mortars By means of *pointing-stakes*, one of the fixed points is established upon the crest of the parapet or at the foot of the interior slope, and another in rear of the piece. Then by a cord called the *pointing-cord*, stretched between these two points, with the plummet suspended from it, a vertical plane is determined with which the line of metal is made to coincide.

POINTING-RINGS.—Two rings, one smaller than the other, attached to the upper surface of the trail of the stock of a field gun-carriage, for the reception of a handspike, which enables the cannoneers to raise the trail and carry it to the right or left. The trail-handles serve the same purpose, but are used principally for raising the stock.

POINTING-RODS.—Pickets or rods of iron $\frac{3}{4}$ inch round, and about 2 feet long, two of which are placed upon the epaulement of a battery in front of each mortar, by means of which, with the aid of a plummet, the mortar can be directed with tolerable accuracy upon the object to be struck. The pickets are first lined upon the object; the plummet, which is in the hands of the laying officer, who stands behind the mortar, is made to coincide with them, and the mortar is then traversed until the line of the plummet covers the center line on the mortar, which is denoted by a notch on the muzzle, and another behind the vent; a chalked line is generally drawn on the exterior surface of the mortar between these notches. In masonry works, they must be placed on a fir plank, and about 6 inches from each end. The plank should be fitted with a grummet or handle at each end. In earthworks, two ramrods will answer for pointing-rods.

POINT OF ATTACK.—In siege operations, after obtaining all the information that can be had from reconnaissances, surveys, and other sources, the next object is to decide upon the portion of the defenses which it will be necessary to gain possession of to force the garrison to a surrender; this portion, which usually embraces one or more fronts of the position, with the outworks and any advanced works that may be connected with them, and which must be reduced before the points of the main work can be assailed, is termed the *Point of Attack*. It is in the choice of this point—a decision which mainly rests with the Commanding Officer—that the judgment and skill of this Officer are shown. In making this selection, not only must the relative strength of the various points of the defenses which are accessible be carefully weighed, but the nature of the site as to soil, natural surface, etc., upon which the trenches and other works of the attack must be laid out, and the facilities afforded of an easy communication between the parks, *depôts*, etc , and the point selected.

In considering the strength of the defenses, those parts are regarded as unassailable by the ordinary measures of an attack, which border upon precipices, marshes, a water-course that cannot be forded; or are protected by works on inaccessible points, the fire from which sweeps in flank and reverse the ground over which the trenches must be run. Those parts, again, are considered as offering peculiar difficulties which present a series of works in good defensive relations which can only be carried in succession; or works which are mined; or those which have their ditches arranged for a play of water; which have dry ditches of unusual depth; or, those parts where the works to be carried are displayed on a right line, embracing nearly the same extent of front that the besiegers can take up with their trenches; or, finally, portions which present a concave front to the attack. The points which are looked upon as most advantageous to the attack are those in which the general combination of the works forms a salient point with respect to the rest of the defenses; as a point so situated can receive but little support from the collateral portions, and can be enveloped by a line of trench of much greater extent than itself, along which positions can be obtained for enfilading and other batteries, the fire of which will be convergent upon that of the defenses. See *Key-point*.

POINT OF FALL.—The point at which the projectile strikes the ground, when permitted to do so. When the gun and *point of fall* are on the same level, the *angle of fire* is always less than the *angle of fall*.

POINT OF FORMATION.—The point taken, upon which troops are formed in military order.

POINT OF HONOR.—A nice discrimination in matters affecting one's honor. A delicacy of feeling, which is most generally acquired by education, and strengthened by intercourse with men of strict integrity and good conduct. It is likewise very frequently the offspring of peculiar habits, received notions, and established etiquettes.

POINT OF IMPACT.—That point or spot which a projectile first strikes on meeting an opposing body. The method of finding the *point of mean impact* is as follows: The horizontal distance of each shot upon the target from a fixed vertical base (generally one side of the target) is first found, and a mean horizontal distance obtained, by dividing the sum of the distance by the number of shot; the same process is followed to obtain a mean vertical distance from a fixed horizontal base (generally the bottom of the target). The intersection of the two lines drawn parallel to the bases respectively and at distances equal to the horizontal and vertical mean distances already found, gives what is termed the *points of mean impact*. The distance of each shot from the *point of mean impact* is measured; these distances are added together, and the sum, divided by the number of shot on the target, gives the *figure of merit*. Half a diagonal is allowed for every shot that does not strike the target.

POINT OF WAR.—A loud and impressive beat of the drum, the perfect execution of which requires great skill and activity. The *Point of War* is beat when a battalion charges.

POINTS.—Movements in Sabre Exercise executed as follows:

Tierce Point.—Being at guard, raise the hand in tierce as high as the eye: throw back the right shoulder, carrying the elbow to the rear, the point of the saber to the front, the edge upward. (Two.) Thrust to the front, extending the arm to its full length, edge up. (Three.) Resume the guard.

Quarte Point.—Being at guard, lower the hand in quarte near the right hip, the point a little higher than the wrist. (Two.) Thrust to the front, extending the arm to its full length. (Three.) Resume the guard

Left Point.—Being at guard, turn the head and shoulders to the left, draw back the hand in tierce toward the right shoulder, the hand at the height of the neck, the edge of the blade upward, the point to the left and as high as the hand. (Two.) Thrust to the left, extending the arm to its full length. (Three.) Resume the guard.

Right Point.—Being at guard, turn the head to the right, carry the hand in quarte near the left breast, the edge of the blade upward, the point to the right and as high as the hand. (Two.) Thrust to the right, extending the arm to its full length. (Three.) Resume the guard.

Rear Point.—Being at guard, turn the head and shoulders to the right and rear, bring the hand in quarte near the left breast, the point to the rear and as high as the hand, the edge upward. (Two.) Thrust to the rear, extending the arm to its full length. (Three.) Resume the guard.

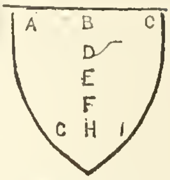
Against Infantry, Right Point.—Being at guard, this movement is executed the same as quarte point, turning the head and shoulders to the right, inclining the point downward. (Two.) Thrust in quarte. (Three.) Resume the guard.

Against Infantry, Left Point.—Being at guard, this movement is executed the same as Left Point, except the point is downward. (Two.) Thrust down in tierce. (Three.) Resume the guard.

Against Infantry, Front Point.—Being at guard, bend well down to the right, extend the right arm well downward, the hand in rear of the thigh, the back of the saber upward. (Three). Resume the guard. See *Saber Exercise.*

POINTS OF PASSING.—The ground on which one or more bodies of armed men march by a Reviewing General.

POINTS OF THE ESCUTCHEON.—In Heraldry, in order to facilitate the description of a coat-of-arms, it is the practice to suppose the shield to be divided into nine points, which are known by the following names: A, the dexter chief point; B, the middle chief; C, the sinister chief; D, the collar or honor point; E, the fess point; F, the nombril, or naval point; G, the dexter base point; H, the middle base point; and I, the sinister base point. The dexter and sinister sides of the shield are so called, not in relation to the eye of the spectator, but from the right and left sides of the supposed bearer of the shield.



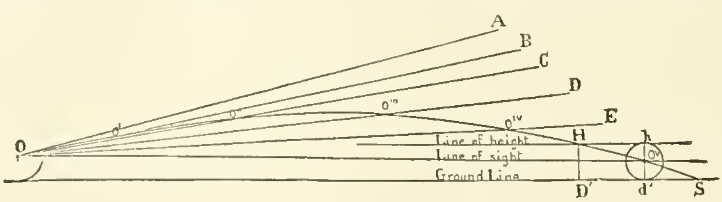
Points of the Escutcheon.

POITRAIL.—That portion of the horse armor which covers the breast, fitted either with hinges or like a flounce. Also written *Poitrel.*

POITRINAL.—In ancient armor, the horse's breast-plate, formed of metal plates riveted together as a covering for the breast and shoulders. The term *Pectoral* has a like signification, and is commonly used.

POLANS.—A term applied to knee-pieces in ancient armor.

POLAR DISTORTION.—In the practice of gunnery, trajectories are generally constructed by the system of *polar distortion*. By this method the angles of elevation are multiplied by an assumed co-efficient of distortion. The data necessary are the angles of elevation and the corresponding ranges. Assume a range scale, a co-efficient of distortion, and a point as the origin of the curve. Through the origin draw a straight line representing the axis of fire, and from this line, with the origin as a center, plot successively (commencing with the least) the angles of elevation multiplied by the co-efficient of distortion. Upon the lines of sight so established mark points at distances from the origin equal to the corresponding ranges reduced to scale. A curve drawn through the origin and the points located will represent the trajectory. Let O, be the origin; OA, the axis of fire; AOB, AOC, AOD, etc., the angles of elevation, multiplied by the co-efficient of distortion, to which correspond respectively the ranges from 100 to 500 yards; then will O^{i}, O^{ii}, O^{iii}, O^{iv}, O^{v}, be points of the curve. The portion of the curve lying above each line of sight will represent the trajectory for that range. The *dangerous space*, or the limits in distance within which the object aimed at is liable to be hit, is dependent, with the same arm, on the extent of that object above and below the point of aim. To determine this, describe

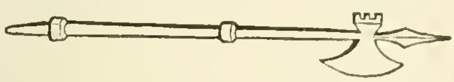


two circles one about the origin as a center, the other about the point aimed at; the former with a radius equal to the assumed muzzle height multiplied by the co-efficient of distortion, and the latter with a radius equal to the height of the point aimed at above the ground multiplied by this same co-efficient. A straight line tangent to these circles at their lowest point will be the *ground line*; and a line tangent to the second circle and parallel to the ground line, will be the *line of height*. The dangerous space will be the projection, on the ground line, of the portion of the trajectory comprised between these two lines. With the U. S. Rifle the dangerous space is calculated for the muzzle fifty-six inches from the ground, aimed at a point thirty-four inches from the ground; for 500 yards, this extends 40 yards before the object (a foot soldier) and 30 yards behind it. The distance on the figure is D'S, D'd' being equal to H*h*. To ascertain the vertical height above the ground line of a particular point of the trajectory at any distance from the origin; with this distance as a radius describe an arc cutting the trajectory. The length of the perpendicular to the ground line from this intersection is the required height. The number 10 may be employed as a convenient co-efficient of distortion. By this method of plotting, the relative curvature of consecutive portions of the trajectory is represented with sufficient accuracy to determine the "dangerous space."

POLAR PROJECTILES.—A designation applied to projectiles which pursue their flight through the air, always keeping one end or aspect foremost.

POLE.—In artillery, that portion of a carriage to which the wheel horses are attached. At the extremity of the pole are placed two pole-chains, by which it is held up, and a pole-yoke with two movable branches, to prevent, as much as possible, the pole from oscillating and striking the horses.

POLE-AXE.—A weapon much used by the early northern nations, Celtic and Scandinavian, requiring great strength in its use. Some were held with one hand; some with two, the former kind could be wielded equally by horse and foot, but the latter was for foot-soldiers only. The pole-axe had a longer handle, and a broader, stronger, and sharper blade than the common axe. During the Middle



Ages, and somewhat earlier, it was much used in sorties, and to prevent the escalading of a besieged fortress. The pole-axe differed but little from the battle-axe. The *black bill* and *brown bill* where a sort of halbert, having the cutting part hooked like a woodman's bill, with a spike projecting from the back, and another from the head. The *glaive* was a kind of pole-axe, or bill, used by the Welsh.

POLE HAMMER.—An early weapon of war, consisting of a spiked hammer placed at the end of a very long shaft or pole. See *War-hammer*, and *Luzerner*.

POLE MARCH.—Originally, in Grecian antiquity, the Commander-in-Chief; but, afterwards, a civil Magistrate, who had under his care all strangers and sojourners in the city.

POLE-PAD.—A pad placed on the end of the pole in field-gun carriages, to prevent injury to the horses.

POLE PROP.—A bar for supporting the end of the pole or tongue, especially used with the various carriages of the artillery service.

POLE STRAP.—A heavy strap by which the pole of the carriage is attached to the collar of the horse. Also called *Pole-piece*.

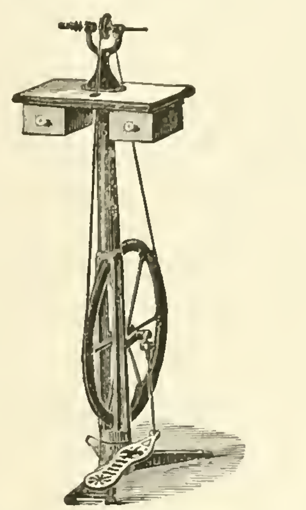
POLIABOLE.—A ballista, which was capable of throwing both arrows and stones. Also written *Palintonne*.

POLICE.—1. The term *Military Police* has two significations—1st, the organized body employed within an army to preserve civil order, as distinct from military discipline; and, 2d, a civil police with a military organization. The police of an army commonly consists of steady, intelligent soldiers, who act under the orders of the Provost-Marshal, and arrest all persons out of bounds, civilians not authorized to pass the lines, disorderly soldiers, etc.; they also attend to sanitary arrangements. As in all military matters, the police of an army possess summary powers, and a sentence of the Provost-Marshal is carried out immediately after it is pronounced. Of civil police with military organization may be instanced, as specimens, the Gendarmerie of France, the Sbirri of Italy, and, in an eminent degree, the Irish Constabulary.

2. The cleaning of a camp or garrison, or the state of a camp in regard to cleanliness. The working party engaged in policing is called the *Police Party*, and the Sergeant in charge of the same, the *Police Sergeant*.

POLICE GUARD.—An interior guard, having the care of the arms, property and prisoners; also charged with enforcing the regulations of the camp in regard to order and cleanliness. In each regiment, in the field, a police guard is detailed every day, consisting of two Sergeants, three Corporals, two drummers, and men enough to furnish the required sentinels and patrols. The men are taken from all the companies from each in proportion to its strength. The guard is commanded by a Lieutenant, under the supervision of a Captain, as Regimental Officer of the Day. It furnishes ten sentinels at the camp—one over the arms of the guard; one at the Colonel's tent; three on the color front, one of them over the colors; three, fifty paces in rear of the field-officers' tents; and one on each flank, between it and the next regiment. If it is a flank regiment, one more sentinel is posted on the outer flank. See *Field-service*.

POLISHING.—Polishing, in the armory, is effected by first removing any tarnish or oxidation by means of some material which will chemically act upon it; for this purpose sulphuric, hydrochloric, oxalic, and acetic acids are used, and in various states of dilution. Usually, it is necessary to remove the acid with clean water, and dry rapidly, to prevent re-oxidation; and then either friction with various polishing materials, or rubbing with a smooth, hard surface or burnisher, brings out the luster of the metal. The *foot*-polishing lathe, shown in the drawing, is used for all small articles and parts. It has a spindle, one end of which is threaded and tapers



to a point for holding a brush, buff, or other polishing wheels. The other end of the spindle forms an arbor for holding emery and other grinding wheels, also for small drills. *Polishing Pastes* vary according to the materials upon which they are to be employed. For brass, the best kind is a mixture of 2 parts of soft soap with 4 parts of rotten-stone in very fine powder. Another sort is 8 parts of fine rotten-stone powder, 2 parts of oxalic acid powdered, 3 parts olive oil, and enough of turpentine to make them into a paste. For iron, a mixture of emery powder and lard is used; and for pewter a mixture of finely-powdered bath-brick and soft soap. For wood, a paste called furniture paste is made by adding spirit of turpentine to beeswax, sufficient to form it into a soft paste, which is rubbed on thinly with a brush and woolen rag, and afterwards polished with a dry woolen cloth and soft brush. See *Emery*.

POLITICS.—That branch of ethics which has for its subject the proper mode of governing a State, so as to secure its prosperity, peace, and safety, and to attain as perfectly as possible, the ends of civil society. Among the subjects which political science embraces are the principles on which Government is founded, the hands in which the supreme power may be most advantageously placed, the duties and obligations of the governing and governed portions of society, the development and increase of the resources of the State, the protection of the right and liberties of the citizens, the preservation of their morals, and the defense of the independence of the State against foreign control or conquest. While the philosophy of governing constitutes the *science* of politics, the *art* of politics consists in the application of that science to the individual circumstances of particular States. The ancient Greek writers treated politics with reference to an ideal perfect State, which each propounded according to his own speculative views, pointing out the variation of every existing government from his standard. The politics of a country, in common parlance implies the course of its Government, more especially in its relations with foreign powers.

POLKOWNICK.—A Colonel of a Polish regiment.

POLO.—This may be described as hockey on horseback. It is a game of Asiatic origin, and was introduced into England in 1872 by Cavalry Officers who had learned it in India. Two goals, as for football, are set up about 350 yards apart, and the object is to drive a ball about the size of a cricket-ball through the goal by striking it with long sticks having bent or crooked ends. The players are mounted on ponies, and much depends on the skill with which these are managed. Four or five a side are the usual numbers, and those scoring the greater number of goals win the game. Polo has become very popular among English Cavalry Officers, and a few clubs have also been formed.

POLRON.—That part of the armor which covers the neck and shoulders.

POLTROON.—A coward; a dastard; one who has no courage. The origin of this word is stated by some to come from the Latin *pollex truncus*, in consequence of the frequent instances of men cutting off their thumbs to disqualify themselves for military service. Others, however, derive it from High Dutch, *polster*, a bed, from poltroons taking to their beds whenever any peril presents itself; or again, from the Italian *poltrone*, a colt, because of that animal's readiness to run away.

POLYGAR HELMET.—A casque of Central India, with fixed nose-piece, cheek pieces, and very long neck-guard, or mail hood.

POLYGON.—1. A school of practice for artillery in Japan. 2. The name applied to the many-angled forms in which the outer walls of all fortified places are built. Polygons of 5, 6, 7, 8, etc., sides are denominated pentagons, hexagons, heptagons, octagons, etc., and when the number of sides exceed twelve, the figure is merely mentioned as a polygon of so many sides. The quindecagon, or figure of 15 sides, is the only common exception to this rule. Polygons have many general properties; such as that the sum of the angles of a polygon, when increased by four right angles, or 360°, is equal to twice as many right angles as there are sides in the polygon, and that (supposing the number of sides of the polygon to be expressed by n) the number of its diagonals is $\frac{n(n-3)}{2}$; also, if a polygon of an even number of sides be circumscribed about a circle, the sums of its even and odd sides are equal; and if a polygon of an even number of sides be inscribed in a circle, the sums of its even and odd angles are equal. A polygon which has all its sides and angles equal is called a *regular* polygon. All polygons of this class are capable of being inscribed in or circumscribed about, a circle; but though the problem is merely to divide the circumference of a circle into a number of equal parts, corresponding to the number of sides in the polygon, geometry was till lately only able to perform it in those cases where the number of sides of the polygon belongs to one or other of the series 2, 4, 8, 16, etc.; 3, 6, 12, 24, etc.; or 5, 10, 20, 40, etc. Gauss, however, in the beginning of the present century, showed how it could be done in the case of all polygons, the number of whose sides was of the form $2^n + 1$ (provided it be a prime number), or a multiple of this prime number by any power of 2. This discovery supplies us with innumerable series representative of the numbers of the sides of polygons which can be described around or inscribed in a circle, such as 17, 34, 68, etc.; 257, 514, 1028, etc.

POLYGONAL SYSTEM OF FORTIFICATION.—The polygonal system has been proposed by several engineers of distinction, but its most ardent advocate has been the celebrated Montalembert. Consisting of either a simple polygonal enceinte without re-enterings, the sides of which are flanked by casemated caponnières, placed at the middle point of the fronts; or of fronts either slightly tenailled or of a bastion form, with short casemated flanks to flank the faces of the central caponniéres, this system affords more interior space, and from the mode adopted of flanking the enceinte, will admit of much larger fronts than either the bastioned or the tenailled systems. The salient angles moreover will be more open in this than in the other two systems. From these peculiarities of this system the positions suitable for the erection of batteries to enfilade the faces of the enceinte are less advantageous, from their being thrown in nearer to the adjacent fronts than in either of the other systems; whilst a greater development of trenches will also be requisite to envelop the fronts of attack. The polygonal tracé has certain prominent advantages and defects which may be seen by a slight comparison with the bastioned system. As the exterior sides are longer and the re-enterings of the enceinte less deep than in the bastioned systems, it follows: 1. That the interior space enclosed by the enceinte is greater in the polygonal tracé. 2. That the faces of the enceinte are less exposed to ricochet from the greater obtuseness of the salient angles. 3. That the fire of the faces has thus a better bearing on the distant defence. 4, That requiring fewer fronts on a given extent of line to be fortified, there will be fewer flanks and more artillery therefore disposable for the faces and curtains. 5. That, in the usual mode of attack; the besiegers will be forced into a greater development of trenches for the same number of fronts.

The defects of the system are: 1. That the enceinte, having no other flanking defense than the main caponnière, will be exposed to an escalade so soon as the fire of this defense is silenced. 2. That the progress of the besiegers during the last and most important period of the siege is but little delayed, owing to the want of the concentrated cross-fires which are afforded in both the bastioned and tenailled systems, in advance of the salients of the enceinte, and upon the ground generally in advance of the fronts, due to the slighter re-entering formed by the independent works in front of the enceinte salient. It is further objected that in the German method, *First*. The system makes use of numerous works of masonry that can be easily ruined by distant batteries of heavy caliber, especially when pierced with embrasures and loop-holes like the casemated caponnières and defensive barracks of the German method. *Second*. That the distribution of troops and *matériel* of war throughout the independent works deprive the defense of the union and concerted action that can only exist under a single commander. *Third*. That the expense of construction is much greater, in consequence of the numerous works of masonry requiring nice workmanship. And, *Fourth*. That it is imprudent to abandon existing systems that have stood the test of experience for those not possessing this advantage. See *German System of Fortification*, *Montalembert System of Fortification*, and *System of Fortification*.

POLYSPASTE.—The crane of Archimedes, an engine which was used to raise and shatter to pieces whole vessels, and identified with those enormous hooks that were used to pull off the heads of the battering-rams.

POLYTECHNIC SCHOOL.—An Institution, first established in Paris (1794) by the National Convention, under the name of *Ecole des Travaux Publics* (School of Public works). No students were admitted but those who intended to enter the public service; and though the general object of the Institution was the supplying of well-educated youths to all branches, it was more particularly devoted to the thorough instruction of recruits for the Corps of Civil and Military Engineers. The Institution received the name of "Ecole Polytechnique" in 1795. The pupils were at first 319 in number, and each received, during his stay of two years in the Institution, an annual stipend of 1,200 francs (£48 nearly); the teachers were in most cases the most eminent savants of France. In 1799 some modifications were introduced into the working of the School; the number of pupils was at the sime time limited to 200, and they were put into uniform. The advantages of an Institution of this sort, when ably conducted, soon made themselves evident, and the Polytechnique, in consequence, rose into high estimation, not only in France, but throughout Europe, so much so, that it became common for foreign nations, when entering into a treaty with France, to stipulate for the admission of a certain number of their subjects into the Institution, after passing the prescribed entrance examination. In 1804, the Emperor Napoleon introduced various modifications into its working, and gave it a military organization; it was also removed from the Palais Bourbon (where it had existed from its first establishment) to the Old College de Navarre. The Institution became more and more, as the end of the Napoleonic Empire drew near, a training-school for young artillerists and engineers; and such was the enthusiasm of the pupils in the Emperor's cause, that, after the disasters of 1814, they demanded to be enrolled *en masse* in the ranks of the French Army. However, Napoleon was (to use his own words) not inclined "to kill the hen for the golden eggs;" but he allowed them to form three out of the twelve companies of which the Artillery Corps of the National Guard was composed. These three companies rendered important service in manning the walls of Paris, and behaved heroically in the battle of March 30, 1814. After the First Restoration, the Polytechnique, being considered to be evil-disposed to the Government, suffered considerable reductions; but was restored to its former importance for the brief period of the "hundred days." After the Second Restoration (July, 1815), the Staff of Professors was remodeled; Lacroix and some others were dismissed, and replaced by Poisson, Arago, Cauchy, etc. Notwithstanding these changes, the Government still had its doubts as to the loyalty of the establishment, and took advantage of an outbreak, April 3, 1816, to break it up. It was reconstituted in September of the same year, under a revised code of regulations, and in 1822 the old severity of military discipline was restored. During the war of 1870-71, the Government of National Defense ordered the pupils to meet at Bordeaux, and classes were opened there under distinguished pupils of the School brought from all parts of France. However the attempt had to be abandoned, and the pupils having sought permission to take part in the war, were divided among the different sections of the army, in which their services were highly appreciated. The Constitution of the School, which has so frequently suffered change, was, in the end of 1873 regulated by *Décret* of Nov. 30, 1863, and Ministerial Rules issued on Mar. 5, 1857. 1. No pupil can be admitted unless he has been successful in the public competitive examination which is held each year. 2. The conditions of admission to the competitive examination are, that the candidate shall be a Frenchman; that he shall be more than 16, and less than 20 years of age, on the 1st of January of that year; and that he shall be either a Bachelor of Letters or a Bachelor of Sciences of the University of France. If he holds both degrees he is allowed 50 marks in the examination for admission. 3. Regular soldiers are admitted up to the age of 25 years, provided they have been on real and effective service for two years. 4. The charge for board is 1,000 francs (£40) per annum, and the cost of outfit (to be also paid by the pupil) about 600 francs. 5. The duration of the course of instruction is two years; the pupils, after finishing their course, must pass a final examination; the successful candidates, if found to be physically qualified, are arranged in order of merit, and choose in order what branch of the public service they wish to enter. 6. The branches of the public service which are recruited from the Polytechnique are, the Corps of Land and Naval Artillery, Military and Naval Engineers, the Imperial Marine, the Corps of Hydrographic Engineers, that of Engineers of Roads, Bridges, and Mines, the Corps of Staff Officers, the Superintendence of Telegraphs and Gunpowder and Tobacco Manufactories; and generally every Department which, requiring special scientific knowledge, may be added by *Décrets* to these. The following branches of study are embraced in the curriculum: Mathematics, Physics, Chemistry and Chemical Manipulation, History and Literature, German, Written Exercises, Drawing, Geodesy, Mechanics, Architecture, Art Militaire. Lessons in Fencing, Music, and Dancing are given out as optional, and must be separately paid for. The number of pupils varies with the requirements of the public service. In 1794 there were 396 pupils; in 1820 only 66. During the First Empire, the numbers increased from 110 in 1808, to 227 in 1813; under Louis Philippe the average number was 130. During the Second Empire, it had risen to 140 and 150. After the war with Germany in 1870-71 the number rose to 260. The numerous and admirably equipped Technical Schools of Germany, often called *Polytechnica*, have received no military restriction, and are available for all interested in the industrial arts; they are in many cases scientific centers comparable to the Universities.

Pommettée Cross.

POMADA.—An exercise of vaulting the wooden horse, by laying one hand over the pommel of the saddle. See *Gymnastics*.

POMEL CROSS.—In Heraldry, a cross whose extremities terminate in single knots or pomels, like the *Bourdon* or Pilgrim's Staff. Also written *Pommettée Cross*.

POMERIUM.—In ancient architecture, that space of ground which lay between the walls of a fortified town and the inhabitants' houses. The term is still used among modern architects, particularly by the Italians, to describe the breadth of the terreplein of the rampart, its inward talus, and the vacant space which is usually left between this talus and the houses of the town.

POMME.—In Heraldry, a bearing or device representing, or in the form of, an apple.

POMMEL.—The knob on the hilt of a sword. Also the protuberant part of a saddle-bow. The term *Pommeled*, or *Pommelled*, signifies furnished or mounted with one or more pommels, as a sword, dagger, or the like.

POMMELION.—The cascabel, or hindmost knob of a cannon. See *Cascabel*.

POMPON.—A tuft of wool, or other material, sometimes worn by soldiers on the top of the hat in front, instead of a feather.

PONCHARRA RIFLE.—In 1833, Colonel Poncharra suggested placing a "sabot" of hard wood underneath the ball with a greased patch, which, resting on the offsets of the mouth of the chamber, was prevented from entering it. This rifle was objected to as a war weapon on account of the complicated nature of its ammunition, and the difficulty of procuring it in the field; besides which, the sabots frequently broke in loading, from the ramming necessary to expand the bullet into the grooves.

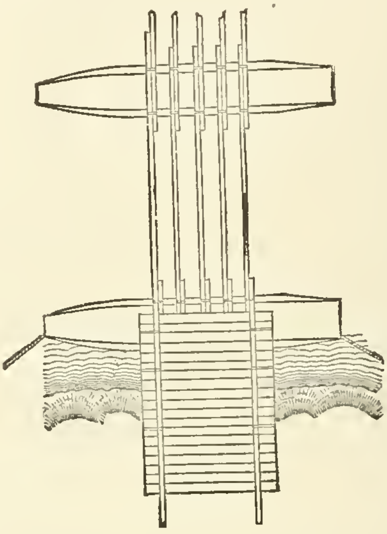
PONCHO.—A Spanish-American garment, consisting of a piece of woolen cloth, 5–7 ft. long, 3–4 feet broad, having in the middle a slit through which the wearer passes his head, so that the poncho rests upon the shoulders and hangs down before and behind. In the fashions of recent times, the poncho has been introduced in Europe. In the United States Army, mounted troops are issued a waterproof poncho, consisting of painted cotton or rubber cloth.

PONIARD.—A pointed instrument for stabbing, usually borne in the hand, at the girdle, or in the pocket. See *Dagger*.

PONTONES.—Ancient square-built ferry-boats for passing rivers, as described by both Cæsar and Aulus Gellius.

PONTOON.—The name given to buoyant vessels used in military operations for supporting a temporary bridge. Pontoon bridges have been constructed, with greater or less skill, from the earliest times. Darius passed the Hellespont and Danube by pontoon bridges, and the former was traversed by Xerxes' immense army on similar temporary bridges, very admirably formed. A pontoon train is a necessity for every army maneuvering in a country where there are rivers, and many campaigns have proved failures for want of this cumbrous but indispensable apparatus. In most armies the pontoons are under the charge of the engineers; but in the Anstrian army there is a distinct and highly-trained corps, called *pontonieren*. Marlborough used clumsy wooden pontoons. Napoleon and Wellington had them lighter of tin and copper. They were flat-bottomed, rectangular boats, open at the top. Anchored at stem and stern, beams were laid over from one to another, and transoms with planks crossing these beams completed the roadway of the bridge. These open pontoons were exposed to the disadvantage that they were very liable to be filled with water, and thus ceased to support the bridge. They were, moreover, very heavy, one pontoon, with appurtenances, constituting a wagon-load. As 36 were deemed necessary for the train, a pontoon equipment was a serious item in the *impedimenta* of an army. The open pontoons are now, however, obsolete, modern science having substituted closed cylindrical vessels of copper (or occasionally of India-rubber), which are far lighter, can in an emergency be rolled along, and can only be submerged if perforated. Against the last contingency, they are divided within into water-tight compartments, so that one perforation may not seriously detract from the total buoyancy of a pontoon. In the British service two pontoons are used: the larger, with hemispherical ends, being 22 ft. 3 in. in length, and 2 ft. 8 in. in diameter; the smaller, cigar-shaped, with conical ends, 15 ft. in length, 1 ft. 8 in. diameter. Two of the largest used to form a raft weigh 8 cwt. 7 lbs.; the superstructure 18½ cwt. At 24 ft. apart from center to center, this raft will carry infantry four deep, marching at ease; cavalry, two deep, and light field guns; at 16 ft. interval, heavy guns. A raft of three pontoons, at close distances, will support siege-ordnance. The pontoons can be used in very wide rivers as rafts, in their proper sense, or they can be connected, when the width permits, to form a bridge. In the latter case, each is towed into line, anchored above as it drops to its place, and a second time when its exact spot is reached. It is computed that each pontoon requires 1½ minutes to take its position, and that when the pontoons are placed, the roadway can be laid, if properly arranged previously, in 1½ minutes for each interval between two pontoons. A river of 600 feet may thus be bridged in less than 1¼ hours. The process of throwing a bridge over in face of an enemy is fraught with the utmost danger to the engineers employed. Pontoon bridges have to be passed with great care, and every measure should be adopted, such as breaking step, etc., which can reduce the peculiarly dangerous vibration. The following is the method generally employed for building bridges with the bridge equipage of the United States Army, and known as the construction by *successive pontoons*.

The place for building the bridge having been selected, the pontoons are brought to the banks of the stream, near the spot, and the boats are launched into the water. Each boat is provided with an anchor. Some of the boats cast their anchors up-stream, while others cast them down-stream. The

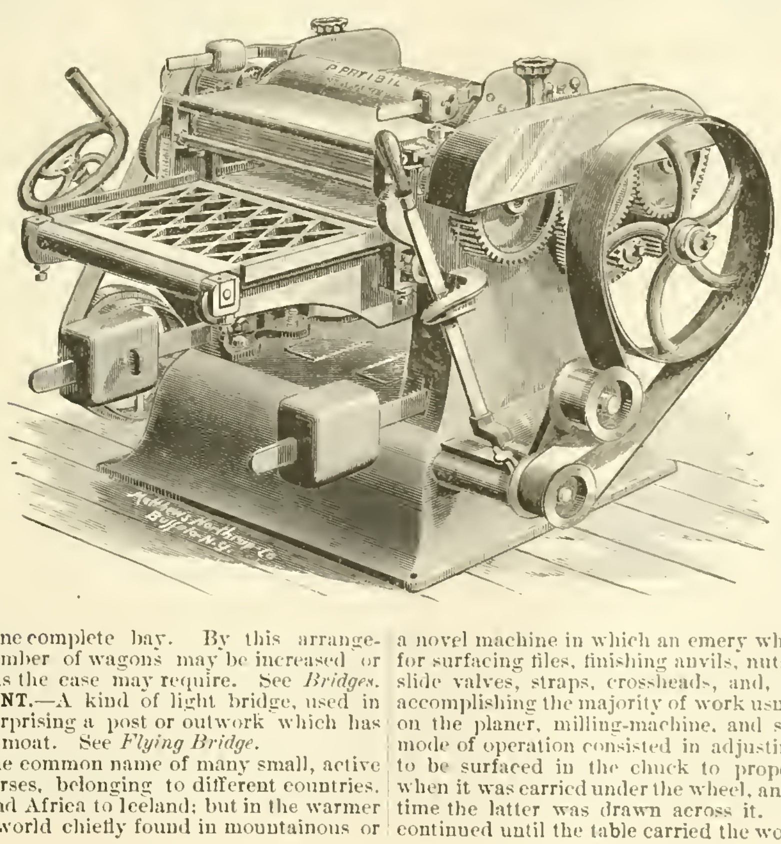


number of anchors to be cast will depend upon the rapidity and strength of the current. Under ordinary circumstances, an anchor cast up-stream from every alternate boat, and half the number down-stream, will be sufficient. The boats casting up-stream anchors are launched above the bridge; the others below. If none exists, an easy approach for the wagons and artillery should be constructed, leading down the bank to the bridge. A strong sill is then imbedded in a trench, perpendicular to the axis of the bridge, and is held firmly in place by four stout pickets, driven about eight inches from each end. This sill is horizontal, and should be as nearly as possible on a level with the flooring of the bridge. A pontoon is then brought up opposite to this sill, and close to it. Five balks are brought forward, and the ends placed upon, and lashed to the outer gunwale of the boat, in the proper places The men holding the balks push the pontoon off, until the ends of the balks on shore rest upon the abutment sill. The pontoon is then secured in position by shore-lines running out from the bow and stern, and fastened to mooring-pickets. The chess are brought forward and laid upon the balks, to within one foot of the boat. A second pontoon is brought alongside of the first; five balks are again used, and this second boat pushed out. The balks are firmly lashed together and to the gunwales of the first pontoon. The intervals between the pontoons are known as bays. The chess are laid as soon as the balks are lashed; and when a bay is completely covered, the side rails are laid and lashed to the balks beneath. This operation is continued until the entire length of bridge is obtained. It is recommended to strengthen the first bay by using two additional balks—one between the first and second, and in contact with the latter; the other, between the fourth and fifth, in contact with the fourth. When the water is not deep enough to float the first pontoon, a trestle, or other fixed point of support, may be used instead of the pontoon. The great objection to this pontoon is its weight, which makes its transportation over bad roads difficult. For bad roads and rapid movements a lighter pontoon than this wooden boat has to be used. The one employed under these circumstances is the canvas pontoon, which consists of a wooden frame covered with canvas. The wooden frame comes apart, so as to be easily loaded on wagons for transportation. It has two side frames, trapezoidal in shape, the upper piece being twenty-one feet long; the lower, eighteen feet and four inches long. The depth of this frame is two feet and four inches. The frames are connected by pieces called transoms, framed into the side frames, and these latter are fastened together by ropes passing through rings in the ends of the frames. The inner width of the boat frame, or distance between the side frames, when the parts are arranged, is four feet and eight inches. In some cases, the side frames are hinged in the middle, so that when taken apart, they may be folded up. The canvas cover is made of cotton duck. The balks are twenty two feet long, with a cross-section of four and and one-half inches, and are provided with claws as before described. The chess is the same as that described, but only eleven feet long, instead of thirteen. The reserve equipage is divided into trains, each train being composed of four pontoon divisions, and one supply division. Each pontoon division contains all the material necessary to construct a bridge of eleven bays, or a bridge two hundred and twenty-five feet long. The advance guard equipage is also divided into trains each train having four pontoon divisions. A division contains eight pontoon wagons two wagons for chess and two for trestles. The pontoon wagons of this equipage are so loaded that each wagon will have all the material necessary to construct one complete bay. By this arrangement the number of wagons may be increased or diminished, as the case may require. See *Bridges*.

PONTVALENT.—A kind of light bridge, used in sieges, for surprising a post or outwork which has but a narrow moat. See *Flying Bridge*.

PONY.—The common name of many small, active breeds of horses, belonging to different countries, from India and Africa to Iceland; but in the warmer parts of the world chiefly found in mountainous or sterile regions. They are in general the property of man, and not truly wild, although, in very many cases, they live almost in a wild state, and receive no care or attention except when they are wanted for use. They are in general very hardy, and their strength is great in proportion to their size. They are often vicious, or at least playfully tricky to a much greater degree than is usual with large horses. Ponies are very often covered with rough hair, and have large, shaggy manes and forelocks. The *Shetland pony* is a very good example of these small races of horse. The *Iceland pony* is scarcely different from it, and is hardy enough to endure the winter of Iceland without shelter. The *Galloway*, *Welsh*, *Dartmoor*, *Exmoor*, and *New Forest* breeds are British races of pony larger than the Shetland. The progress of inclosure and cultivation in their native regions has so changed the circumstances in which they long subsisted, and in which, perhaps, they originated, that scarcely any of them are now to be seen of pure and unmixed race. Sardinia and Corsica have small races of ponies which have subsisted unchanged from ancient times. In the Morea there is a race of ponies, driven in herds to Attica for sale, exceedingly wild and vicious, but capable of being rendered very serviceable. But it is unnecessary to mention the many races both of Europe and Asia. They differ considerably in size, some, like the Shetland pony, suggesting a comparison with a large dog, some much larger. They also differ much in color: a dun or tan color, with a black stripe along the back, is prevalent in many of them. Ponies are seldom employed in agricultural labors; but they are of inestimable value for campaign purposes in many wild and mountainous regions, from their hardiness and surefootedness, and are often used as saddle-horses, the largest kinds being even employed as horses for light cavalry.

PONY PLANER.—Until quite recently the more important arsenals and armories were equipped with a novel machine in which an emery wheel was used for surfacing files, finishing anvils, nuts, gibs, keys, slide valves, straps, crossheads, and, in short, for accomplishing the majority of work usually surfaced on the planer, milling-machine, and shaper. The mode of operation consisted in adjusting the object to be surfaced in the chuck to proper elevation, when it was carried under the wheel, and at the same time the latter was drawn across it. This motion continued until the table carried the work out of the

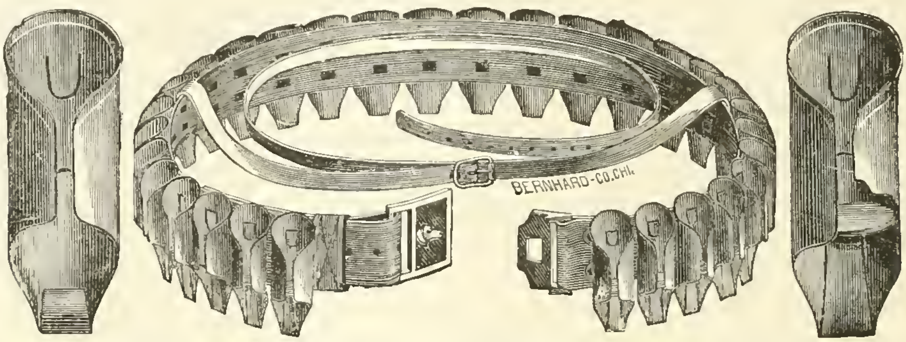


action of the grinder. Then, by means of suitable mechanism, the operator slightly elevated the object and caused it to run back again under the wheel. Of this machine, the invention of the Tanite Company is a modification. The main difference is that the planer bed is made to slide to and fro on its ways by the action of a crank, the work being thus moved to and fro in the line of the emery wheel's revolution, while the wheel also has a cross motion imparted to it by another crank. This motion of the table corrects the inaccuracy resulting from gradual decrease in the wheel's diameter, there being a perceptible wear in the wheel, so that it grinds a long, flat piece taper instead of plane, when the work slowly passes under it; while, by this crank throw, the whole length of work is brought into contact with the wheel at each throw. A chuck rests on four springs, and rises and falls vertically in planed ways. When the adjustable stops have been adjusted, and the wheel no longer cuts, the work must be plane. The springs force the (chuck) work against the wheel, and yet act as safety appliances against over-friction and pressure. The whole table and bed has a vertical adjustment by a screw. Three belts are needed: one to the wheel mandrels, one to the suction fan, and one to the driver. The gears, being interchangeable, allow the proportion of speeds between the wheel shafts and the table to be altered in various ways. The machinery stands 32 inches high, and is 2 feet 8 inches each way. It will grind work 9 inches long by 5 inches wide. It is adapted to all small, flat work, especially to dies of hardened steel and chilled iron, to parts of gun and pistol locks, machine work, small levels, machine keys, locks, etc. It is claimed that thousands of small parts can, by this means, be finished to a gauge with greater exactness than can be done in any other way. The remaining portions of the device are similar to those in the device first alluded to above.

The name Pony Planer is also given to a most useful wood-planing machine. One of the best machines of this class, and one adapted for a great variety of work, is shown in the drawing. It has very powerful, geared, double feed-rolls, four inches in diameter. Those in front are weighted, those behind are provided with self-adjusting scrapers. The machine can take a $\frac{3}{4}$ inch cut, and is adjustable to different thicknesses of stuff by a single bandwheel, $\frac{1}{16}$ of an inch to a turn. Either plane is smooth enough for any work, but three admit of faster feed, and the feed cones are made accordingly. Two pressure bars are close to the cutterhead, the front one hinged and weighted. The machine is suitable for heavy as well as for light and very short stuff. The shaving guard and feed-roll covers are hinged, to give access to the knives, which can be whetted when in place. The principal bearing boxes are self-oiling. The heavy boxed shaped base is proof against twisting even when standing on a weak floor, which will often yield from the weight of lumber, thereby straining the bearings of the machines, and causing them to work hard and wear out quickly. The driving belt can come from above, below or from the back. When standing in front of the machine the cutter-head pulley is at the left hand. See *Emery-grinder*.

POOLER-JONES CARTRIDGE-BELT.—A belt having cartridge holders attached to it, suitable for either paper or brass shells. These holders can be easily attached to any hunting vest, coat front, or belt. An ordinary vest will hold from 36 to 50, each hoder weighing about $\frac{1}{4}$ of an ounce. A belt with 30 holders attached (weighing one pound) is shown in the drawing. The belts can be perfectly adjusted by wearer to fit either a slim or large man, with waist measuring from 30 inches to 41 inches. It can be worn over or under a coat, and it is impossible to lose the cartridges. The belt is intended to be worn or put on with the buckle behind. The cartridges are nearly all to the front and can be easily reached. The holder, B, with the side cut away to show the wad supporter, is for carrying brass or paper shells without being crimped. The form shown at, A, is for carrying paper shells crimped, or with ends turned down.

A



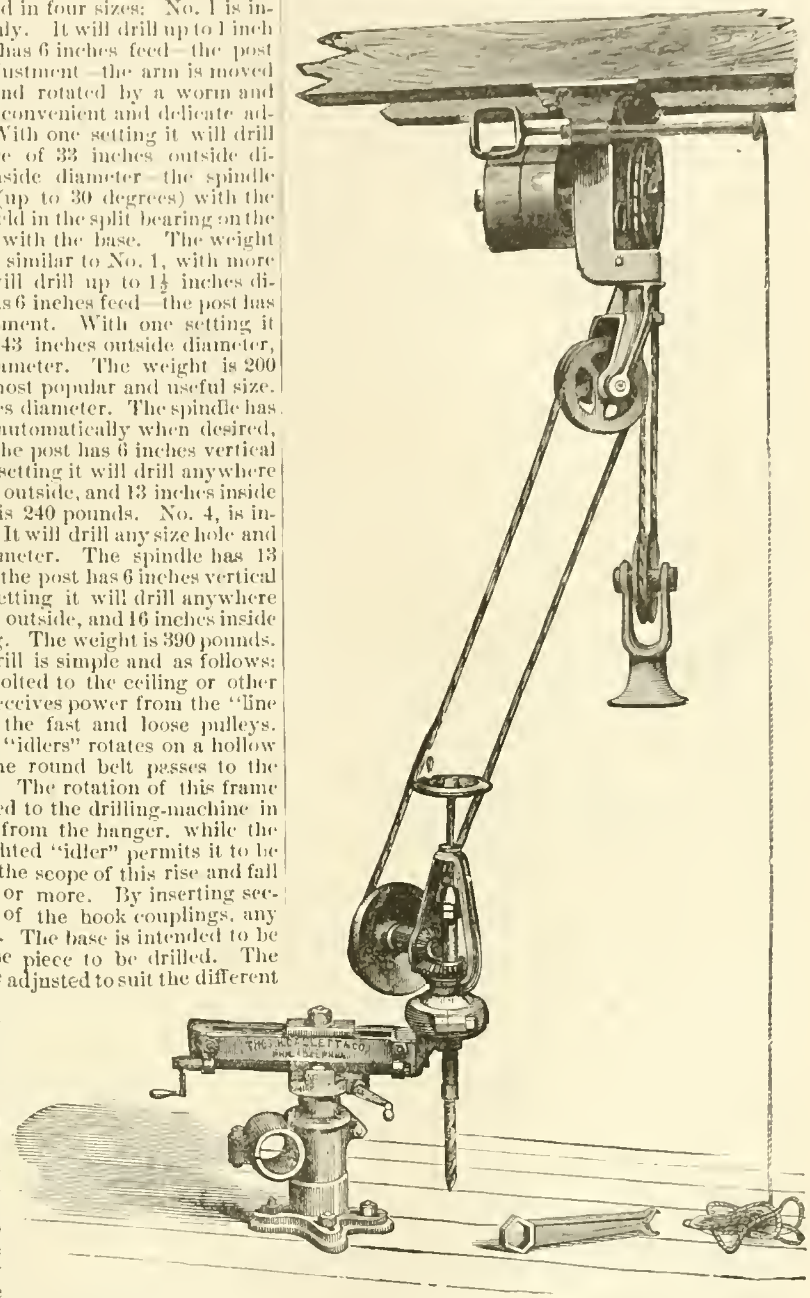
B

POOR KNIGHTS OF WINDSOR.—An institution of Military Knights at Windsor, England, which owes its origin to Edward III., and is a provision for a limited number of old officers. These officers consist of a Governor and 12 Knights on the upper foundation, and 5 on the lower, together 18, and are composed of officers selected from every grade, from a Colonel to a Subaltern, chiefly veterans, or on half-pay. They are allowed three rooms each in Windsor Palace, and 2 shillings per diem for their sustenance, besides other small allowances.

POPPET-HEAD.—That part of a lathe which holds the back-center, and can be fixed on any part of the bed. Boring-machines have a poppet-head.

POROSITY.—By this term we express the experimental fact that no kind of matter completely fills the space it occupies; in other words, that all bodies are full of minute cavities or interstices, such as are illustrated on a large scale by a sponge. On the atomic theory, it is obvious that this must be the case if the atoms of matter are spherical, or, indeed, if they have any form save one or two special ones, such as cubes or rhombic dodecahedrons. It is commonly asserted that all bodies must be porous, because they are compressible; but this is a great mistake, since we have no reason to believe that matter is not *per se* compressible, independently of the existence of interstices. The Florentine Academicians, in their attempts to compress water, proved the porosity of silver by flattening sphere of that metal, filled with water, nd soldered. The water escaped through the pores of the silver, and stood in fine drops on its surface. The porosity of liquids is easily shown by mixing alcohol and water. The bulk of the mixture is considerably less than the sum of the bulks of the components, showing that these must in part have entered each other's pores. This property of matter is of great importance in the Arsenal and Laboratory.

PORTABLE DRILL.—A form of drill much employed in arsenals. It drills at any angle, in any position, at any distance, and in any direction from the power. It is especially adapted to drilling all pieces which are inconvenient to move, or which cannot be readily adjusted under stationary drilling machines. The drawing shows the drill as employed at the Watertown Arsenal. It is used in four sizes: No. 1 is intended for light work only. It will drill up to 1 inch diameter. The spindle has 6 inches feed—the post has 5 inches vertical adjustment—the arm is moved in and out by a screw, and rotated by a worm and tangent-wheel, giving a convenient and delicate adjustment to the drill. With one setting it will drill anywhere over a surface of 33 inches outside diameter, and 11 inches inside diameter—the spindle can be set to any angle (up to 30 degrees) with the base—the post can be held in the split bearing on the side for drilling parallel with the base. The weight is 125 pounds. No. 2, is similar to No. 1, with more power and range. It will drill up to 1½ inches diameter. The spindle has 6 inches feed—the post has 6 inches vertical adjustment. With one setting it will drill over a surface 43 inches outside diameter, and 13 inches inside diameter. The weight is 200 pounds. No. 3, is the most popular and useful size. It will drill up to 2 inches diameter. The spindle has 8 inches feed, working automatically when desired, with 3 speeds of feed—the post has 6 inches vertical adjustment. With one setting it will drill anywhere over a surface 43 inches outside, and 13 inches inside diameter. The weight is 240 pounds. No. 4, is intended for heavy work. It will drill any size hole and bore up to 8 inches diameter. The spindle has 13 inches automatic feed—the post has 6 inches vertical adjustment—with one setting it will drill anywhere over a surface 56 inches outside, and 16 inches inside diameter. Back gearing. The weight is 390 pounds. The operation of the drill is simple and as follows: The counter-hanger is bolted to the ceiling or other convenient place, and receives power from the "line shaft" by a flat belt on the fast and loose pulleys. The frame carrying the "idlers" rotates on a hollow stud, through which the round belt passes to the grooved driving pulley. The rotation of this frame permits the belt to be led to the drilling-machine in any direction, radially, from the hanger, while the rise and fall of the weighted "idler" permits it to be led to any point within the scope of this rise and fall—say ten to fifteen feet or more. By inserting sections of belt, by means of the hook couplings, any distance can be reached. The base is intended to be bolted or clamped to the piece to be drilled. The height of the post can be adjusted to suit the different lengths of drills and chucks used in the spindle. The radial slotted arm is fastened to the post by the stud and nut; the position of the drill being adjusted by the screw which travels the arm, and the worm and tangent-wheel that rotates it on the post. When it is required to drill parallel with the base, the post is held by the clamp bearing on the side of the base. There is a shoulder turned on the bottom of the ball on the gear frame (of sizes 1, 2, and 3), and a half collar fitted to it and bolted on the arm; this keeps the spindle square with the base. When this half collar is removed, the spindle can be set to an angle in any direction. When not being used on the floor, it serves the purpose of a bench drill press. See *Drilling-machine.*



PORTABLE FIRE-ARMS.—The portable-fire arms employed as military weapons of war are rifles, carbines, and pistols; these generally vary in construction with the Nation by which they are used. The term "breech-loading" applies to those arms in which the charge is inserted through an opening in the breech, and in the loading of which no ramrod is required. All military breech-loaders, now in use, employ the metallic case cartridge; they may be divided into *simple breech-loaders* and *repeaters.* The essential parts of all such arms are the *barrel*, the *chamber*, the *breech-mechanism*, the *lock*, the *stock*, the *sights*, and the *mountings*, and in repeaters the *magazine*. If the chamber be made in the piece which closes the breech, commonly called the *breech-block*, the arm is said to have a *movable* chamber; if it be formed by counterboring the barrel, it is said to have a *fixed* chamber. The latter has great advantages, and is generally used. With the fixed chamber the interior of the barrel is divided into two distinct parts, viz., the *bore* proper, or space through which the projectile moves under the influence of the powder, and the *chamber* in which the charge is deposited. The principal parts peculiar to simple breech-loaders are; 1st. The *movable breech-block*, by which the chamber is opened and closed. 2d The *breech-frame*, upon which the breech-block is mounted and united to the barrel. 3d. The *chamber*, with its recess, to receive the rim of the cartridge. 4th. The *firing-pin*, which transmits the blow of the hammer to the cartridge. 5th. The *extractor*, by which the empty case is removed after firing.

The foregoing named parts may be said to be essential to all breech-loading arms in which the metallic cartridge is used; the different ways in which they are combined mark the systems. These combinations have reference chiefly to the modes of operating and locking the breech-block. The different systems may be classified into: 1st, those with a *fixed* chamber; 2d, those with a *movable* chamber. The latter have now become obsolete. The first class have: 1st, a *movable barrel*; 2d, a *movable breech-block*. With each the motion may be *sliding*, in which case it moves in grooves; *rotating*, when it swings on a hinge; or *sliding* and *rotating* combined. The greater number of systems belong to the class of a "movable breech-block rotating about an axis." In arms of this class the axis of motion may be parallel to the axis of the barrel, and above, below, or to one side of it; or perpendicular to that axis, being vertical or horizontal, and lying in or out of the plane of the axis. The position of the hinge has an important influence on the facility of operating the block, inserting the cartridge, and extracting the empty shell; the most suitable position is deemed to be in front of the center of the block. In this case the motion of opening and closing the block is natural and easy; the cartridge is pushed into its place by the block, and a very simple retractor serves to withdraw the empty shell after firing. The most serious defect found in breech-loading arms was the escape of the flame through the joint, which not only incommoded the soldier, but, by fouling the machinery, seriously interfered with its operations. At present this is entirely overcome by the elastic metallic case of the cartridge. The advantages of breech-loading over muzzle-loading arms are: 1st. Greater certainty and rapidity of fire. 2d. Greater security from accidents and loading. 3d. The impossibility of getting more than one cartridge into the piece at the same time. 4th. Greater facility of loading under all circumstances, and particularly when the soldier is mounted, lying on the ground, or firing from behind any cover. The greater security with which the charge is kept in place when the piece is carried on horse-back with the muzzle down.

There are certain functions performed by, and certain important conditions to be fulfilled in, the construction of the different portions of a small-arm. The barrel is by far the most important part of a fire-arm, its office being to concentrate the force of a charge of powder on a projectile, and give it proper initial velocity and direction; for these purposes, and for the safety of the firer, it should be made of the best material and with the greatest care. In determining the *exterior form*, it is not only necessary to give such thickness to the different parts as will best resist the explosion effect of the charge, but such as will prevent it from being bent when used as a pike, or when subject to the rough usage of the service. *Weight*, to a certain extent is necessary to limit recoil, to give steadiness to the barrel in aiming, and to prevent it from "springing" in firing. The latter defect generally arises from bad workmanship, whereby there is a greater thickness of metal, and consequently less expansion, on one side of the bore than on the other. In some sporting rifles the barrel weighs from 12 to 15 lbs., but in the military service, where it is carried by the soldier, it seldom weighs more than 4½ lbs. The *length* of the barrel is determined by the nature of the service to which it is applied, rather than by the effect which it exerts on the force of the charge. It was shown by experiment that the velocity of a projectile in a smooth-bored musket increased with the length of the bore up to 108 calibers at least, but such length of barrel would be too heavy for a fire-arm and too unwieldy as a pike; in a rifled barrel the increase extended to about 250 calibers.

Three points are to be considered in determining the *caliber* of small arms: 1st. It should be as small as possible to enable the soldier to carry the greatest number of cartridges. 2d. To diminish the amount of ammunition required to supply the wants of an army, and to prevent the confusion liable to arise from a variety of calibers, there should not be more than two for all arms of the same service, viz., one for the rifle and the carbine, and one for the pistol. 3d. This point relates to the force and accuracy of the projectile, and to the flatness of its trajectory. The introduction of elongated projectiles afforded the means of increasing the accuracy and range of fire-arms, without increasing the weight of the projectile, simply by reducing the caliber, which diminished the surface opposed to the air. Too great reduction of caliber, however, gives a very long and weak projectile, and besides the effect of a projectile on an animate object depends not only on its penetration, but also on the shock communicated by it to the nervous system, or upon the surface of contact. These considerations have led to a general reduction of caliber of military rifles.

The *grooves* being for the purpose of communicating a rotary motion to the projectile around an axis coincident with its flight, their construction will depend upon the form, dimension and material of the projectile, charge of powder, and angle of fire. The points to be considered in determining the form of grooves for military arms are range, accuracy of fire, endurance, and facility of cleaning the bore. Experiment, in this country, has shown that for breech-loaders these points are best attained by making the grooves broad and shallow, and with a rapid twist. The *chamber* being a receptacle for the charge, its shape is made to conform to that of the cartridge. Its diameter is made a little larger, and that of the bore a little smaller than that of the projectile, this facilitates the insertion of the charge, and causes the projectile to be compressed and held firmly by the lands in its passage through the bore. The bottom of the grooves and the surface of the chamber are generally continuous.

The *breech-mechanism* comprises the principal parts that are peculiar to arms loading at the breech. The functions of these parts are the opening, closing, and locking of the breech, firing the charge, and removing the empty cartridge shell. These are the objects for the accomplishment of which the different systems are variously contrived, and with which alone they are concerned. The most important conditions to be fulfilled in the arrangement of this mechanism are: 1st. The number of parts should be as few as possible, and all should be of the simplest construction. 2d. The strength and union of the parts should be such as not only to resist repeated discharges, but the bursting of a cartridge case, which sometimes occurs from defective material or workmanship. 3d. The locking of the breech-block should not only be secure, but all the parts by which it is effected should work freely without sticking. 4th. The parts should be so arranged that the hammer cannot strike the firing-pin until the breech-block is properly locked. 5th. The hammer should not necessarily rest on the firing-pin when the piece is carried loaded 6th. The breech should be unlocked without the hammer being brought necessarily to full cock. 7th. The working parts should, as far as possible, be covered from dust and water. 8th. The extractor should be so arranged as to require no cuts or openings in that part of the chamber which surrounds the body of the cartridge case. The *lock* is the machine by which the charge in the cartridge is ignited. Those of the present day belong to the percussion class, in which fire is produced by a blow upon the fulminating powder contained in the cartridge-case. Locks are divided into *side* and *center* locks, depending upon the position occupied in the stock; each of these may be either *front-action*, wherein the mainspring is in front of the tumbler, or *back-action*, where this spring is in rear of the tumbler. The mortise, which forms a bed for the lock of the latter construction, seriously affects the strength of the stock at the handle, and for this reason the front-action lock is generally preferred for all military arms, except revolvers. The conditions to be fulfilled in the construction of a military lock, are simplicity, strength, certainty of action, and freedom from such accidental motion of the parts as might produce explosion of the charge in the barrel.

The stock is the wooden part of the fire-arm, to which all the parts are assembled; for military arms it is preferable that it should be in one piece. The material should be light, strong, and well seasoned. The butt, the part intended to rest against the shoulder and to support the recoil of the piece, should be of such length and shape as will enable it to transmit the recoil with the least inconvenience to the soldier. The longer it is, to a certain extent, the more firmly will it be pressed against the shoulder, and the effect of the recoil will be a *push* rather than a *blow*. The stock is crooked at the handle for convenience in aiming, and for the purpose of diminishing the direct action of the recoil. Changing the direction of the recoil in this manner causes the piece to rotate around the shoulder; but if the stock be made too crooked, the butt will be liable to fly up and strike the soldier's face. The *sights* are guides by which the piece is given the elevation and direction necessary to hit the object. There are two; called *front* and *rear sights*. The *front sight* is fixed to the barrel near the muzzle. The *fineness* of its point is regulated by the length of the barrel, or distance from the eye, and the size and distance of the object generally aimed at; it is made coarser in military than in sporting arms, to prevent injury. The *rear sight* is attached to the barrel a short distance from the breech; it has a movable part, capable of being adjusted for different elevations of the barrel. A sight for a military arm should satisfy the following conditions, viz.: 1st, it should be easily adjusted for all distances within effective range; 2d, the form of the notch should permit the eye to catch the object quickly; 3d, it should not be easily deranged by the accidents of service. *Globe* and *telescopic* sights are used for very accurate sporting arms, but they are too delicate in their structure and too slow in their operations for general purposes.

The *mountings* may be divided into three classes, viz.: 1st, those which serve to connect the principal parts, generally bands and screws; 2d, those which protect from wear or strengthen the stock at certain points, as the butt-plate, guard-plate, tip; 3d, the minor parts which secure the different parts (including the mountings proper) in their place, consisting of springs, screws, rivets, pins, washers and nuts.

A *butt-plate* is to protect the end of the stock from injury by contact with the ground; it is generally curved to fit the shoulder in firing. A *guard-plate* is to strengthen the handle of the stock; it may serve as a fulcrum for the trigger. A *tip* is a shield placed on the end of the stock towards the muzzle. If the piece be intended to be carried upon the soldier's back, it is provided with *swivels* for that purpose, generally two, one of which may be fastened to a band and the other to the guard-plate, or to a point of the stock in rear of that plate. The *trigger* is a lever used to set the lock in motion. Triggers are divided, according to their construction and the force required to draw them, into *common* and *set* or *hair* triggers; the latter are employed only in sporting arms. The force required to set off the trigger, if very great, may disturb the accuracy of the aim; if it be slight, the piece will be liable to accidental discharges. The trigger has a guard which protects the finger-piece from injury, and from accidental blows that might produce explosions. The *ramrod* is a long, slender piece, carried with an arm; with breech-loaders it is only employed to wipe out the barrel to remove from it any obstruction, as a defective cartridge-shell. See *Small-arms*, and *Springfield Rifle*.

PORTABLE FORGE.—A light and compact blacksmith's forge, with bellows or blowers, etc., all so arranged as to be readily moved from place to place. Fig. 1, shows a most complete portable forge, designed for army usage. Its height is 22 inches; size of firepan, 22×27 inches, weight, 200 pounds; and diameter of the fan 9 inches. The firepan is made of wrought-iron, and is 10 inches deep, containing all the other parts of the forge when packed for transportation. The blower and gearing are compactly framed together, and fit into a slot on the

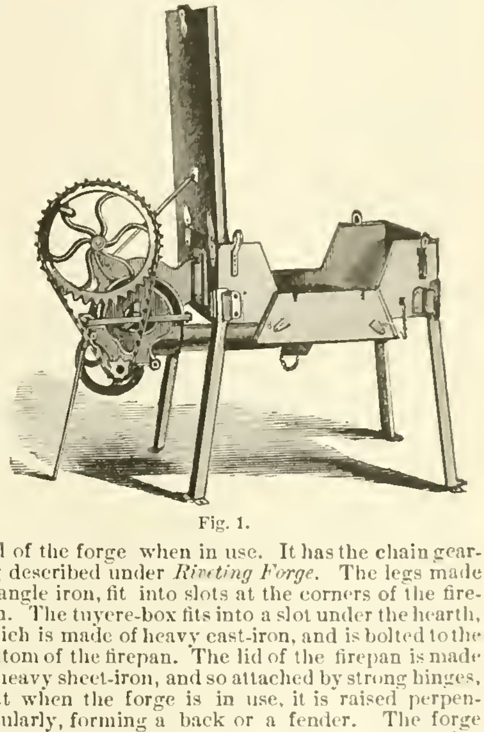


Fig. 1.

end of the forge when in use. It has the chain gearing described under *Riveting Forge*. The legs made of angle iron, fit into slots at the corners of the firepan. The tuyere-box fits into a slot under the hearth, which is made of heavy cast-iron, and is bolted to the bottom of the firepan. The lid of the firepan is made of heavy sheet-iron, and so attached by strong hinges, that when the forge is in use, it is raised perpendicularly, forming a back or a fender. The forge can be set up for use, or packed for transportation in one minute. To pack the forge for transportation,

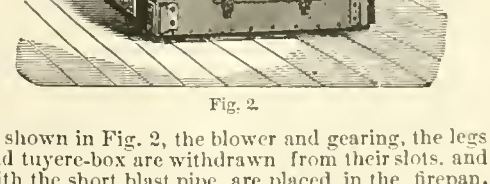


Fig. 2.

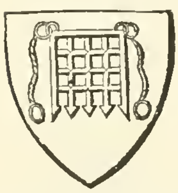
as shown in Fig. 2, the blower and gearing, the legs and tuyere-box are withdrawn from their slots, and with the short blast pipe, are placed in the firepan. The falling doors at the sides of the firepan are closed and fastened. The lid is shut down, and fastened by a hasp. The entire forge thus packed occupies a space only 22×27 inches square and 10 inches deep. This forge will produce a quick welding heat on iron three inches diameter, and on larger iron if required, as there is an abundance of spare blast.

PORTABLE MAGAZINE.—A wooden box or metal-lined case, covered with canvas, and of such size as to be easily carried in a battery from place to place when there is only one expense magazine for several batteries; but this would scarcely ever be the case in the future, as expense magazines in the present fortifications are provided in the proportion of 1 to every 4 or 5 guns, or in the case of very heavy guns, 1 to every 2 or 3.

PORT ARMS.—This old command in musketry drill, is derived from *portare*, to carry, and applies to a motion in which the fire-arm is brought to a slanting position in front of the body, lock to the front, the barrel crossing opposite the front of the left shoulder. See *Arms Port.*

PORTATE.—In Heraldry, borne not erect, but athwart an escutcheon; as, a portate cross.

PORTCULLIS.—A barrier, termed a *portcullis*, which can be lowered or raised vertically by machinery, is sometimes added to secure a passage-way from surprise. The ancient portcullis was a framework of heavy beams, placed vertically, leaving a few inches only between each pair of beams. These vertical beams were either solidly confined between horizontal beams, or clamping-pieces, in pairs; or else they were so arranged that they could slide upwards between the clamping-pieces. Each of the vertical beams was shod at the bottom with a strong pointed iron shoe. The horizontal pieces were framed securely with two heavy vertical beams that formed the sides of the frame, and were fitted into vertical grooves made in the side walls of the passage-way in which the frame could slide when raised or lowered. By arranging the vertical beams to slide upwards between the clamping-pieces, it enabled the passage-way to be closed where an obstruction might be designedly placed before the portcullis to prevent this being done; as the beams which meet the obstruction would be pushed upwards, whilst the others would fall to their ordinary level and close the passage-way on each side of the obstruction.



In the works recently constructed with us the portcullis, and even the doors preceding them, have been constructed of a strong open lattice-work of wrought-iron bars bolted strongly to the wrought-iron uprights and cross-pieces, forming the framework of the lattice. This is a great improvement for these purposes, both as to durability and defense.

Passage-ways of this description should be secured by all the means at an engineer's disposal. A large guard-room, with loop-holes bearing on the passage, should be erected on one side, near the gateway; and if the enceinte is a simple one, without outworks beyond its ditch, a small lunette, or loopholed tambour of masonry, or timber, should be constructed beyond the counterscarp, forming a tête-de-pont, for the security of the bridge from surprise.

2. In Heraldry, the portcullis is represented with rings at its uppermost angles, from which chains depend on either side. It was a badge of the Beaufort family, and borne in virtue of their Beaufort descent by the Tudor Sovereigns. Portcullis is the title of a pursuivant in the English College of Arms, whose office was instituted by Henry VII.

PORTER BAR.—In iron working, when a mass is too large to be handled conveniently with the tongs, a large iron rod, called the porter-bar, is welded to it to serve as a porter or guide-rod. Sometimes a part of the porter-bar is made to form the core of the forging, and the slabs of iron which form the forging are welded and built up on the bar. When the mass of iron is too large to be handled by the forge-man, it is supported by a crane, which serves to swing it from the fire to the hammer. See *Welding.*

PORT-FIRE.—A sort of slow match for firing guns. It consists of a paper tube from 16 to 20 inches in length, filled with a composition thus proportioned: Saltpeter 666 parts, sulphur 222 parts, mealed gunpowder 112 parts. The composition is rammed with force into the paper barrel, and then when ignited it burns for a considerable period. As a substitute may be employed soft brown paper dipped in a solution of two ounces of niter to a gallon of water, dried, and rolled up to the size of a common port-fire. Another port-fire consists of a rod cut square, of lime, birch, or poplar, boiled for six hours in a solution formed by dissolving 1 lb. of nitrate of lead in one quart of water. The rod is subsequently boiled in spirits of turpentine. When thoroughly dried, one yard will burn three hours.

Port-fires are packed in boxes containing 100 or 200. The contents of the box should be marked in white letters on each end, and the place and date of fabrication on the inside of the cover. The following are the particulars of the packing-boxes for port-fires.

	Length.	Width.	Depth.	Weight.
For 100 port-fires,	18	9.1	5.1	38
For 200 port-fires,	18	9.1	10.1	70

See *Fireworks.*

PORT-FIRE CLIPPER.—The name formerly given to the cutting implement which was fixed on the off side of the beam trail of a gun carriage, for cutting off the lighted end of the port-fire. Port-fires being no longer in use, except on emergency, and having been superseded by friction tubes, the sockets and cutters have been removed from all artillery carriages.

PORT-FIRE CUTTER—An implement for cutting port-fires to place in shells or for other purposes. It is simply a strong pair of steel scissors, with an indentation one inch wide and four inches deep made in one of the blades for the purpose of holding the port-fire.

PORTGLAVE.—An ancient name for a sword-bearer.

POSITION OF THE SOLDIER.—When dismounted, the proper position of the soldier is as follows: Heels on the same line, and as near each other as the conformation of the man permits. The feet turned out equally, and forming with each other an angle of about sixty degrees. The knees straight, without stiffness. The body erect on the hips, inclining a little forward. The shoulders square, and falling equally. The arms hanging naturally. The elbows near the body. The palms of the hand turned slightly to the front, the little fingers behind the seams of the trousers. The head erect and square to the front. The chin slightly drawn in, without constraint. The eyes straight to the front, and striking the ground at about the distance of fifteen yards.

These points will be better understood by a reference to the following remarks: *Heels on the same line.* If one be in rear of the other, the shoulder on that side will be thrown back, and the position constrained. *Heels more or less closed.* Men who are knock-kneed, or who have legs with large calves, cannot, without constraint, make their heels touch while standing. *Feet turned out equally, and not forming too large an angle.* If one foot be turned out more than the other, the shoulders will be deranged, and if both feet be too much turned out, it will be impossible to incline the upper part of the body forward without making the whole position unsteady. *Knees straight, without stiffness.* If stiffened, constraint and fatigue will be unavoidable. *Body erect on the hips.* This gives equilibrium to the position. The Instructor will observe that many recruits have the bad habit of dropping a shoulder or advancing a hip, These defects he will labor to correct. *The upper part of body incling forward.* Recruits are commonly disposed to the reverse, to project the belly and throw back the shoulders, which causes great inconvenience in marching. The habit of inclining forward the upper part of the body is so important to contract, that the instructor must enforce it from the beginning, particularly with recruits who have naturally the opposite tendency. *Shoulders square.* If the shoulders be advanced beyond the line of the breast, and the back arched (the defect called round-shouldered), the man cannot align himself nor use his arms with address. Unless the coat fits easily about the shoulders and armpits, it will be difficult to correct this defect. The shoulders must not be thrown too far back, as this will make the belly project, and curve the small of the back. *Arms hanging naturally; elbows near the body; palms of the hands turned slightly to the front; little fingers behind the seams of the trousers.* These positions prevent the men from occupying unnecessary space in the ranks, and keep in the shoulders. *Head erect and square to the front; chin slightly drawn in without constraint.* If there be stiffness in these positions, it will be communicated to the upper part of the body, embarrass its movements, and give pain and fatigue. *Eyes straight to the front.* This is the surest way of maintaining the shoulders in a line—an essential object to be insisted upon and attained.

When mounted (horse unsaddled) the proper position of the soldier is as follows: The buttocks bearing equally upon the horse's back, and as far forward as possible. The thighs turned upon their flat side without effort, embracing the horse equally, and stretched only by their own weight and that of the legs. The knees bent without stiffness. The legs and feet free, and falling naturally, the feet, parallel to the horse. The body erect and unconstrained. The shoulders equally thrown back. The arms free, the elbows falling naturally. The head erect, square to the front, and without constraint. One rein in each hand, the rein coming into the closed hand on the side of the little finger, and passing out over the first finger, on which the thumb is pressed, the bight (end) of the reins falling to the front and between the right rein and the horse's neck; the hands as high as the elbows, and six inches apart; the fingers turned toward each other.

These points will be better understood by a reference to the following remarks: *Buttocks bearing equally upon the horse's back.* If they do not support equally the weight of the body, its steadiness will be impaired. *As far forward as possible.* That the thighs may readily clasp the horse. *Thighs turned upon their flat side, without effort, embracing the horse equally.* The more the thighs adhere to the horse, the greater is the stability of the rider; if they do not clasp the horse equally, the seat will be deranged. *Stretched only by their own weight, and that of the legs.* If they do not fall naturally, they can only be extended by an effort, which will cause constraint. *Knees bent without stiffness.* To give facility in carrying the legs more or less to the rear, without deranging the position of the thighs. *Legs and feet free, and falling naturally; feet parallel to the horse.* Stiffness in the legs will impair their action; if the feet be parallel to the horse, the thighs will be in proper position. *Body erect and unconstrained.* This gives ease, and enables it to conform with suppleness to the motions of the horse. *Shoulders equally thrown back.* If thrown forward, the back will be curved, and the breast contracted; if not thrown back equally, the position of the body will be distorted. *Arms free, and elbows falling naturally.* That they may contribute to the steadiness of the seat, and not stiffen the shoulders or forearms. *Head erect, square to the ront, and without constraint.* If not erect, the body will incline to one side; if there be stiffness, it will be communicated to the upper part of the body, and prevent the head from moving with freedom.

POSITIONS.—The skill of the Engineer is chiefly shown in adapting the resources of his art to the great variety of topographical features met with in the positions that an army is necessarily obliged to occupy when acting on the defensive. No less skill is called for on the part of the General in the selection of his defensive points, as no engineering skill can remedy, in other than a defective manner, a position which is strongly commanded by points which the assailed can occupy within good cannon range, or the flanks of which can be readily turned. To fortify similar positions demands a degree of effort in the inverse ratio of their strength, and for the most part is but labor in vain. Two principal questions present themselves in a strictly defensive war; the one *strategical*, the other *tactical*. The first is based upon the general features of the territory to be defended as affecting the operations of the assailing force, and the system of warfare the best adapted to the assailed; the second on the particular topographical features of the positions where resistance is to be made. The first attention will naturally be given to the system of defense for the frontier, whether one or more strong points shall be alone occupied from which the assailed can be observed; or whether a continued line of natural and artificial obstacles shall be presented to obstruct the movements of the invading force. Although opinion is against the latter method, the question is one that cannot be decided in an absolute manner. The numbers and quality of the army on the defensive; political as well as numerous military considerations; the character of the frontier in great detail; the facilities for the rapid concentration of the troops; and the security of the line of retreat have an important bearing upon it and at all times demand the most careful consideration. That a very extended line is necessarily a weak one is generally admitted; still a system of continued lines, in a country difficult to penetrate, may be used with advantage, and if weak when assailed by a strong force, may serve as an obstruction to a weak one, and be particularly serviceable againts raids. Such a line may be made to play the same part as the lines thrown up in siege operations to prevent the garrison besieged from obtaining succor or supplies by detachments trying to penetrate them. The tactical considerations are the same in the application of field fortifications a position as for the distribution of troops for its defense. Their principal value depends upon the character of the site itself. If it has the qualities of a good defensive field of battle, and lends itself to such a disposition of intrenchments as the troops themselves would naturally assume, then the essential tactical considerations can be secured. In all such cases both the plan and the command of the system employed must be subordinate to the site; to attempt more than this would require the time and means far beyond the command of an army in the field.

Positions derive their great importance from the influence of fire-arms in the decision of battles; for whatever enables one party to deliver its fire with effect against the other, whilst it, at the same time, remains sheltered in any degree from that of its adversary, places the advantage, all other things being equal, greatly on its side: and it is this advantage which should be principally kept in view in selecting a position. *Woods, commanding heights, precipices,* and *villages,* constitute the strong points of a position. They serve as points of support against which the wings of the army rest; or else, by covering parts of the front, they may serve as the key points in the defense. A wood, if properly intrenched, covers the infantry from the attacks of cavalry; conceals its maneuvers, and enables it to deliver its fire without being exposed to that of the enemy. Heights, by giving a commanding view of the surrounding ground, increase both the range and the effects of fire-arms; whilst they, at the same time, serve to screen the troops behind them until they are required to be brought into action. Precipieces offer similar advantages to heights, and are moreover unassailable. Villages serve as secure shelters for detachments, which, by their fire, cover the maneuvers of the troops in their rear; and, if properly intrenched, will cause the enemy great loss in his effort to force his way into them. *Rivers, marshes, hollows* and *ravines*, are the most unfavorable features of a position, because they may prevent a free circulation from one point to another, and thus impede the maneuvers; and they are exposed to the full fire of the enemy. They may, however, be of service when they are so placed as to support the wings, or, when the position being too extended for the number of troops, they render parts of the front unassailable. The best positions are those which, being in due proportion to the force by which they are occupied, command all the surrounding ground within cannon range, the ground descending in a gentle slope to the front, presenting woods, villages, etc., to support the wings and cover parts of the front, and admitting of a free circulation from one point to another, with secure communications in their rear in case of retreat. If with these advantages, they present marshes, or other obstacles, which will embarrass the enemy's movements, and force him to advance in column, exposed to the fire and free maneuvers of the assailed, they will unite everything desirable in a favorable field of battle.

POSITIVE FEED.—The earlier model Gatling guns had cartridges fed to them by means of feed cases, or by a drum, but recently a new method for supplying the cartridges to the gun has been devised, which is *positive and certain in its action*. In the old methods of supplying ammunition to the gun, it was possible for the cartridges to jam in feeding down from the feed cases into the carrier or receiver, but in this newly-improved feed, the mechanism never loses control of the cartridges from the time they leave the feed magazine, until they enter the chambers, are loaded, fired, and the empty cases extracted. With this new feed, it is impossible for the gun to fail in its operation, even when it is worked by men unacquainted with its use. This new improvement not only greatly increases the rapidity and certainty of fire, but enables the gun to be fired at the rate of over 1,200 shots per minute, and at all degrees of elevation or depression, which is something no other machine gun can do. By firing the gun at proper elevations, ascertained by means of a quadrant, the bullets discharged from it can be made to fall upon men behind breastworks, or entrenchments, at all distances, from 200 to 3500 yards from the gun. This "high angle," or "mortar" fire, adds greatly to the effectiveness of the gun, and will, no doubt, prove of inestimable value in future warfare. Experiments have proved that musket-size balls, fired from a Gatling gun at high angles, strike the ground with sufficient force to penetrate from two to three inches of timber. About 1,200 shots per minute can be fired from the gun, raining down a hailstorm of bullets on the heads of men behind entrenchments, thus making such positions, in a short space of time, untenable. Open breastworks, or uncovered entrenchments, would furnish little or no protection to troops against the fire of this formidable weapon.

POSSE COMITATUS.—A Sheriff or Marshal, for the purpose of keeping the peace and pursuing felons, may command all the people of his county, above 15 years old, to attend him, which is called the *Posse Comitatus*, or Power of the County.

It is not lawful to employ any part of the Army of the United States, as a Posse Comitatus, or otherwise, for the purpose of executing the laws, except in such cases and under such circumstances as such employment of said force may be expressly authorized by the Constitution or by some special Act of Congress; and no money appropriated is used to pay the expenses of any kind incurred in the employment of any troops in violation of this law; and any person willfully violating the same is deemed guilty of a misdemeanor, and on conviction thereof is punished by fine not exceeding ten thousand dollars or imprisonment not exceeding two years, or by both such fine and imprisonment. The provisions of the Constitution and of Acts of Congress understood as intended to be excepted from the operation of this law, authorizing the employment of the military forces for the purpose of executing the laws, are as follows:

1. The United States guarantees to every State in this Union a republican form of government, and protects each of them against invasion; and on application of the Legislature, or of the Executive (when the Legislature cannot be convened), against domestic violence.

2. It is lawful for the President of the United States, or such persons as he may empower for that purpose, to employ such part of the land or naval forces of the United States, or of the militia, as may be necessary to aid in the execution of judicial process issued under any of the provisions of the "Civil Rights" bill, or as shall be necessary to prevent the violation, and enforce the due execution of the same.

3. No military or naval officer, or other person engaged in the civil, military, or naval service of the United States, can order, bring, keep, or have under his authority or control, any troops or armed men at the place where any general or special election is held in any State, unless it may be necessary to repel the armed enemies of the United States, or to keep the peace at the polls.

4. The military forces of the United States may be employed at any time in such manner and under such regulations as the President may direct—First. In the apprehension of every person who may be in the Indian country in violation of the law; and in conveying him immediately from the Indian country, by the nearest convenient and safe route, to the civil authority of the Territory or judicial district in which such person shall be found, to be proceeded against in due course of law; Second. In the examination and seizure of stores, packages, and boats, authorized by law; Third. In preventing the introduction of persons and property into the Indian country contrary to law; which persons and property shall be proceeded against according to law; Fourth. And also in destroying and breaking up any distillery for manufacturing ardent spirits set up or continued within the Indian country. No person apprehended by military force under the preceding laws can be detained longer than five days after arrest and before removal. All officers and soldiers who may have any such person in custody shall treat him with all the humanity which the circumstances will permit. The superintendents, agents, and subagents, endeavor to procure the arrest and trial of all Indians accused of committing any crime, offense, or misdemeaner, and of all other persons who may have committed crimes or offenses within any State or Territory, and have fled into the Indian country, either by demanding the same of the chiefs of the proper tribe, or by such other means as the President may authorize. The President may direct the military force of the United States to be employed in the apprehension of such Indians, and also in preventing or terminating hostilities between any of the Indian tribes.

5. The President is authorized to employ so much of the land and naval forces of the United States as may be necessary effectually to prevent the felling, cutting down, or other destruction of the timber of the United States in Florida, and to prevent the transportation or carrying away any such timber as may be already felled or cut down; and to take such other and further measures as may be deemed advisable for the preservation of the timber of the United States in Florida.

6. The quarantines and other restraints established by the health laws of any State, respecting any vessels

arriving in, or bound to, any port or district thereof, are duly observed by the officers of the customs revenue of the United States, by the masters and crews of the several revenue-cutters, and by the military officers commanding in any fort or station upon the sea-coast; and all such officers of the United States faithfully aid in the execution of such quarantines and health-laws, according to their respective powers and within their respective precincts, and as they shall be directed from time to time, by the Secretary of the Treasury.

7. Whenever any person is delivered by any foreign government to an agent of the United States, for the purpose of being brought within the United States and tried for any crime for which he is duly accused, the President has power to take all necessary measures for the transportation and safe-keeping of such accused person, and for his security against lawless violence, until the final conclusion of his trial for the crimes or offenses specified in the warrant of extradition, and until his final discharge from custody or imprisonment for or on account of such crimes or offenses, and for a reasonable time thereafter, and may employ such portion of the land or naval forces of the United States, or of the militia thereof, as may be necessary for the safe-keeping and protection of the accused.

8. Every person who, within the territory or jurisdiction of the United States, begins, or sets on foot, or provides or prepares the means for, any military expedition or enterprise, to be carried on from thence against the territory or dominions of any foreign prince or state, or of any colony, district, or people, with whom the United States are at peace, is deemed guilty of a high misdemeanor, and is fined not exceeding three thousand dollars, and imprisoned not more than three years.

9. In every case in which a vessel is fitted out and armed, or attempted to be fitted out and armed, or in which the force of any vessel of war, cruiser, or other armed vessel is increased or augmented, or in which any military expedition or enterprise is begun or set on foot, contrary to the provisions and prohibitions of the Neutrality Acts, and in every case of the capture of a vessel within the jurisdiction or protection of the United States as before defined; and in every case in which any process issuing out of any court of the United States is disobeyed or resisted by any person having the custody of any vessel of war, cruiser, or other armed vessel of any foreign prince or state, or of any colony, district, or people, or of any subjects or citizens of any foreign prince or state, or of any colony, district, or people, it is lawful for the President, or such other person as he shall have empowered for that purpose, to employ such part of the land or naval forces of the United States, or of the militia thereof, for the purpose of taking possession of and detaining any such vessel, with her prizes, if any; and also for the purpose of preventing the carrying on of any such expedition or enterprise from the territories or jurisdiction of the United States against the territories or dominions of any foreign prince or state, or of any colony, district, or people with whom the United States are at peace.

10. It shall be lawful for the President, or such person as he shall empower for that purpose, to employ such part of the land or naval forces of the United States, or of the militia thereof, as shall be necessary to compel any foreign vessel to depart the United States in all cases in which, by the laws of nations or the treaties of the United States, she ought not to remain within the United States.

11. In case of an insurrection in any State, against the government thereof, it is lawful for the President, on application of the Legislature of such State, or of the Executive, when the Legislature cannot be convened, to call forth such number of the militia of any other State or States, which may be applied for, as he deems sufficient to suppress such insurrection; or, on like application, to employ, for the same purposes, such part of the land or naval forces of the United States as he deems necessary.

12. Whenever, by reason of unlawful obstructions, combinations, or assemblages of persons, or rebellion against the authority of the Government of the United States, it becomes impracticable, in the judgment of the President, to enforce, by the ordinary course of judicial proceedings, the laws of the United States within any State or Territory, it is lawful for the President to call forth the militia of any or all the States, and to employ such parts of the land and naval forces of the United States as he may deem necessary to enforce the faithful execution of the laws of the United States, or to suppress such rebellion, in whatever State or Territory thereof the laws of the United States may be forcibly opposed, or the execution thereof forcibly obstructed.

13. Whenever insurrection, domestic violence, unlawful combinations, or conspiracies in any State so obstructs or hinders the execution of the law there of, and of the United States, as to deprive any portion or class of the people of such State of any of the rights, privileges, or immunities, or protection, named in the Constitution and secured by the laws for the protection of such rights, privileges, or immunities, and the constituted authorities of such State are unable to protect, or, from any cause fail or refuse protection of the people in such rights, such facts, are deemed a denial by such State of the equal protection of the laws to which they are entitled under the Constitution of the United States; and in all such cases, or whenever any such insurrection, violence, unlawful combination, or conspiracy, opposes or obstructs the laws of the United States, or the due execution thereof, or impedes or obstructs the due course of justice under the same, it is lawful for the President, and it is his duty, to take such measures, by the employment of the militia or the land and naval forces of the United States, or of either, or by other means, as he may deem necessary, for the suppression of such insurrection, domestic violence, or combinations.

14. It is unlawful to take any vessel or cargo detained under section 9 from the custody of the proper officers of the customs, unless by process of some court of the United States; and in case of any attempt otherwise to take such vessel or cargo by any force, or combination, or assemblage of persons, too great to be overcome by the officers of the customs, the President, or such person as he shall have empowered for that purpose, may employ such part of the Army or Navy or militia of the United States, or such force of citizen volunteers as may be necessary, to prevent the removal of such vessel or cargo, and to protect the officers of the customs in retaining the custody thereof.

15. The President is authorized, at his discretion, to employ the land and naval forces of the United States to protect the rights of the discoverer [of a guano island] or of his widow, heir, executor, administrator, or assigns.

Officers of the Army can not permit the use of the troops under their command to aid the civil authorities as a *Posse Comitatus* or in execution of the laws except as authorized in the foregoing enactments. If time will admit, the application for the use of troops for these purposes must be forwarded, with a statement of all the material facts, for the consideration and action of the President; but, in cases of sudden and unexpected invasion, insurrection, or riot, endangering the public property of the United States, or in cases of attempted or threatened robbery or interruption of the United States mails, or other equal emergency, officers of the Army may, if they think a necessity exists, take such action before the receipt of instructions from the seat of Government as the circumstances and the law under which they are acting may justify; and will then promptly report their action and the reasons therefor to the Adjutant-General for the information of the President. See *Civil Authority*, and *Execution of Laws*.

POST.—1. A soldier's beat while on sentry, or a position assigned to or taken up by a soldier or body of men; it generally consists of an entrenched village or position, or any building placed in a state of defense. The necessity of strengthening a post is admitted to be of paramount importance, and every endeavor should be made by an officer in command to place himself in such a defensive position as shall prevent his being taken unawares, or, if attacked, enable him to make a good fight. Often neither time, material, intrenching tools, nor men, will permit of solid works, such as a redoubt or other elaborate field-works, being thrown up, but it is possible, when villages or detached houses are occupied by troops, to throw up temporary cover which shall greatly strengthen the position. The following are principles to be borne in mind in forming a post, or in strengthening a position: 1—To obtain cover for the men and animals from the enemy's fire. 2—To enable the troops to fire, in the most advantageous manner, on the ground over which the enemy must advance. 3—To hinder the approach of the enemy by obstacles, which, even if surmountable, shall be sufficient to break his order and detain him for some time under fire. 4—To enable the troops to pass freely from one part of the works to another, in order to concentrate on any point attacked. 5—To impede the flank movements of the enemy as much as possible, and thus prevent his different parties from supporting each other effectually.

2.—*Post*, in a military sense, frequently means to station; as, to *post* a sentinel or relief. *To be posted* signifies to be formed ready for action. Thus, when troops are brought up in column, and ordered to deploy, it frequently happens that some part of the line is refused, in order to flank an enemy, or to cover a weak position; the part that is aligned is said to be *posted*. The phrase also means, in a familiar sense, to be publicly announced as an infamous or degraded character.

3.—In the British service, the term *Post* is given to the bugling which precedes the tattoo. This is the *First Post*, the *Last Post* that which follows it. See *Advanced Post*, *Garrison*, *Military Post*, *Outpost*, and *Station*.

POST BAKER.—The person who bakes bread for a garrison. In the United States service the Post Baker is an enlisted man, who receives additional pay for his labor.

POST CEMETERIES.—The Commanding Officers of all posts, situated on all public lands of the United States, see that a suitable portion of such land is set apart and properly maintained for the burial of deceased officers, and soldiers, and their families, and of Government employés. The burial ground is suitably and securely inclosed with the best material available—a stone or adobe brick wall, or a neat wooden picket fence—and maintained by the labor of the garrison. At each grave is placed a head-board, plainly marked with a number, and with the name, company, regiment, and date of death of the occupant, the number on the head-board to correspond with the number on the record of burials. The head-boards are about four feet long, ten inches wide, and one and three-eighths inch thick; and stand two feet out of the ground; of well-seasoned wood, and painted with three coats of white paint; inscription in black letters one inch long. The walks are about four feet wide, neatly rounded up, properly drained, and graveled when the material is at hand. Where practicable, a good grass sod covers all the rest of the ground, including the graves; and native trees and shrubs are preserved or planted for ornament and shade. A record of interments is kept at each post by the Acting Assistant Quartermaster in the form on page 569; and when he is relieved, is turned over by him to his successors; and if the post be broken up, is transmitted to the Quartermaster General.

A list of the names of those buried (including a transcript of the items embraced in columns 1, 2, 7, 8, 9, 10, 11, 22, and 25) is forwarded to the Quartermaster General at the end of each year.

A public Cemetery is established near Salt Lake City, Utah, under the provisions of an Act approved May 16, 1874. This Cemetery is under control of a Board of which the Commanding Officer, Camp Douglas, Utah, is *ex-officio* a member. See *Battle-grounds Cemeteries*, *National Cemeteries*, and *Superintendent of National Cemeteries*.

POSTERN.—Posterns are arched, bomb-proof passage-ways constructed under the terre-pleins and ramparts, forming subterranean communications between the parade and the enceinte ditch, or between the ditches and the interior of the outworks. The width and height of the interior of posterns depend upon the use to which the communication is to be applied. For artillery the width is usually taken at 10 feet, and the height under the crown or key of the arch at least 8 feet. Posterns for infantry may be only from 4 to 6 feet wide, and from 6 feet 6 inches to 8 feet high under the crown of the arch. The thickness of the piers of the arches is generally taken at about half the width of the postern. The arches are from 18 inches to two feet thick, and are covered with a thickness of earth sufficient to protect them from any injury from shells bursting over them. A strong wooden door is placed at each outlet of the postern to secure it against surprise. The doorway in posterns for the service of artillery should be of just sufficient height for the convenient passage of a gun.

The most important postern is the one leading from the parade to the main ditch. This generally receives a width of 12 feet and the same height under the crown. For greater security from surprise, its outlet is at least 6 feet above the bottom of the ditch, this difference of level being overcome by means of a temporary wooden ramp which receives an inclination of at least $\frac{1}{6}$. Besides two strong doors at the two ends of the postern, there is a partition of masonry about midway between the two ends, which is pierced with a doorway of the same size as the doorways of the ends, and closed by a strong door which, as well as the partition wall, is loop-holed for musketry.

In cases where the postern forms the main entrance to the work, an arched chamber is placed on one side of it, at the outlet, which serves as a guard-room for a few men, to secure the outlet from surprise. The wall between this chamber and the postern is loop-holed, so that a fire can be brought to bear on the doorway of the postern; and as a further precaution against surprise a machicoulis defense is sometimes arranged at the top of the scarp wall just above the doorway of the postern. See *Communications*.

POST FLAG.—In the United States Army, the Post Flag is the National Flag, It is twenty feet fly and ten feet hoist, is furnished to all posts garrisoned by troops, and is hoisted only in pleasant weather. See *Flags*.

POST FUND.—In the United States Army, a fund constituted by the troops baking their own bread and thereby saving $33\frac{1}{3}$ per cent., the difference between bread and flour. The Post Trader also pays an assessment of 10 cents, or less, a month for every officer and soldier in the garrison, which is carried to the credit of the *Post Fund*. The following (exclusive of sums transferred to the regimental fund) are the objects to which the Post Fund may be appropriated, and Councils will give them precedence in the order named: 1. Expenses of bake-house. 2. Garden seeds and utensils (for all troops serving at the post). 3. Post schools. 4. Post library and reading-room. 5. Gymnasium. When the necessary material and labor are in the Post Quartermaster's Department, and can be spared from more im-

Record of Deceased Officers and Soldiers buried by ——, —— *Quartermaster, U. S. A., at* ——, ——.

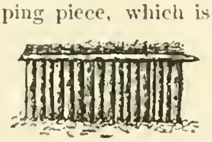
Number and name of the person interred.		Number and locality of the grave.		Hospital number of the deceased.		Rank.	Letter of company.	Regiment.			Residence before enlistment.			Conjugal condition, if married or single.	Residence of widow.			Cause of death.	Age of the deceased.	Place of nativity.	Date of death and burial.		Locality of death.	Remarks.
Number.	Name.	Number.	Locality.	Ward.	Bed.			Number.	State or U. S.	Arm.	Town.	County.	State.		Town.	County.	State.				Died 18 .	Buried 18 .		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

portant work, the necessary apparatus for the gymnasium, and for such games and exercises as the Council may consider desirable for the health and amusement of the soldiers at the post may be constructed by the Quartermaster's Department. 6. Chapel. 7. For fruit and shade trees. 8. For fruit-bearing vines and bushes. 9. For printing press. The Quartermaster General, under direction of the Secretary of War, procures and forwards to the post librarian such periodicals and newspapers as his appropriation for incidental expenses can afford to pay for, or school books in lieu of periodicals, when the Post Fund is not sufficient to supply them and the post does not desire periodicals. The periodicals, newspapers and school books are intended for the use of the enlisted men, and must not be taken from the library or school-room. If used at all by officers it must be at a time when other duties prevent their use by enlisted men. The necessary school books for soldiers and for soldiers' children are purchased from the Post Fund, except in cases provided for in the foregoing paragraph. See *Company Fund* and *Regimental Fund*.

POST GARDENS.—Commanding Officers of posts, at or near which suitable public lands are available, set aside for Company or Post Gardens such extent of those lands as may be necessary for the production of vegetables for the command, and cause the same to be duly cultivated by the garrison, and such varieties and quantities of vegetables to be raised as may be necessary for the subsistence or health of the troops. On approved requisitions, the Subsistence Department procures for sale to companies or posts, seed potatoes, garden seeds, and agricultural implements necessary for establishing, cultivating, and perpetuating company or post gardens. Payment to the Subsistence Department for these articles, at cost price, is made from the company or post fund. The Commissary General of Subsistence gives to the officers of his Department the necessary instructions for the purchase and distribution of seeds and agricultural implements. If in changes of station a company or garrison is succeeded by another, the latter succeeds to the garden of the former, reimbursing the fund of the former for its actual expenditures for seeds, agricultural implements, etc. Commanders of Divisions and Department give such detailed instructions as may be necessary for carrying these regulations into effect, and for the proper distribution of products of gardens among those entitled to them. Surplus products may be sold, and the proceeds credited to the post fund, or divided among the company funds of the garrison, whichever may have borne the expense of the cultivation.

POST OF HONOR.—The guard in the advance. The right of the two lines is also the post of honor, and is generally given to the eldest corps; the left is the next post, and is given to the next eldest, and so on. The laws of military discipline forbid an inconvenient accordance with this practice, as the circumstances of the case may require a very different arrangement, which it would be wanton to oppose.

POST REVETMENT.—A revetment constructed of posts from 4 to 6 inches in diameter, cut into lengths of 5.5 feet, and set with proper slope, in close contact, in a trench two feet in depth, at the foot of the breast-height. The tops of the posts, if not already so, are sawed off level, to receive a horizontal capping piece, which is spiked on. Anchor ties are dove-tailed into the cap and secured to an anchor log imbedded in the parapet. On top of the cap are laid several courses of sods, raising the interior crest to the proper height. With a good quality of timber this revetment is durable. It is easily constructed, and next to sods, is the best. See *Revetment*.



POST SCHOOLS.—Schools are established at all the posts, garrisons, and the permanent camps at which troops are stationed, in which the enlisted men may be instructed in the common English branches of education and especially in the history of the United States; and the Secretary of War details such officers and enlisted men as may be necessary to carry out this provision. It is the duty of the Post or Garrison Commander to set apart a suitable room or building for school and religious purposes. The teachers and schools are under the control of the Post Commander, or such officer as the Post Commander may designate. School teachers are detailed from the enlisted men of the Army. The number of teachers detailed cannot exceed one for each company serving at the post. At any post at which there are no soldiers suitable for detail as school-teachers, application is made to the Adjutant General of the Army by the Post Commander for the necessary number of teachers. A soldier while serving as school teacher receives extra-duty pay as overseer (35 cents per day) from the Quartermaster's Department, not deducting for Saturdays and Sundays. Soldiers while detailed as school teachers will attend such parades, inspections, and drills as, in the judgment of the Post Commander, are necessary to keep them well instructed in their company duties. While it is left optional with soldiers whether to attend school or not, yet they are advised to avail themselves of the means afforded to improve themselves, and Commanding Officers not only give them all possible opportunities, but advise and encourage them to use them. The children of soldiers are required to attend the post school for children, unless specially excused by the officer in charge of schools. The children of citizens living near a post are allowed to attend the post school for children. For the instruction given them they are required, if able, to pay a small rate into the post fund. Officers and citizens furnish the school books necessary for their own children. The Post Council of Administration decide whether it is advisable or practicable to have separate schools for adults and children. An officer is detailed by the Secretary of War to visit and inspect regularly the various post schools. It is made his duty to examine into the system of instruction; to advise Commanders of Posts of defects which he may discover, and to suggest methods of improvement; to endeavor to bring about uniformity in the methods of management and instruction, and to make known throughout the Army the best methods and systems in existence at any Military Post. He reports the results of his inspection fully to the War Department from time to time. His inspections do not dispense with or interfere with those of the Inspector Generals of the Army, but are specially and directly addressed to the schools alone.

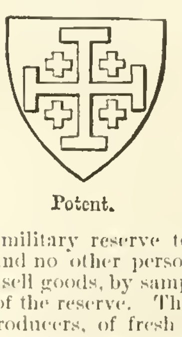
POST TRADER.—In the United States, every military post may have one Trader, who is appointed by the Secretary of War, on the recommendation of the Council of Administration, approved by the Commanding Officer. Post Traders are furnished with a letter of appointment from the Secretary of War indicating the posts to which they are appointed. They are subject, in all respects, to the rules and regulations for the government of the Army. They actually carry on the business themselves, and habitually reside at the station to which they are appointed. They can not farm out, sublet, transfer, sell or assign the business to others. They are permitted to erect buildings for the purpose of carrying on their business upon such part of the military reservation or post where they are assigned as the Commanding Officer may direct. Such buildings are in convenient reach of the garrison. [*Circ. A. G. O., Aug.* 28, 1879.] When a Trader is removed from his post, he has a right to remove and dispose of the materials of the buildings erected by him as his own property. He cannot lease or sell his buildings to another Post Trader without permission of the military authorities; but such permission would have the same force as a license to a new Post Trader to erect such a building at that spot. Post Traders have the exclusive right of trade upon the military reserve to which they are appointed; and no other person is allowed to trade, peddle, or sell goods, by sample or otherwise, within the limits of the reserve. This does not prohibit the sale, by producers, of fresh fruit or vegetables by permission of the Post Commander. Post Traders in the Indian country have no right to maintain a traffic in goods with the Indians, unless they be properly licensed for such trade. For the exclusive privilege allowed them, Post Traders are assessed and held to pay for the benefit of the post fund, at a rate to be determined by the Post Council of Administration, not exceeding ten cents per month, for every officer and enlisted man serving at the post—the monthly average to be determined equitably by the Council. The Council of Administration once in six months, and not oftener, examines the Post Trader's goods and invoices or bills of sale, and, subject to the approval of the Post Commander, establishes the rates and prices (which should be fair and reasonable) at which the goods shall be sold. A copy of the list thus established is kept posted in the Trader's store. Should the Post Trader feel himself aggrieved by the action of the Council of Administration, he may appeal therefrom, through the Post Commander, to the War Department. In determining the rate of profit to be allowed, the Council considers not only the prime cost, freight, and other charges, but also the fact that the Trader has no lien on the soldier's pay, and is without security in this respect. Post Commanders report to the War Department any misconduct, breach of military regulations, or failure on the part of Post Traders to comply with the requirements of regulations.

When any cause of complaint against a Trader arises, the Post Commander places the same before the Council of Administration, and the Council examines the evidence for and against the Trader, and makes a report of the facts, through the Post Commander, to the Adjutant General of the Army, for the action of the Secretary of War, in whom alone is the power vested to remove a Post Trader. When a new Trader is selected, and his appointment is issued, the appointment of the former Trader will be revoked; but, in order that injustice may not be done the former Trader in the total loss of his investment in buildings and goods, the new appointee will be required to purchase a portion or all of the same at a fair valuation—the articles to be so purchased and the appraisement of their value to be determined by the Council of Administration. The former Trader is not debarred from withdrawing his goods if he so elect, nor from entering upon the reservation to attend to the settlement of his business until the same has been closed; such privilege, however, does not entitle him to continue to trade at the post. See *Canteen* and *Sutler*.

POT.—The paper cylinder forming the head of a signal-rocket and containing the decorations. To diminish the resistance of the air the pot is surmounted by a paper cone.

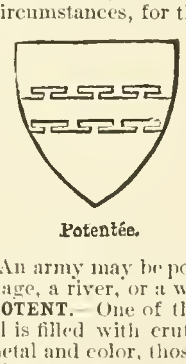
POT-DE-FER.—A heavy helm worn in siege operations. It is related that Louis XIV., like the other soldiers, went into the trenches in full armor, and wearing the *pot-de-fer*. See *Pot Helmet*.

POTENCE.—Troops are ranged *en potence* by breaking a straight line, and throwing a certain proportion of it either forward or backward, from the right or left, according to the circumstances, for the purpose of securing that line. An army may be posted *en potence* by means of a village, a river, or a wood.



Potent.

Potent Counter-Potent.



Potentée.

POTENT COUNTER POTENT.—One of the heraldic furs, in which the field is filled with crutch-shaped figures alternately of metal and color, those of opposite tinctures being placed base against base, and point against point. The metal and color are understood to be argent and azure, unless they be specially blazoned otherwise. Potent counter-potent is sometimes blazoned vairy-cuppy.

POTENT CROSS.—In Heraldry, a cross crutch-shaped at each extremity.—It is also called a Jerusalem cross, from its occurrence in the insignia of the Christian kingdom of Jerusalem, which are, argent a cross potent between four crosslets or. This coat is remarkable as being a departure from the usual heraldic rule which prohibits the placing of metal upon metal.

ed tunic and *chausses*, was frequently worn by the Knights of this period beneath the surcoat, which was, as a general thing, considerably lengthened, and very richly emblazoned with the arms of the wearer.

POWDER.—A common term for gunpowder. Under this name is found a variety of powders in use at the present day for small-arms and guns.

Countries	Gunpowder. Saltpeter.	Charcoal.	Sulphur.	Small-arm Powder. Saltpeter.	Charcoal.	Sulphur.
America	75	12·50	12·50	75·50	13·20	11·30
Austria	70	17	16	75·50	13·20	11·30
England	76	15	10	76·50	14·50	9
	76	14·50	9·50	76	13·50	9
France	75	14·50	9·50	75	12·50	12·50
Germany	75	13·50	11·50	75	12·50	12·50
Italy	76	12	12	75·50	13·20	11·30
Russia	71	17·50	11·50	80	11·30	8·70
Spain	76·50	12·70	10·80	75·50	13·20	11·30

POTENTEE.—A heraldic line of division which takes the form of the outline of a succession of crutch-shaped figures.

POT-GUN.—A mortar for firing salutes. The name is derived from its shape being formed like a pot. It is now obsolete.

POT-HELMET.—A sort of skull-cap of thick iron, and very heavy. It was used, particularly in sieges in the 16th and 17th centuries. The word *pot-helmet* is also very commonly used for iron hats much lighter in weight, that were much worn by Cromwell's foot-soldiers.

POT-METAL.—An alloy of lead and copper, obtained by throwing lumps of copper into red-hot melted lead. It is of a gray color, brittle and granular.

POUCH.—A stout leather box, black or brown, lined with tin, covered with a strong flap, and ornamented with the device of the regiment. It serves to carry the cartridges required by a soldier for immediate use. When cartridges are supplied for a whole day's service, two pouches are worn, one on the front point of the hip, and a larger one on a belt suspended over the left shoulder. The leather cases containing primers, lanyard, etc., in field and heavy artillery, and those containing a gunner's level, vent-punch, gimlet, etc., in heavy artillery, are also called pouches.

POULEYNS.—In ancient armor, a variety of knee-guards, which were very elaborately and variously enriched.

POUNDER.—The name by which different natures of ordnance and shot and shell are distinguished. By being so denominated, the weight of the projectile which the gun throws is implied. Projectiles fired from heavy howitzers and mortars are distinguished by the diameter of the pieces, such as those propelled from the 10-inch and 8-inch howitzer and mortar; and it would be advisable to denominate all projectiles by the diameter of the piece, and also by the weight of the projectile itself. This is done in the case of shot and shell used with the heavy M.L. R. guns of 7-inch caliber and upwards, but below this caliber they are known only by the weight of the shot. The weight of heavy rifled ordnance is always expressed in tons, if of 5 tons or upwards; otherwise in cwts.

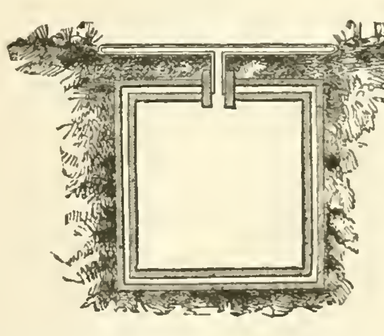
POURPOINT.—A military habit worn in the thirteenth century, but which was subsequently modified, and from the peculiar work with which it was then ornamented, obtained the name of *Pourpoint* or *Counterpoint*. A complete suit, consisting of a sleev-

The following table gives the proportions of the composition most generally used in the manufacture of gunpowder in the countries mentioned. See *Gunpowder*.

POWDER-BARREL.—Barrels in which gunpowder is stored. There are three sizes, called *whole*, *half*, and *quarter*, holding respectively 100 lbs., 50 lbs., 25 lbs., of ordinary powder. The whole barrel is capable also of containing 125 lbs. of pebble powder. There is also a barrel in the service termed a *bouge* barrel, which is the size of a quarter barrel, and intended to be used, not for storage, but for holding loose powder for mortars or cartridges in a standing battery. This barrel is distinguished from the ordinary powder barrel, in having a leather bag attached to it, which takes the place of one head of the barrel, and is closed by a leather thong. The word *bouge* or *budge* is a corruption of the French word *bouget*, a leather bag.

Powder barrels are composed of heads and staves bound round with copper and ash hoops, and are made by hand or by machinery. The wood used in English barrels is usually American oak, whereas the Indian powder barrels are made of teak, if anything a stronger and closer-grained wood than the oak alluded to, so that it is not found necessary to bind them round with ash hoops, as in the English barrels.

POWDER BOXES.—Contrivances analogous to fougasses, used by the Russians at Sebastopol. Each consisted of a double deal box, of a capacity suffi-



cient to contain 35 pounds of powder, water-tight, and effectually secure it from the penetration of damp, into the top of each box was inserted a vertical tin tube, connected with a horizontal tin tube at the surface of the ground. Within the latter was a glass tube, filled with sulphuric acid, and coated with a composition of chlorate of potassa, sugar, sulphur, and gum-water, which immediately takes fire on coming in contact with the acid. The space between the interior of the tin tube, and the exterior of the glass tube, as well as the vertical tin tube, is filled with gunpowder. A little earth spread lightly over the whole completes the arrangement. A person walking over the ground, and treading on the tin tube, crushes it and the glass tube contained in it, causing the escape of the sulphuric acid, and the explosion of the gunpowder. See *Fougasses*.

POWDER CART.—A two-wheeled carriage covered with an angular roof of boards. To prevent the powder from getting damp, a tarred canvas is put over the roof; and on each side are lockers to hold shot, in proportion to the quantity of powder.

POWDER DEPOTS.—Large depots for the storage of powder, and the materials for its manufacture. In selecting sites for these depots, the following considerations should be observed: 1st. That the depot should be in a region of country which does not admit of being populated, so that destruction of life and property in case of accident would be a minimum. 2d. The tract should be sufficient in extent to contain suitable positions for magazines for storage of 10,000 tons of powder, material for its manufacture, etc.,and the necessary buildings for a government powder-mill. 3d. It should be near enough to rail and water transportation to afford facilities of transportation to the seaboard, interior, and the lakes, having a short line of government railroad connecting the site with rivers and trunk-lines. When the present arsenals in the United States were established, their locations were but sparsely settled. The rapid increase of population in the adjacent towns and cities has, however, in the majority of cases, rendered these magazines dangerous to the communities in which they are located and hence the Government either has abandoned, or eventually will have to essentially abandon, the storage of powder at all of our arsenals. The damp sea-air renders our fortifications unfitted for this purpose, and the Government has now large quantities of powder rapidly deteriorating at these places for want of proper storage-facilities. See *Lightning Conductors*, *Magazine*, and *Preservation, Storage, and Transportation of Powder*.

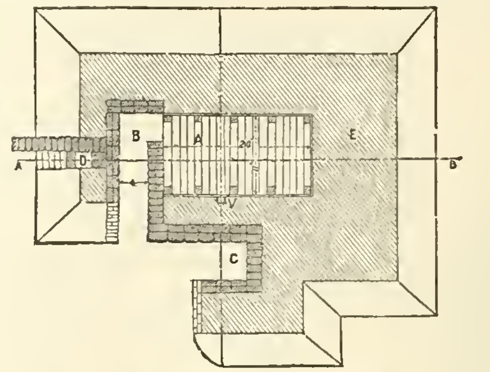
POWDER DUST.—All gunpowder, in the process of reeling, gives off a certain amount of dust. It is a great object to remove the dust from the powder, as it quickly absorbs moisture from the atmosphere, and, consequently, impairs its preserving qualities. This dust is not lost to the factory, but is worked over again, receiving first the process of incorporation for a short time, and then going through the rest of the mills until it becomes perfect gunpowder. The operation of dusting is effected by cylindrical reels covered with canvas, which revolve at a given rate. See *Dusting Reels*.

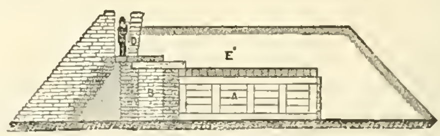
POWDERED.—In Heraldry, *Powdered*, or *Semée*, signify strewn with an indefinite number of small charges.

POWDER-FLASK.—A pouch or metallic case for holding gunpowder, and having a charging nozzle at the end. A horn is often fitted to hold powder and used as a flask.

POWDER-HOSE.—A tube of strong linen, about an inch in diameter, filled with powder, and used in firing military mines.

POWDER MAGAZINE.—The main objects to be obtained in constructing a powder magazine are, to place it in a position convenient to the pieces to be served, and one least exposed to the fire of the enemy; to make it shot-proof; and to secure the contents from moisture. It is usually placed 30 feet in rear of the parapet of the battery. The ceiling of the magazine should not be more than a few inches above the natural level. The interior height need not be more than 5 feet. The width may be 6 feet, and the length 12 feet in the clear. The sides of the magazine may be formed of frames and sheeting boards; or, of a row of gabions crowned with two courses of fascines. The magazine is covered at top by splinter-proof of timbers, 6 by 9 inches, laid in





juxtaposition and covered with at least 3 feet of earth, both on top and on the sides towards the parapet. A passage leads into the magazine on the side from the parapet, which is reached by one or two inclined trenches.

The drawing shows the plan and section of a powder magazine employed at the siege of Fort Wagner A, the Magazine; B, the covered entrance; C, the telegraph office; D, the lookout on top; E, an embankment of sand covering the magazine. The plan is taken just below the ceiling. In the section, A′, is the interior of the magazine; B′, the entrance; D′, the lookout; E′, the covering of sand. The rules given for the construction and location of bomb-proof shelters for men, apply equally to shelters of this class. The only difference in construction is in the size of the shelters, it being much smaller, as a rule, than that required for the use of troops. Large magazines are not constructed in ordinary field works. They take up too much room, and even the best of them are but poor places in which to store ammunition for any length of time. The usual method adopted is to construct as many service magazines as may be necessary, near the guns to be served by them, making them large enough to contain the amount required for a definite service of the gun or guns to which they belong.

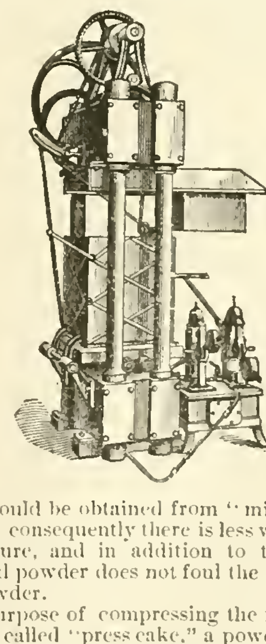
In Permanent Fortification, powder magazines are built with strong, full center bomb-proof brick arches, supported on heavy stone piers which form the outward walls, and to which interior buttresses are sometimes added. The capping of the arches is covered with from 4 to 10 feet of solidly packed earth. The interior of the magazine, the floors, and the doors and windows, are built with a view to security from fire; and to preserve the powder from dampness, by a good system of drainage around the foundations, and of ventilation by means of air-holes made through the piers, and panels of copper pierced with small holes placed in the doors. No iron or steel fastening or sheeting is allowed in any part of the structure; and in arranging the air-holes through the piers they receive a broken direction, and have a copper mesh-work placed across them, to prevent any combustible material or rats, or mice, penetrating to the interior of the magazine. In large works the magazines are isolated, as far as practicable, from the enceinte, so as not to endanger it should an accidental explosion take place. The magazine is inclosed by a strong, high wall for security, and is provided with lightning rods. In small works some one or more of the casemates in the position least exposed to the assailant's fire are built for the purposes of a magazine.

The following memoranda respecting the ventilation of powder magazines is herewith appended: 1. The dampness complained of in buildings will frequently be found to arise from condensation of the watery vapor of the air which enters the building. Buildings with thick walls and vaulted roofs, and especially those covered with earth, are particularly liable to dampness from this cause. 2. Air always contains some proportion of watery vapor. When the proportion is small, the air is said to be dry, and when large, the air is said to be damp; when the proportion is the greatest that can be diffused through air at a given temperature, the air is said to be saturated at that temperature. 3. The proportion of watery vapor which saturated air contains varies with the temperature, being greater for high than for low temperatures. Air containing a particular proportion of moisture is rendered less capable of depositing moisture by its temperature being raised, and the reverse when it is lowered. 4. Air may be brought to a state of saturation by reducing its temperature. If the air contain but little moisture, the reduction of temperature must be considerable; but if it contain much, a slight reduction will bring it to a state of saturation. 5. If air be cooled below the degree of temperature at which it will be in a state of saturation, a portion of the watery vapor contained therein will be deposited on any cold substance with which it may come in contact. The degree of temperature at which air will thus begin to deposit moisture is called its *dew-point*. 6. When warm air enters a comparatively cold building, the temperature of the air is reduced by coming in contact with the interior walls and other cold surfaces; and if its temperature be thus reduced below the *dew-point*, condensation will take place. In the latter case it is obvious that the admission of fresh air will not tend to dry a building, but to render it damp. 7. If a magazine 40 feet by 24 feet by 12 feet, the temperature of whose internal walls, etc., is 45°, were to be filled with saturated air having a temperature of 50°, and the magazine were then closed, nearly a pint of moisture would be deposited during the cooling of the fresh air to the temperature of the walls. The pint of moisture would result from the quantity of air sufficient merely to fill the magazine; but if the ventilators were opened, the air might be renewed many times in the course of a day, and very much more than a pint of moisture be deposited. 8. Air entering a building whose temperature is higher than its own becomes capable of absorbing moisture from damp surfaces. 9. The efficiency of the ventilation of a magazine will depend upon the degree of dryness which the fresh air admitted into it possesses, and the rapidity of the current of dry air passing through the building. 10. The dryness of air is indicated by the number of degrees by which its temperature exceeds its dew-point. 11. The ventilators of magazines should, in all cases, be constructed so as to exclude or admit the external air at discretion, *and the instructions for their use should be framed with a view to the exclusion of the external air when the temperature of its dew-point is above that of the interior of the building, and the admission of the air when its dew-point is below the temperature of the interior of the building.* 12. The interior of a bombproof magazine with thick walls and a vaulted roof is commonly colder than the outside air in summer and warmer in winter. Winter is therefore the more favorable season for ventilation; but in the climate of England the exceptions to this rule are numerous, owing to the prevalence during winter of warm, damp winds from the south and west, and during summer of cold, dry winds from the north and east. 13. Whenever, notwithstanding a careful attention to ventilation, magazines are found to be damp, their condition may be improved by the use of quick-lime, which has the property of absorbing from the air about one third of its own weight of water. 14. The proper time for using lime is when the condition of the magazine would not be improved by ventilation, and when, consequently, the ventilators are closed. Lime would be of very little service while a rapid current of air was passing through the building. 15. Lime will be used during the seasons of the year least favorable for ventilation in all magazines that show signs of dampness. 16. The lime should be fresh from the kiln, broken into lumps not larger than about the size of a pigeon's egg, and exposed to the air of the interior of the magazine in shallow vessels. It should be kept in air-tight casks until spread out for use.

POWDER MILL.— Works in which the materials for gunpowder are prepared and compounded, and the powder grained and faced. See *Gunpowder*.

POWDER MINE.—A cave or hollow in which powder is placed to be fired at any particular time. These were first used in 1503, at Naples, when it was besieged by the Spanish General Gonzalvo, of Cordova.

POWDER PRESS.—The last operation of breaking down the mill cake, and the one now about to be described, of pressing the meal into a solid cake, is merely for the purpose of fitting it to be made into a hard grain of equal density. In the pressing process, the powder that has passed through the breaking-down machine is brought from the small magazines to the press-house, where it is compressed into hard cake. Many advantages are gained by this operation, first, the cake when made into grain of the required size absorbs less moisture from the atmosphere than if it had been soft and not pressed, and the lasting qualities of the powder are much increased, especially if glazed; again, by having been compressed the powder is less liable to be reduced to dust in transport, for if properly made it may safely be kept for a number of years, even on board ship at sea, without any appreciable deterioration. Further, by a closer connection of the ingredients a larger volume of gas is produced, bulk for bulk, than from a soft light powder; it also produces more



grain than could be obtained from "mill cake" not pressed, and consequently there is less waste by dust in manufacture, and in addition to this, a hard, clean-grained powder does not foul the gun so much as a soft powder.

For the purpose of compressing the meal powder into what is called "press cake," a powerful hydraulic press is employed. The apparatus for holding the meal consists of a very strong gun-metal box incased on the outer and inner sides with oak; it is

2′ square and 2′ 6″ deep, the bottom and one side are permanently fixed to each other, but the other three sides are hinged to the bottom, so as to allow of their being opened; when shut these sides are firmly held together by strong, coarse-threaded metal screws. The box, when about to be filled, is first laid on its side in front of the press, and the uppermost side is then opened and laid back. Two guide racks, of gun-metal, with wooden ribs on them, forming a number of grooves one-tenth of an inch in width and five-eighths of an inch apart, are hung on the inside of the box to those sides that have not been opened; into these grooves a series of gun-metal plates one-tenth of an inch thick are slid, the racks keeping them upright and equidistant. The spaces between the plates are now filled in with the meal powder, and this being done, the racks are withdrawn, leaving the plates supported in their position by the powder between them. The third side—which has remained open until now—is then lowered down and screwed fast up to the two sides already in position. The box is provided with two projecting gun-metal claws that fit into a mandrel attached to the front of the press; upon this mandrel the box is now turned by means of overhead tackle, the mandrel being so adjusted that when the box is raised partly into a vertical position it is pushed over and lowered down exactly on the center of the press table. Attached to the press cross-head are two overhead rails, carrying a large block of hard wood, which is hung and travels upon these rails by means of four wheels; when the box is turned over on its side for the purpose of filling, this block is drawn back to the extremity of the rails, and when the box is filled and replaced on the table and in the proper position for pressing, the block is drawn forward again until it arrives exactly over the center of the box, where it is retained in position by means of a catch.

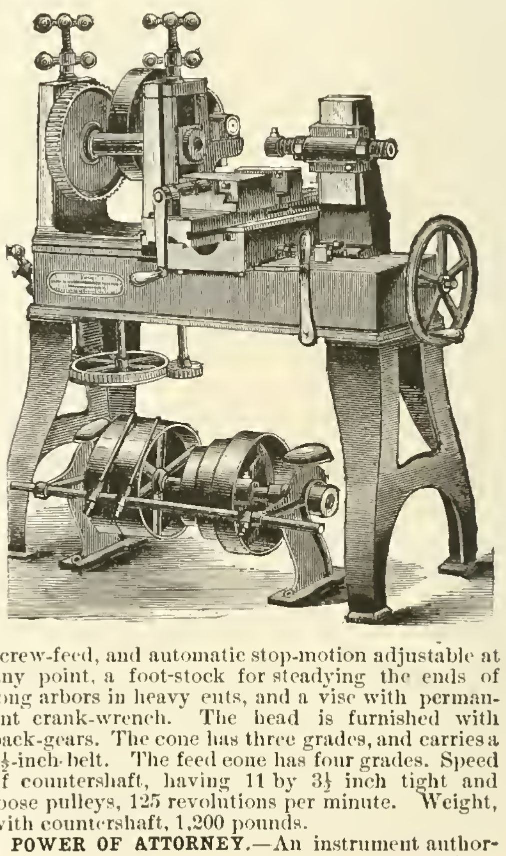
The press is now put in motion by means of pumps, which are driven either by steam, water, or hand power, and are placed in a separate building, on the opposite side of a high traverse that divides the one building from the other. In the pump-house the attendants remain in safety while the pressing operation is being performed. The pumps are of the description generally used for such purposes, and are fitted with large and small plungers. At first, when the material to be pressed is soft, the large plungers are used and the box is raised rapidly, but when the press has traversed about three-fourths of its distance the use of the large plungers is discontinued, and the smaller ones worked until such time as the powder is subjected to a pressure of 70 tons per square foot of surface. When the pumps are first put in motion, one of the attendants remains in the press-house for a short time to see that the block enters the box fairly, and that it is in the center; a clearance of about a quarter of an inch is allowed all round between it and the box. If all is in order, the attendant then retires to the pump-house, and when the requisite pressure has been obtained, the press is allowed to stand for a few minutes with the full pressure on it; this allows the air to escape and the powder to consolidate. Should the pressure go down from this cause, the pumps are again set in motion until the full pressure is attained; and, after allowing a few minutes to elapse, the escape valve is opened and the ram with the box descends. The overhead block is now run back out of the way, the box turned over on its side, and all the fixing screws removed from the three sides, the uppermost one is lifted up and turned over, and the other two are opened out. The powder, with the gun-metal plates between it, will now be found to be standing like a solid mass on the side of the box underneath, and which for the time forms the bottom.

The plates and powder cakes are now separated by copper chisels, and the cake—being from three-eighth of an inch to one-half inch in thickness, and looking like slabs of slate—is broken into pieces about the size of a man's hand by means of wooden mallets. It is now collected, put into tubs, and removed to the next magazine, where it is allowed to remain for two or three days; this renders it so hard that it is not easy to break it. Some difficulty is at times experienced in obtaining precisely the same density in the pressed powder, and it is an ascertained reality that any great difference in this particular causes the powder to vary considerably in quality and strength; in fact, until the greatest precision and certainty are obtained, firstly, in purifying the ingredients, so as to ensure their containing the same percentage of gases and carbon; and, secondly, by an equally precise amount of incorporating and pressing, absolute uniformity in the quality and strength of the powder manufactured cannot be secured. See *Gunpowder*.

POWDER PROOF.—All *gunpowder* for proving ordnance should be of the best quality, of the kind used in the gun to be proved, and giving not less than the standard initial velocity; it should be tested immediately before being used unless it shall have been tested within one year previously, and there be no reason to suspect that it has become deteriorated.

POWER.—In military affairs, as well as in all others power is knowledge—of human passions, of arms, of distance, of the skill and numbers of an enemy. To be in the *power* of an enemy, is to have taken up, injudiciously, such a position as to expose to defeat whenever the enemy may think proper to attack.

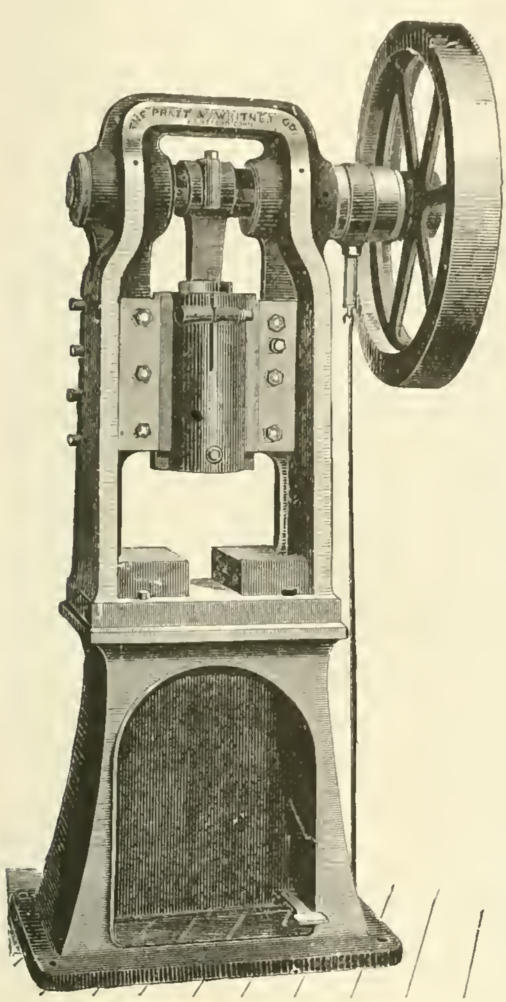
POWER MILLING-MACHINE.—A machine much used in the manufacture of small-arms. The drawing represents the Pratt & Whitney No. 2 Power Milling-Machine (Lincoln Pattern), which is in extensive use in armories and manufactories in America and Europe, and is highly approved at the National Armory, Springfield, Mass. It has automatic



screw-feed, and automatic stop-motion adjustable at any point, a foot-stock for steadying the ends of long arbors in heavy cuts, and a vise with permanent crank-wrench. The head is furnished with back-gears. The cone has three grades, and carries a 1½-inch belt. The feed cone has four grades. Speed of countershaft, having 11 by 3½ inch tight and loose pulleys, 125 revolutions per minute. Weight, with countershaft, 1,200 pounds.

POWER OF ATTORNEY.—An instrument authorizing a person to act as the agent or attorney of the person granting it. A general power authorizes the agent to act generally for the principal. A special power limits the agency to particular things. A power of attorney may be by parole, or under seal. The attorney cannot execute a sealed instrument that will bind his principal unless his own power is given under seal. Grants of this nature are very strictly construed. Authority given to one person cannot be delegated by him to another, unless expressly set forth in the original grant: The death of the principal at once cancels a power of attorney. All conditions in the power must be strictly observed to render the attorney's action legal.

POWER PRESS.—A form of press extensively employed in the manufacture of fire-arms. That repre-



sented in the drawing is provided with Stannard's hydraulic adjustment. A foot-lever actuates a stop-motion that instantly stops the plunger, always at the highest point of the stroke. The crank-shaft, of steel, is made with a throw of 2½ inches, or less, as it may be ordered for trimming or for punching purposes. The shaft-bearings are 3 inches diameter and 8 inches long. The driving-wheel, 32 inches diameter and weighing 380 pounds, receives a 4-inch belt. The plunger is a hollow cylinder, open at the top, and bored to receive a piston, which is also hollow. The plunger travels in gibbed slides, and has a portion of one of its flanges toothed, to engage with a pnion operated by a crank-wrench. The hollow piston contains oil, or glycerine (preferably the latter, as being unaffected by changes of temperature). This piston is attached to the crank by a connecting-bar. By means of a thumb-value in the bottom of the piston, operated by a rod extending up through the top and terminated by a knob, the liquid may be allowed to pass from the piston to the plunger, and *vice versá*, as the plunger is lowered or raised by the pinion and toothed flange. The adjustment of the punch can thus be made very minute and exact, and the relative positions of the plunger and piston may be firmly secured by a binding-screw on the former, which is split a portion of its length for this purpose. The bed of the press may receive a die-plate, 12 by 14 inches. Weight of the machine, 2,750 pounds. Speed of driving-wheel, 175 revolutions per minute. The hydraulic adjustment being quite costly, is seldom ordered. In lieu of it, one is made by substituting for the hollow piston, a solid one, having its circumference threaded to match an annular nut placed in the central part of the plunger, and projecting therefrom sufficiently to be readily turned to raise or lower the plunger. The press is also furnished without plunger adjustment.

POWER SHEARS. A shearing-machine manufactured by the Pratt & Whitney Company, for use in armories. The machine, as represented on page 576, is novel in style and action, noiseless in its operation, and all its parts liable to be clogged by dust or injured by scale are contained inside of the pedestal, but are still fully accessible through the medium of doors. On a shaft passing through the machine from end to end is a worm engaging with a large worm-wheel. This shaft is driven by a faced balance-wheel (used as a pulley for belt) from which connection with the shaft is made by means of Pratt's Patent Friction-clutch. The transverse shaft carries the worm-wheel, which has an eccentric, forming a part of the wheel, a connecting-rod from which engages with the lower end or prolongation of a vertically vibrating horizontal cutter-head, furnished with steel jaws on either side the central bearing, which engage as shears with corresponding fixed jaws. One pair of these jaws is made with recesses of the form of segments of circles to receive round bars, and the other is straight. In front of the jaws are adjustable sliding rests, to resist the upward tendency of the piece to be cut, and at the back is an adjustable gauge for determining its length. The machine is started or stopped instantaneously, without the slightest shock, and there is no loss of power by starting it from a perfect stand-still. Speed of pulley on machine is 280 to 300 every minute. The steel cutting-blades may be removed from the jaws for sharpening or replacement with very little trouble. The combination of the screw, worm-wheel, eccentric, and lever results in a machine of immense power. One size machine is made. It will cut round iron to 1⅝ inches diameter; or flat iron ¾ inch thick to 3 inches wide. Weight, with countershaft, 4,600 pounds. Speed of countershaft, having 16 by 6 inch tight and loose pulleys, about 240 revolutions per minute. See *Angle Shearing-machine, Lever Shearing-machine*, and *Shearing-machine*.

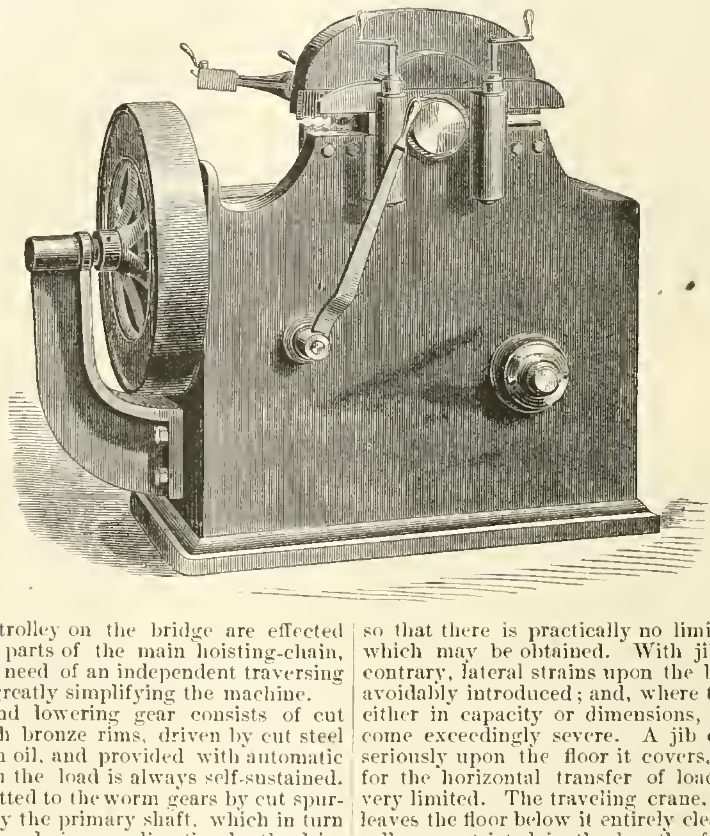
POWER TRAVELING CRANE.—This crane consists of a bridge composed of two wrought-iron girders carried at each end by a two-wheeled truck with double-flanged truck wheels having chilled treads. At one end of the bridge is a crab containing the operating mechanism, and suspended beneath this is the operating platform. Power is communicated to the crane by an endless rope, moving continually in one direction, and driven by a suitable wheel on a stationary shaft at one end of the longitudinal tracks, this shaft being driven by the power transmitted in any convenient manner from a stationary engine, either directly or through the line shafting. The mechanism of the crab is such that the operator, standing upon the suspended platform, is enabled by means of three levers, to apply power so as to cause the bridge to travel longitudinally on the tracks in either direction, or the trolley to travel in either direction, across the bridge, or to raise or lower the load. The bridge and trolley may be moved independently or simultaneously, at will.

The illustration on page 577 shows Weston's Travelling crane, driven by power transmitted from a stationary source, and controlled by an operator standing on a platform suspended from the crane at one end of the bridge. The bridge is arranged to travel longitudinally upon overhead tracks, and the trolley to travel transversely across the bridge, so that the efficiency of the crane covers the entire rectangle included between the tracks, which latter may if desired, be 400 or 500 feet, or more, in length. Cranes of this construction are built of any desired capacity from 5 to 50 tons, and of any span.

The motions of the bridge are effected by fixed wire cables, so arranged as to constitute a perfect squaring device, which insures the absolute parallelism of the end trucks of the bridge with their tracks under all conditions, so that the bridge always moves smoothly and with the least possible friction. The motions of the trolley on the bridge are effected through the two parts of the main hoisting-chain, thus avoiding the need of an independent traversing mechanism and greatly simplifying the machine.

The hoisting and lowering gear consists of cut worm-wheels with bronze rims, driven by cut steel worms running in oil, and provided with automatic devices by which the load is always self-sustained. Motion is transmitted to the worm gears by cut spur-gearing, driven by the primary shaft, which in turn is driven continuously in one direction by the driving rope. Automatic stops are provided for arresting the transverse motion of the trolley at either end of the bridge, and also of the bridge at either end of the longitudinal tracks, so that over-travel, either of the bridge or of the trolley, cannot by any accident occur.

Provision is always made for two speeds of hoisting and lowering, and when desired back gearing is added to the crab, thus affording four speeds of hoisting and lowering and two speeds of travel, both of bridge and trolley. When desired, hand gearing can be also added to enable the crane to be moved by hand in the event of the power being temporarily disabled. This adds somewhat to the expense of the crane and is usually not desirable, as the motions by hand are necessarily very slow and the occasions for its use very rare. The operating platform should, if possible, be arranged as shown in the engraving, beneath the bridge, as in this position the operator has best command of the floor below. Where the head room does not allow of this, or where other obstructions interfere, the platform can be arranged at each side of the bridge, and projecting but slightly below the crab. But, for the reason above given, this arrangement is not so good as that shown in the engraving. A foot way across the bridge gives access to the parts attached to the latter, and also to the trolley. The main chain sheaves have anti-friction bushings, and the action is such as to distribute the wear equally throughout the entire length of the chain. The power traveling crane constitutes the most perfect and complete apparatus for handling heavy loads, and is to be preferred to all other types of cranes, wherever the construction of the building, and the other surrounding conditions admit of its use. It avoids all strains other than vertical upon the building in which it is contained, and for its support requires merely a trestle or wall of sufficient stability to resist the direct pressure of the crane and its load,



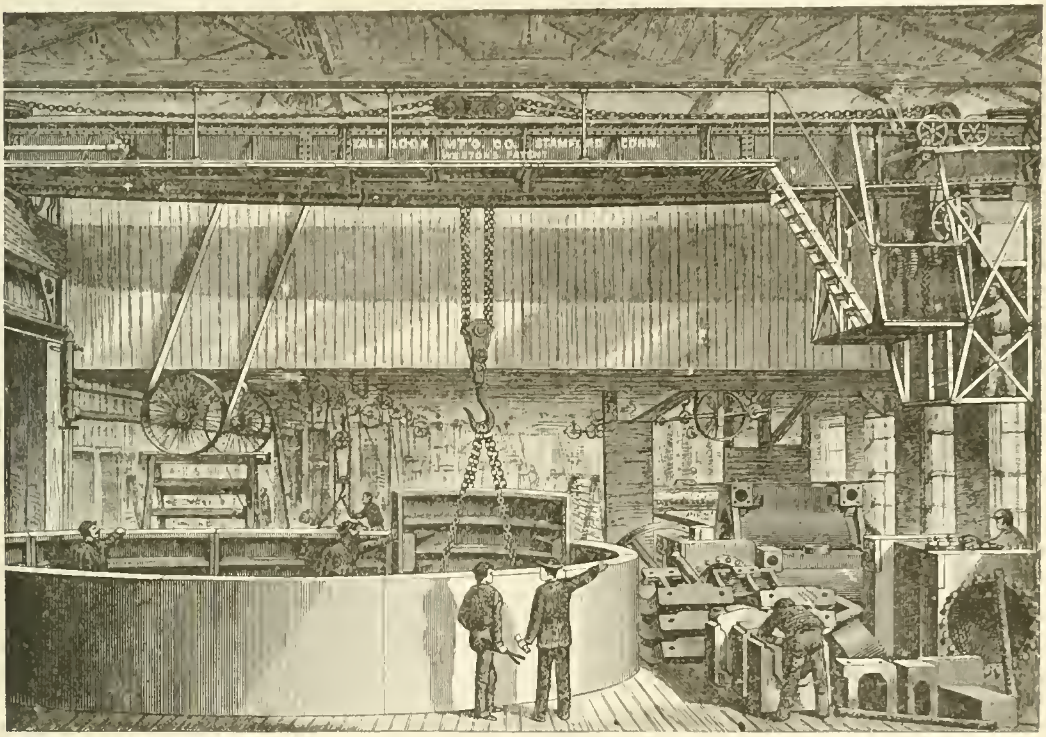
so that there is practically no limit to the capacity which may be obtained. With jib cranes, on the contrary, lateral strains upon the building are unavoidably introduced; and, where the crane is large, either in capacity or dimensions, these strains become exceedingly severe. A jib crane encroaches seriously upon the floor it covers, and its capacity for the horizontal transfer of loads is necessarily very limited. The traveling crane, on the contrary leaves the floor below it entirely clear, and is practically unrestricted in the length of its travel. The designing of the Weston power traveling cranes has been a subject of the most careful study and thorough experiment, extended over a number of years. It is believed that these are the most highly organized and mechanically perfect cranes which have ever been built. Cranes of this construction are adapted for use in foundries, armories, forges, machine shops, rolling mills, stone yards, and other places where heavy loads are to be handled, and where it is desired to accomplish this in the most efficient and economical manner. Where actively employed cranes of this type will do the work of from 20 to 50 men using the ordinary devices of tackles, jacks and screws, so that it is demonstrable in many cases that the economy effected by a crane within one or two years will entirely cover the cost of procuring it. See *Cranes*, and *Hand Traveling Crane*.

POWLDRON.—In Heraldry, that part of armor which covers the shoulders.

POWLETT GUN CARRIAGE.—A pneumatic carriage consisting of an improved slide fitted with suitable cross-transoms and angle-knees for the support of running and recoil cylinders, which are placed underneath the gun and between the slide rails in such a manner as to be entirely protected thereby from the chances of disarrangement by a shot or shell in action. A rack-piece runs along the inside of one of the slide rails with a rolling, eccentric clutch, with a lever attached to its collar, so that when the gun is fired and the recoil is "brought up", the lever falls and automatically secures the gun in that position until it is desired to run in battery, or to be brought back to the rear buffers for loading. The running cylinders are firmly fixed to the cross-transoms of the slide, and are fitted with pistons, the rods of which are secured to the forward transom of the brackets of the sliding carriage carrying the gun. This attachment of the collar of the piston-rod to the carriage has a slot motion, so arranged that when the gun is fired there is sufficient play not to strain the piston-rod in the gland stuffing box at the forward end of the cylinder head.

This running cylinder is fitted with supply and exhaust pipes, with reversing valves or cocks, whereby compressed air furnished from below at a pressure may be supplied to either end of the cylinder, at will, by moving the lever attached to the stem of such reversing valves forward or backward, for running out or running in. When the gun is run out and fired, a pressure of any number of pounds of compressed air as may be desired remains at the rear end of the cylinder for picking up the recoil, and, if it is desired, the clutch-lever may be elevated and secured and the gun made to run immediately in battery again, automatically, after each fire. In training this carriage, which is done without tackle, winch, or chain wheel, there is placed at the rear of the carriage slide and between the same a pair of oscillating cylinders laid horizontally with a plane of the slides and attached directly with a worm geared into a worm wheel having a pinion geared into a cogged racer wheel, so arranged and meshed that any motion to the right or to the left will traverse or train the gun to right or left, as desired. The oscillating cylinders are placed at such an angle that there is no center of axis or motion, and, likewise, there are no slide valves for reversion of motion, as this is accomplished by two pairs of supply pipes leading to the ports or base of the cylinders on both sides of the trunnion support; therefore, by moving the lever to the right or left, the training engine would follow that motion and train the gun to the right or left, as desired.

The elevating and depressing gear of this carriage is operated by an upright cylinder, with sufficient drift to give instantaneously the extreme degree of elevation or depression required by the action of compressed air. On either side of the breech of the gun are racked standards, with movable slot, having a compressor screw encompassing a racked die or slot-plug, by which, with one-half turn of the screw lever, the breech of the gun is firmly secured at any degree of elevation or depression desired. By this method of working heavy guns, two men and a gunner are all the crew that is required to work and load the heaviest ordnance, and all the power is furnished from below, from an air compressor engine and receiver of suitable size. The drawing represents a 25-ton B.L.R. gun mounted on the Powlett carriage. Connected with this carriage is an ingenious stand-by recoil check device, which, should any accident happen to the compressed-air machinery or pipes during action, can be thrown by a lever and clutch instantly into service. This recoil check is mechanical, and has no cogged gearing, and keeps itself in order by running perfectly free during all maneuvering, until thrown into gear in an emergency. See *Brake*.



POWWOW.—A priest or conjuror among the North American Indians; also, conjurations performed for the cure of diseases and other purposes, attended with great noise and confusion, and often with dancing. When an accepting Chief wishes to organize his war party, he mounts his horse, both in full war paint, raises a pole to which is attached a bunch of feathers and a small red blanket, and rides about the village singing the war song. Those wishing to go, mount their ponies and follow the chief. This is continued several days, until there is a sufficiency of volunteers for the work.

During the absence of the war party, the people at home become very anxious, and all the conversation is centered on the absent party and its probable time of return. When it is announced that the warriors are returning victorious, there is a great excitement throughout the village. The womnn chant songs of victory, while the old men narrate the deeds of their forefathers and themselves to excite the emulation of the young. The "Medicine Men" gallop through the camp beating their drums and shouting encouragement, while the warriors painted black, with their horses in the full war paint, perform the scalp dance.

If the expedition turns out to be a failure, and some of the party are killed, the relatives of the killed cut off their own hair and the tails and manes of the favorite horses of the deceased, and cry without cessation for days, weeks, and even months.

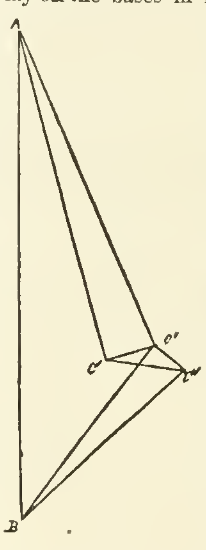
POYNADO.—An early name for a poniard.

PRAELIARES.—Among the Romans, fighting days on which they thought it lawful to engage in acts of hostility; for during the time of some particular feasts, they reckoned it a piece of impiety to raise, march, or exercise men for war, or to encounter the enemy, unless first attacked.

PRAIRIE.—The name given, by the early French Explorers of the northern portion of the Mississippi Valley, North America, to the vast fertile plains which extend from western Ohio and southern Michigan, across the States of Indiana, Illinois, Missouri, Arkansas, Iowa, Kansas, Nebraska, and Dakota Territory, including the southern portions of Wisconsin and Minnesota. These great plains or savannas are sometimes flat, but oftener rolling like the long swells of the ocean, and rise in gradual elevation from 800 to 1,500 feet above the level of the sea. They are drained by numerous rivers, branches of the Ohio, Mississippi, and Missouri, or emptying into Lake Michigan, whose channels seem to have been worn to the depth of 50 to 300 feet, with vertical walls or bluffs of limestone, sandstone, displaying in some places banks of clay, sand, and loam, 200 feet in thickness. Beneath the prairies, northwest of the Ohio, are extensive coal-fields, with deposits of iron, lead, etc. The soil is finely comminuted, rich, and extremely fertile, varying in thickness from 1 or 2 feet to the bottom-lands on the borders of the rivers, which are of great depth and inexhaustible fertility. These plains are destitute of trees, except in isolated groves, a few rocky ridges, and the borders of streams. They are covered with fine grasses, and brilliant flowers of various species of the helianthoid *compositæ*. Water is found from 15 to 30 feet below the surface. These great prairies, covering an area of about 400,000 square miles, formerly fed vast herds of buffalo, deer, wild turkeys, prairie-hens or grouse, prairie-dogs, squirrels, etc. In the autumn, the dried grasses, fired by the Indians, converted them into seas of flame. The lack of timber is attributed by some to the fineness of the soil. Remains of ancient mounds, fortifications, and cities show that they were, at some distant period, inhabited by a more civilized race than the Indians found by European discoverers. These great rolling plains, or natural pastures, with only the labor of plowing, produce large crops of wheat or maize, and, penetrated by navigable rivers, and crossed by cheaply built railways, they form one of the most easily cultivated and prolific regions of the world, and are capable of sustaining immense populations.

PRAIRIE CARRIAGE.—The necessity for a small carriage for the mountain howitzer, when used on our western prairies, has led to the adoption of a special carriage for that service, with a limber attached as in a field carriage. This renders the carriage less liable to overturn, and preferable in every respect to the two-wheeled one. The limber is furnished with two ammunition boxes, placed over the axle-tree, and parallel to it, and just wide enough for one row of shells and their cartridges. See *Gun-carriages*.

PRATT RANGE-FINDER.—Any device, by means of which the distance between two objects may be measured with such accuracy as will warrant its application in determining what elevation should be given to a fire-arm discharged at one of the points, in order that its projectile shall strike the other, or within effective proximity, may be called a range-finder. For military purposes, a range-finder should be as small inexpensive, durable, and simple as is possibly consistent with necessary accuracy. It should also not be limited in its application to one base, and the base should not be long in comparison with the range. It is thought that the method of use suggested by Lieut. Sedgwick Pratt, Third Artillery, U. S. A., may materially increase the value of fixed-angle telemeters. An outline of this method is here given as applied in general to telemeters with fixed angles. It enables the observer to obtain the distance between two points even when he can occupy neither of them. The observer being at C, to obtain the distance between the points A and B, he lays off the bases C C′ and C C″, as if to determine the distances C A and C B, respectively. Without measuring these bases he measures the distance C′C″, and this is multiplied by the number corresponding to the instrument, 20, for instance, giving the distance A B. This is because the angle C′ C C″ is equal to the angle A C B, and the sides C C′ and C C″ are proportioned to the sides A C and B C in the triangles C C′ C″ and A B C. Care must be taken to lay off the bases in the same direction from C, that



is, both to the right or both to the left of the observer at C as he stands facing the points A and B for the two bases respectively. Where the instrument is adapted to laying off a right angle also, the observer can place himself on the line between two points, A and B, and obtain the distance between them in a very simple manner. Being at C, he lays off in the same direction the bases C C′ and C C″, one corresponding to the distance C A and the other to C B, adds the bases, and multiplies their sum by the usual number. Lieutenant Pratt's instrument consists of four mirrors. Two are set at an angle of 45° and two at a lesser angle. The number of mirrors is the same as in the modified Azémar instrument, which gives three angles. The bases are $\frac{1}{10}$ and $\frac{1}{20}$ of the distance to be determined, and with the longer base the instrument is used like Weldon's. The method shown in the figure is applicable to the Weldon range-finder, as well as to those giving a right angle. When the right-angle instruments are used, care must be taken to lay off this angle at the right or at the left extremity of the base in both observations. When A C C′ and B C C″ are both right angles the line C′ C″ will be perpendicular to the line A B, and this affords an easy method of laying off a perpendicular to an inaccessible line, two points of which are visible to the observer. This method can be used also with variable-angle telemeters. See *Nolan Range-finder*, *Russell Prism Range-finder*, *Telemeter*, *Watkins Range-finder*, and, *Weldon Range-finder*.

PRECEDENCE.—Priority in rank or precedenc in military life is regulated by the date of an officer's commission, or the standing in the Corps to which he may belong. The following is the order of precedence of the several Regiments and Corps of her Majesty's service, viz:— (1) The Regiments of Life Guards, and the Royal Regiment of Horse Guards. (2) The Royal Horse Artillery; but on parade, with their guns, this Corps will take the right and march at the head of the Household Cavalry. (3) The Regiments of Cavalry of the Line, according to their number and order of precedence. (4) The Royal Regiment of Artillery. (5) The Corps of Royal Engineers. (6) The Regiments of Foot Guards. (7) The Regiments of Infantry of the Line according to their number and order of precedence. (8) The Departmental Corps. The Royal Marines, when acting with the Troops of the Line, take rank next to the 49th Regiment. The Rifle Brigade rank next to the 93d Regiment. The Militia Regiments have precedence after those of the Line, according to their respective numbers as fixed by lot. When Regiments of British and Irish Militia of the same arm are serving together, the Militia of that part of the United Kingdom in which the Regiments may at the time be quartered has precedence over other Militia, but Regiments of Artillery Militia always have precedence over the Infantry Militia. On parade for purposes of maneuvering, Corps are to be distributed and drawn up in the mode which the General or other Officer commanding may judge most convenient, and best adapted to the purposes of the service. Rifle Battalions should be formed upon a flank.

PRECEPTORY.—The name given to certain houses of the Knights Templar, the Superiors of which were called Knights Preceptor. All the preceptories of a province were subject to a Provincial Superior, called Grand Preceptor; and there were three of these who held rank above all the rest, the Grand Preceptors of Jerusalem, of Tripolis, and of Antioch. Other houses of the order were called "Commanderies."

PRECISION.—Exactness; accuracy; scrupulous observance of certain given rules. In military phraseology, this term is often employed when remarking on the drill or marching of a regiment. The term is also applied to rifled arms under the name of *Arms of Precision*.

PREDAL WAR.—A war carried on by plunder and rapine. Commonly written *Predatory War*.

PREFECT.—A common name applicable to various Roman functionaries. The most important was the *Præfectus Urbi*, or warden of the city, whose office existed at an early period of Roman history, but was revived under Augustus, with new and greatly altered and extended authority, including the whole powers necessary for the maintenance of peace and order in the city, and an extensive jurisdiction civil and criminal. The *Præfectus Prætorio* was the Commander of the troops that guarded the Emperor's person.

PREFECT PRETORIAN.—In Roman antiquity, the Commander of the *Praetorian Guards*.

PREFET.—The name of an important magistrate in modern France, so called from his exercising functions somewhat similar to those of the *præfectus urbi* at Rome. In old times, the officers whose duty it was to superintend the details of administration in the Provinces were called *Maitres de Requetes*. Under Henry II., their office was rendered permanent; and at a later period, their powers were much extended, and they were known by the designation of *Intendants*. The Intendants were abolished at the Revolution; and a law of 1800 first appointed Préfets for the departments, with powers greatly similar to those of the Intendants. The office, as it now exists, includes the superintendence of police establishment, the enforcement of the laws, and the entire control of the administration of the departments. The Préfet is the head of the executive, exercises most of the government patronage, including the appointment of a *sous préfet* for each *Arrondissement*, and in time of tumult may call out the military, or provisionally declare a state of siege. The chief check on these extensive powers is to be found in the *Conseil de la Préfecture*, which acts in some measure as a court of appeal from the decisions of the Préfet.

PREPONDERANCE.—The excess of weight of the part of the piece in rear of the trunnions over that in front. It is expressed by the lifting force, in pounds, which must be applied at the cascabel to balance the piece upon the trunnions. It is useful only for pieces mounted on traveling carriages, to keep them steady in transportation. For all other pieces of recent model the axis of the trunnions intersects the axis of the piece at the center of gravity, thus enabling the piece to be elevated and depressed with greater ease. The discharge does not sensibly change the position of the piece before the projectile leaves the bore.

PRESBYOPIA.—This condition is an accompaniment of the later years of life; it is a physiological or natural, not an abnormal change, and effects all eyes. It depends almost solely upon the failure of the accommodation, due to a gradual hardening of the lens and decrease of the power of the ciliary muscle as age advances. Although this decrease in the power of adjustment for near objects is not noticed until, perhaps, the 40th or 45th year, yet, from the age of nine or ten, the accommodation is gradually growing weaker, that is, fine print can no longer be seen as close to the eye as formerly.

This defect is not of itself a cause for the rejection of a recruit, but those in whom it exists are usually over age. All eyes undergo the changes producing presbyopia; we frequently, however, hear of persons, ripe in years, who have never felt the necessity of glasses for reading or other fine work, and whose "strong" eyes are their especial pride. Such persons have been near-sighted, probably, all their lives their defect neutralizing the normal changes taking place; a weak concave glass before such eyes will usually improve distant vision.

The popular opinion that the use of glasses should be postponed as long is possible, is erroneous. As soon as unpleasant feelings denote the approach of presbyopia, glasses should be resorted to at once, as the longer the eyes are deprived of the aid which they need, and consequently are subjected to strain, the more rapidly will the changes in the eye become developed.

The treatment of presbyopia is found in convex glasses, of such strength that fine print may be seen readily at 7 to 8 inches. Here such a glass is employed not to correct the refraction, as the case of the convex lenses in hypermetropia, but to aid the power of the eye in accommodating. Presbyopia, in a perfectly healthy eye, does not affect the sharpness of distant vision, although in extreme old age, distant vision also is somewhat diminished, owing to other changes which affect the eye.

The glasses should be used at first only while reading by lamp or gaslight. When the unpleasant sensations show themselves also in the day-time, then the glasses previously worn at night should be used for reading by daylight, and their place supplied by a pair of slightly stronger glasses for night-work. In old persons, when distant vision is improved by weak convex glasses, those of the proper strength may be worn constantly. See *Recruits*.

PRESENT.—A term used in the British service, meaning to bring the musket to a horizontal position, the butt resting against the right shoulder for the purpose of discharging its contents at a given object.

PRESENT ARMS.—A command in tactics directing that the musket be brought to a certain prescribed position, for the purpose of paying a military compliment. The movement is executed as follows: The Instructor commands: 1. *Present*, 2. ARMS. Carry the piece with the right hand, in front of the center of the body, at the same time grasp it with the left hand at the lower band, the forearm horizontal and resting against the body. (Two.) Grasp the small of the stock with the right hand, below and against the guard. 1. *Carry*, 2. ARMS. Resume the carry with the right hand. (Two.) Drop the left hand by the side. See *Manual of Arms, Fig.* 2.

PRESERVATION OF AMMUNITION AND FIREWORKS.—Storehouses and magazines should be kept in the neatest possible order, the stores arranged as much as possible, by classes, kinds, and calibers, and labeled. They should be ventilated from time to time, in the middle of the day, in fine weather, particularly those which contain ammunition and fireworks, which are injured by moisture. *Leaden balls* are generally kept in cellars, on account of their weight; the boxes should be kept as dry as possible, and so piled as to admit the circulation of air about them. *Cartridges for small-arms* are kept in magazines, the barrels or boxes being piled 3 or 4 tiers high at most. *Fixed ammunition for cannon*, if not in boxes, should be placed in piles formed of two parallel rows of cartridges, with the sabots together, in 4 tiers for 12-pounder; chock the lower tier with strips of wood fastened with small nails; put a layer of tow 2 inches thick between the shot; let the piles rest on planks, if there be no floor, and cover them with paulins; have the place swept, and the cartridge-bags brushed off. Leave a passage of 18 inches between the double rows, and keep them 2 feet from the walls. Fixed ammunition should not be put into powder-magazines if it can be avoided; it should be kept in a dry place, above the ground-floor if practicable. The store-rooms should always be aired in fine weather; the piles should be taken down and made up again every six months at most, the bags examined, repaired, and the damaged cartridges broken up. A ticket on each pile should show the number and kind of cartridges, the additions to the pile, and the issues. Canisters are piled up like fixed ammunition, in 4 or 5 tiers. Empty cannisters in 10 or 12 tiers, the bottoms and covers separately. *Cartridge-bags* are filled and kept like fixed ammunition, or packed in boxes or barrels. When empty, they are stored in bundles of 50, sealed up in paper cases, carefully closed with strips of thin paper pasted over the seams. Paper cartridge-bags are kept in bundles,packed in boxes or on shelves,in a dry place, with pounded camphor and black pepper or tobacco; the flannel bottom dipped in a solution of the sulphate of copper. *Loaded shells* should never be put into magazines, except from absolute necessity; powder is not well preserved in them. They should be piled on the ground-floor of a secure building, on planks, if the floor be not boarded, in 6 tiers at most; the fuses of the lower tier, in the vacant spaces between the shells; those of the other tiers, turned downwards, like the fuse-holes of empty shells. The pile should be covered with a paulin. Use the same precautions against moisture and accidents as in a powder-magazine. The different kinds of *canister shot* are kept together, in bins or boxes. *Slow-match* is kept in a dry place, such as a garret, in boxes or barrels, or are piled on the floor. *Quick-match*, if not in boxes, may be hung up in bundles on ropes or pins and covered with paper. *Friction-primers* should be kept in tin boxes. *Port-fires*, in bundels of ten, are placed in boxes or in barrels on end in safe and dry situations. *Fuses* are packed in boxes, the same kind, as much as possible, in the same box, in very dry and well-ventilated stores. *Cylinders of rock-fire* are kept in boxes or barrels like fuses. *Fire-balls* are kept in cool but dry and airy places, suspended by the handle, the bottom resting on a board or floor that they may not become deformed. Each ball should be labeled, stating its caliber, weight, and year of fabrication. *Signal-rockets* are packed in boxes, the sticks tied together. Each box should contain rockets of but one caliber, and should be marked with the size and the kind of decoration. If the sticks be attached they are tied in bundles of 5 according to the kind of decoration. *War-rockets* are preserved in dry places with the same precautions as loaded shells. *Tarred links* are strung on a rope and hung up. For transportation they are packed in barrels with straw between the tiers. *Fascines* and *torches* are packed like tarred links. The parts of ornamental fireworks, owing to their liability to deteriorate in store, are generally made as required. They may be packed in the same manner as port-fires. See *Ammunition*.

PRESERVATION OF PROJECTILES.—Projectiles for rifle guns should be neither lacquered nor painted, for the reason that either of these substances would adhere to and foul the grooves of the piece. When practicable, they should be kept under cover, in a dry place, and if unboxed, should be oiled once a year with sperm oil. They are piled, according to kind and caliber, on their sides, in tiers of convenient height. The fuse holes should be stopped with tow or cotton-waste. Great care should be taken when handling them to avoid injuring the sabot. No shells of any description should be kept habitually charged. This is done, as occasion requires, when firing. Empty shell, whether in store or in transportation, are most carefully protected from dampness. They have the fuse-bouching coated with composition, and the fuse-hole is stopped by a plug of very soft wood which is well coated with a mixture of oil and tallow, and screwed in. The ends of the plugs are not sawed off even with the shell, but left square, and project sufficiently to allow them to be unscrewed by means of a wrench; and when these plugs are removed for the purpose of fitting the shells for service, they are not thrown away, but preserved for future use.

When projectiles have been allowed to become very rusty, they may be thoroughly cleaned in the following manner: Provide stout rectangular wooden tubs, fitted with faucets and troughs, for conducting the waste water, acids, etc., to the gutters. The loose rust having been removed with a file-card, place the projectiles in the tubs, and cover them with a mixture of three parts muriatic acid and four parts water. After pickling for an hour, or an hour and a half, remove the acid directly into another tub, if convenient, as the same mixture may be used many times. Then thoroughly rinse the projectiles in running water; if any rust remains it will be in a spongy,half-dissolved condition,easily removed with a file-card. After rinsing, the projectiles are wiped with a dry cloth and piled, when they will be ready for lacquering.

Whenever projectiles are to receive lacquer, care is taken that the quantity applied does not increase the diameter more than is indispensably necessary, and in no case above established high gauge. Old lacquer and rust are removed by scraping, as far as can be conveniently done, before a new coating is applied. Neither hammering nor beating is resorted to for this purpose. After numerous experiments upon different lacquers employed for the preservation of projectiles from rust, the French have abandoned all of them. The projectiles are simply piled, under sheds when practicable, or in the open air, and, when put on board of ship, cleaned of rust and rubbed over with whale-oil; the same means are adopted every three months of the cruise.

In emptying shell they are handled carefully and placed on a bench with a hole in it to receive and support the inverted shell. A wooden vessel placed below receives the powder. The powder which has been removed from shells is only used for filling shell, as it always contains a small quantity of grit, which renders it unfit for general service. All powder taken from shell is sifted, and all dust and particles of dirt removed, as far as possible, before putting it into barrels. Should the powder have become caked, so as not to be easily removed by washing out the shell, a handful of small iron shot put in the shell facilitates this operation. See *Piling of Balls* and *Projectiles*.

PRESERVATION, STORAGE, AND TRANSPORTATION OF POWDER.—In the powder-magazines the barrels are generally placed on the sides, three tiers high, or four tiers, if necessary. Small skids should be placed on the floor and between the several tiers of barrels, in order to steady them, and chocks should be placed at intervals on the skids to prevent the rolling of the barrels. The powder should be separated according to its kind, the place and date of fabrication and the proof-range. Fixed ammunition, especially for cannon, should not be put in the same magazine with powder in barrels, if it can be avoided. In a room 13 or 14 feet wide, the barrels may be arranged in a double row in the center, two alleys 2½ feet wide, and two single rows 6 to 12 inches from the walls; in this way the marks of each barrel may be seen and any barrel can be easily reached. In a room 12 feet wide, an equal number of barrels may be placed in two double rows, with a central alley of 3 feet, and two side alleys, next the walls, of about 10 inches each. There should be an unencumbered space of 6 or 8 feet at the door or doors of the magazine.

Should it be necessary to pile the barrels more than four tiers high, the upper tiers should be supported by a frame resting on the floor; or the barrels may be placed on their heads, with boards between the tiers. Besides being recorded in the magazine book, each parcel of powder should be inscribed on a ticket attached to the pile, showing the entries and the issues.

For the preservation of the powder, and of the floors and lining of the magazine, it is of the greatest importance to preserve unobstructed the circulation of air under the flooring as well as above. The magazine should be opened and aired in clear, dry weather, *when the temperature of the air outside is lower than that inside the magazine*. It should not be opened in damp weather if it can be avoided. The ventilators must be kept free; no shrubbery or trees should be allowed to grow so near as to protect the building from the sun. The magazine yard should be paved and well drained. The moisture of a magazine may be absorbed by chloride of lime suspended in an open box under the arch, and renewed from time to time; quicklime is dangerous, and should not be used. The sentinel or guard at a magazine, when it is open, should have no fire-arms, and every one who enters the magazine should take off his shoes, or put socks over them; no sword or cane, or anything which might occasion sparks, should be carried in. The windows should have inside shutters of copper wire-cloth. Fire should never be kindled near the magazine for the repair of the roof or lightning rods. Barrels of powder should not be rolled for transportation; they should be carried in hand-barrows, or slings made of rope or leather. In moving powder in the magazine, a cloth or carpet should be spread; all instruments used there should be of wood or copper, and the barrels should never be repaired in the magazine. When it is necessary to roll the powder for its better preservation and to prevent its caking, this should be done, with a small quantity at a time, on boards in the magazine yard.

In the spring an inspection of the barrels should be made, and the hoops swept with a brush wherever they can be got at, to remove the insects which deposit their eggs at this season. In wagons, barrels of powder must be packed in straw, secured in such a manner as not to rub against each other, and the load covered with thick canvas. In transportation by railroad, each barrel should be carefully boxed and packed, so as to avoid all friction. The barrels should have a thick paulin under them. The cars should have springs similar to those of passenger cars. When powder has been damaged by being stored in damp places, it loses its strength, and requires to be worked over. If the quantity of moisture absorbed does not exceed 7 per cent., it is sufficient to dry it to restore it to service. This is done by exposing it to the sun, or in a drying room. When powder has absorbed more than 7 per cent., of water it is sent to the powder-mills to be worked over, or sold as condemned powder. When it has been damaged by salt water, or become mixed with foreign matters which cannot be separated by sifting, the saltpeter is dissolved out from the other materials and collected by evaporation.

Proportions of ingredients.

	Saltpeter.	Charcoal.	Sulphur.
By the atomic theory	74.64	11.51	11.85
In the United States:			
For the military service (the latter proportion is generally used)	76.	14.	10.
	75.	15.	10.
For sporting	78.	12.	10.
	77.	13.	10.
In England same as United States:			
For the military service	75.	15.	10.
For sporting	78.	14.	8.
	75.	17.	8.
In France (Wetteren powder has given best results; many experiments have been made with varying proportions):			
For the military service	73.775	14.205	12.020
For sporting	78.	12.	10.
For blasting	62.	18.	20.
In Prussia, same as England and United States:			
For the military service	75.	15.	10.
In Spain:			
For the military service	76.5	12.7	10.8
In Austria:			
For the military service	74.	16.	10.

See *Gunpowder* and *Powder Depots.*

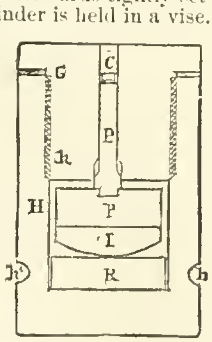
PRESIDENT.—The President of the United States is Commander-in-Chief of the army, navy, and militia called into service. His functions as such are assigned by Congress, but embrace of course whatever authority may be assigned to any Military Commander, on the principle that the authority of the greater includes that of the less. For the command, government, and regulation of the army, however, Congress has created a military hierarchy or range of subordination in the army with rights and duties regulated by Congress, and the Commander-in-Chief cannot make use of any other agents in exercising his command; and all orders issued by him must be according to the rules and articles made by Congress for the government of the army. In his capacity of Chief Magistrate of the Union, Congress has also invested the President with many administrative functions relating to military affairs; and for the performance of the latter duties the Secretary of the Department of War has been made his Minister, upon matters connected with *matériel*, accounts, returns, the support of troops, and the raising of troops.

PRESIDENT OF COURT.—The President of a Court-Martial is the senior member. He preserves order in Court; administers the oath taken by the Judge-Advocate, and the proceedings of the Court are authenticated by his signature and that of the Judge-Advocate. See *Courts-Martial.*

PRESIDIO.—A place of strong defense; a garrison guard-house.

PRESS CAKE.—Gunpowder after it has been subjected to hydraulic pressure. The different natures of powder used in the service receive a pressure of so many tons on the square foot, with reference to the density required. Pebble powder receives a pressure which gives it a density in excess of the usual powders. The amount of pressure varies with the season of the year, less pressure being required in summer than in winter. See *Gunpowder.*

PRESSURE-GAUGE.—An apparatus invented by General Rodman for measuring the pressure exerted by the gases of exploded powder. The drawing shows the construction of the instrument. It consists of the *housing*, H, closed by the *plug*, h; of the *piston*, P, with its *head*, p, to which is attached the *indenting-tool*, I; and the *recorder*, R, of copper. The *gas-check*, C, a thin copper cup, and the *gasket*, G, a copper ring, exclude the gas from the cavity of the housing. When the gauge is placed in the cartridge-bag, it is securely tied to it at the groove. h′ h′. In using this instrument, all its parts, except the exterior of the outer cylinder, are carefully cleaned before each fire, and the threads of the screw-plug and the indenting-piston carefully oiled; the copper specimen is then placed in the bottom of the cylinder, the indenting-piston inserted into the screw-plug, and with the outer cylinder horizontal the plug is screwed home, being afterwards tightly set in with a wrench while the cylinder is held in a vise. The cylinder is



then carefully set down upon its closed end, and the indenting-piston gently pushed down till the point of the indenting tool rests upon the copper specimen; a small gas check is then inserted, mouth outward, till it rests upon the end of the indenting-piston. It gives additional security against the passage of gas to place a small wad of cotton or tow over the gas-check, pressing it in firmly without driving, as a very light blow, several times repeated, might give a greater indentation than that due to the pressure to which it was to be subjected, and thus give erroneous results. The instrument is inserted into the gun with the screw-plug toward the muzzle, and is generally found in the bore of the gun after its discharge, when the screw-plug is withdrawn and the specimen removed, having an indentation in its surface, due to the pressure that has been exerted upon the outer end of the indenting-piston. The indications of pressure are found to be, generally, something less, for equal charges, by this instrument than by the external housing; this may be, and probably is, due to the retardation of the rate of inflammation of the charge by the presence of the instrument, and to the heat absorbed by it. Another reason for this is probably owing to the fact that in the external gauge the gas has a considerable space to travel through between the powder-chamber and the indicating parts, so that before reaching the piston the gases have attained a high *vis-viva*, especially with quick-burning powders. For these reasons this instrument should be as small as may be compatible with its practical use. See *Crusher-gauge, External Pressure-gauge,* and *Internal Pressure-gauge.*

PRESSURE-SCREW.—A screw variously applied in ordnance constructions to exert pressure and hold parts in proper positions. An example of the importance of the *pressure-screw* may be seen in the Breithaupt fuse, when gauging the fuse for firing.

PRESUMPTION.—An inference drawn by the law in certain circumstances or conditions of facts, and is used generally as a mere starting point in an argument or litigation. Presumptions are often divided into *presumptio juris* and *presumptio juris et de jure.* The former serves as a mere starting-point, and may be rebutted by proof to the contrary. Thus, a person who has possession of goods, is presumed to be the owner till the contrary is proved. A man is presumed to be innocent until the contrary is proved. A *presumptio juris et de jure* is said to be a presumption which cannot be rebutted; but there are few instances of this. Presumptions abound in all departments of the law, and are adopted from the necessity of coming to some conclusion or other in most cases where the evidence is general or inconclusive.

PRETENSE.—In Heraldry, an *Escutcheon of Pretense* or Escutcheon Surtout, is a small shield placed in the center of the field of another shield. The husband of an heiress may bear the arms of his wife in an Escutcheon of Pretense; instead of impaling them. Feudal arms are also sometimes placed on an Escutcheon of Pretense, particularly in the insignia of Elective Sovereigns, who have been in use of bearing their own proper arms in surtout over those of the dominions to which they are entitled. The Crown of Charlemagne is placed in surtout in the Arms of Hanover; and from 1801 to the accession of Queen Victoria, the Hanoverian insignia occupied an Escutcheon of Pretense in the center of the Royal Arms of the United Kingdom.

PRETOR.—Among the ancient Romans, the title given to the Consuls as leaders of the armies of the State; but it was specially employed to designate a Magistrate whose powers were scarcely inferior to those of a Consul. The Pretorship, in this specific sense of the term, was first instituted in 366 B. C., as a compensation to the Patricians for being obliged to share with the Plebeians the honors of Consulship. It was virtually a third Consulship; the Pretor was entitled *Collega Consulibus;* he was elected by the same auspices and at the same Comitia. For nearly 30 years, Patricians alone were eligible for the office; but, in 337 B.C., the Plebeians made good their right to it also. The Pretor's functions were chiefly judicial. Though he sometimes commanded armies, and, in the absence of the Consuls, exercised considerable authority within the city, yet his principal business was the administration of justice both in matters civil and criminal; and "to the edicts of successive Pretors," says Mr. G. Long, "the Roman law owes, in a great degree, its development and improvement."

Originally, there was only one Pretor; but, as the City and State increased, and their relations with other nations became more complicated, others where added. In 246 B. C. a second Pretor was appointed, to settle disputes that might arise between Romans and Foreigners temporarily resident at Rome, for trading or other purposes, hence called *Prætor Peregrinus* (Foreign Pretor), to distinguish him from the original *Prætor Urbanus* (City Pretor). In 227 B. C., two new Pretors were appointed, to administrate affairs in Sicily and Sardinia; and in 197 B. C., two more for the Spanish Provinces, or 6 in all. Sulla increased the number to 8, and Julius Cæsar to 16. Augustus reduced the number to 12; but at a later period we read of 18, if not more. The city Pretor-ships were reckoned the highest; and after a person had filled these offices, he sometimes received the administration of a province with the title of *Propritor* or *Proconsul*.

PRETORIAN BANDS.— The name given more particularly during the period of the Roman Empire, to a body of soldiers, organized for the purpose of protecting the person and maintaining the power of the Emperors. We indeed read of a *Prætoria Cohors*, or select guard of the most valiant soldiers attached to the person of Scipio Africanus, who, according to Festus, received six-fold pay, and the exigencies of the civil wars naturally increased their number; but it was to Augustus that the institution of them as a separate force is owing. He formed 9 or 10 cohorts, each consisting of 1,000 men (horse and foot); but kept only three of them in Rome, the rest being dispersed in cities not far off. Tiberius, however, assembled the 9 cohorts at the capital in a permanent camp, and Vitellius increased their number to 16. The Pretorians served at first for 12, and afterward for 16 years; they received double pay; the privates were held in equal rank to the Centurions in the regular army, and on their retirement each received 20,000 sesterces. They soon acquired a dangerous power, which they exercised in a most unscrupulous manner, deposing and elevating Emperors at their pleasure. Aspirants for the Imperial Dignity found it advisable, and even necessary, to bribe them largely; while those who acquired that dignity without their assistance were accustomed on their accession to purchase their favor by liberal donations. The Pretorians, however, had no political or ambitious views; they were simply an insolent and rapacious soldiery, fond of substantial gratifications, and careless how they got them. After the death of Pertinax (193 A. D.), they actually sold "the purple" for a sum of money to Didius Julianus; but in the same year their peculiar organization was entirely broken up by Severus, who formed new cohorts altogether out of the best legions serving on the frontiers, which he increased to four times the number of the old. After several other changes, they were entirely abolished by Constantine (312 A. D.), who dispersed them among his regular legions.

PRETORIUM.—The Hall or Court where the Pretor lived and administered justice. It also denoted the tent of the Roman General, in which councils of war were held. The place where the Pretorian Guards were quartered or lodged was likewise called pretorium.

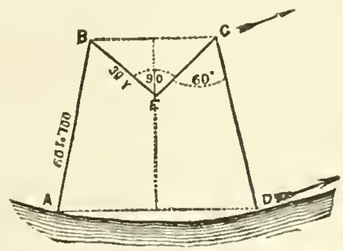
PREVENTOR ROPE.—A contrivance for checking the forward motion of a carriage. It is attached to the rear block of the carriage, and being twisted round the *bollard* of the platform, is held by one of the cannoneers.

PRICE RETORT FURNACE.—The Price furnace is in part a gas furnace, and it embraces some of the features of the regenerative system, as the temperature of the air, as well as that of the gaseous and fixed constituents of coal, is raised by the waste heat before it enters the chimney. It consists of a combustion chamber or fire-box, furnished with grate-bars in the ordinary way; a heating chamber or hearth, separated from the combustion chamber by the usual bridge; and a neck leading into a flue, which opens to the retort chamber. In the center of the retort chamber is a circular firebrick pillar, on which is placed a cast-iron cylindrical air-vessel protected all round by firebrick. On this air-vessel is built the retort, the lower part of which is made of brick while the upper part is cast-iron. At the top of the retort and above the closed end of the chamber is placed a hopper, in the throat of which are fitted two doors worked by a lever from the ground. This feeding apparatus may be of any other suitable construction. In the firebrick portion of the retort are two passages, the one leading to the combustion chamber, and the other to the outside of the furnace for the insertion of stoking tools to force the fuel forward into the combustion chamber. The entrance to the outer passage is closed by a tight door. Near the bottom of the retort chamber, and in a line with the center of the air-vessel, are pipes inserted in the walls of the chamber and passing all around it. On the inner side of these pipes and opening into the retort chamber are a number of holes leading into the space around the pipes. This space affords room for expansion and for a free circulation of heat. The pipes are connected with the blast from a fan or from any suitable blower. The air passes into the air-vessel and is delivered through an outlet in the ash-pit, directly under the grate. It will be seen from this description that the retort furnace embraces some of the best features of the regenerative system, while it entirely dispenses with its complications of producers, regenerators, and reversing valves. See *Furnace*.

PRICKER.—1. An early name for a light horseman. 2. A priming-wire.

PRIDE.—A term in Heraldry. A peacock, or other bird, when the tail is spread out in a circular form, and the wings dropped, is said to be "in his pride."

PRIEST-CAP—When the faces of a redan cannot be so placed as to sweep well the flank approaches without making the salient angle too acute; or when

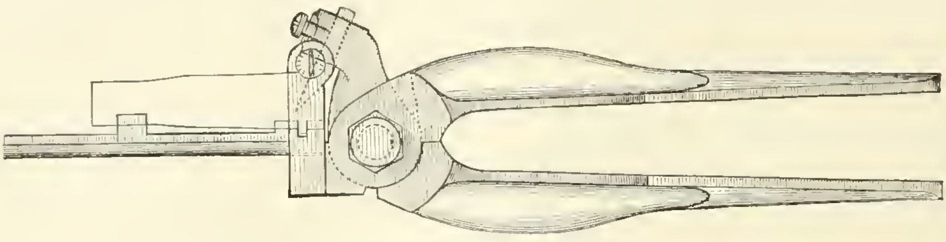


the flank approaches extend towards the rear; then the plan may, in the first case, be what is termed a *priest-cap*, or *swallow-tail*, in which the two main faces sweep the flank approaches, and, instead of a *pan-coupé*, a broken line forming a reentering angle, placed in the salient, affords a cross-fire on the ground in front. In the second case a flank is added to each face of the redan, and receives such a direction as to sweep that portion of the flank approach which cannot be reached from the faces except by a very oblique fire. The priest-cap is so named from its shape. See *Field Works* and *Swallow-tail*.

PRIME.—1. In fencing, one of the chief guards. 2. To charge with the powder, percussion-cap, or other device for communicating fire to the charge, as a fire-arm.

PRIMER.—A wafer, cap, tube, or other device for communicating fire to the charge of powder in a cannon. The cap or tube usually contains a friction or percussion-powder. The *friction-primer* is generally used in the land service. For service on ship-board, a quill filled with rifle-powder, having on the top a capsule of fulminate of mercury, is generally employed. The capsule is exploded by a blow from the lock-hammer. The *tape-primer*, used sometimes in blasting, is formed of long, flexible strips of paper or fabric containing fulminate or other quick-burning substance. The *electric primer* is used to fire simultaneous discharges, both in ordnance and blasting. In firing wet gun-cotton, the small charge of dry gun-cotton used in conjunction with the *detonating exploder* is called a primer. In small-arms, the term is specially applied, at the present time, to the percussion-caps used in reloading metallic cartridge-cases. See *Cannon-primers*.

PRIMER EXTRACTOR.—A reloading tool, whose function is to extract the *primer* from the cartridge-shell, when it is required to reload the shell. It is variously designed. The drawing shows a very handy and efficient form of extractor, suitable for reloading central fire cartridge-shells of any caliber. To operate it, it is only necessary to insert the shell, close the handles just enough to cause the chisel to penetrate the primer, and elevate the tongue sufficiently to throw it out.



PRIMIGENIA.—A kind of *pike* very much resembling the pilum.

PRIMING-TUBE.—A tube to contain an inflammable composition, which occupies the vent of a gun whose charge is fired when the composition is ignited. There are several kinds of priming-tubes, fired by *port-fire*, *lock*, or *friction*. The tube is made of *quill*, *paper*, or *metal*, and is charged with mealed powder damped with methylated spirit, or by a detonating composition, such as chlorate of potash and antimony. The tube is slightly smaller than the gun vent, in the relative proportions of $\frac{2}{10}$ and $\frac{2}{9}$ of an inch, and a hollow is made down the middle of the composition, so that the fire may involve the whole length instantaneously. The simplest form is that in which the tube is merely a holder for the priming, which is touched off by a port-fire. This is the *quill*, Dutch, or *common metal tube*. Another variety has a cross-head or snipe to contain a detonating composition which is exploded by a hammer. This is the *cross-head*, or *detonating tube*. A third variety is operated by friction, a roughened bar occupying the hollow in the composition, and exploding by friction the detonating composition in the head of the tube. The rough bar is jerked out by a lanyard. See *Friction-primer*.

PRIMING-WIRE.—An implement used to prick the cartridge before priming when the quill or metal tubes are used. It is made of wire a little less in diameter than the vent, sloping to a point at one end, and at the other vent into a circle, which serves to hold it by, as well as prevent it from slipping through the loop on the primer pouch, where it is carried when not in use.

PRIMIPILUS.—The Centurion belonging to the first cohort of a legion. Among the Romans, the *Primipilarii* were such as had formerly borne the office of Primipilus. Among other privileges which they enjoyed, they became heirs to what little property was left by the soldiers who died in the campaign.

PRINCE.—An epithet which was originally applied to the *Princeps Senatus* of the Roman State and afterward became a title of dignity. It was adopted by Augustus and his successors; hence the word was afterward applied to persons enjoying kingly power, more especially the Rulers of small States, either Sovereign, as in the case of the ancient Princes of Wales, or Dependent, like the Rulers of certain States in Germany. The title is now very generally applied to the sons of Kings and Emperors, and persons of the Blood-Royal. In various parts of Continental Europe, the title Prince is borne by families of eminent rank, but not possessed of sovereignty; and in England a Duke is, in strict heraldic language, entitled to be styled "High Puissant and Most Noble Prince," and a Marquis or Earl as "Most Noble and Puissant Prince." Practically, however, in Britain, the term Prince is restricted to members of the Royal Family. The eldest son of the reigning Sovereign is by a special patent created Prince of Wales, and this is the only case in which the title Prince is connected with a territorial distinction. In Germany, the ambiguity of applying the same title to the members of Royal Houses and Princely Families, not Sovereign, is avoided, the former being styled "Prinz," the latter "Fürst." The German Fürst takes rank below the Duke (Herzog). Most of the Counts who had a seat in the old German Diet were elevated to the dignity of Prince on the acquiescence in the dismemberment of the German Empire. In a more general acceptation, the term Prince is often used for a Sovereign or Ruler of a State.

PRINCE ALFRED GUN.—This gun was forged hollow, on a plan intended principally to overcome the defect of unequal shrinkage and initial strain and rupture. Broad plates, bent to the proper curve, were laid and welded upon a barrel made of rolled staves. Its dimensions are: length (without cascabel), 1,151 inches; length of bore, 137 inches; diameter over the chamber, $31\frac{3}{4}$ inches; diameter at muzzle, $14\frac{1}{2}$ inches; diameter of bore, 10 inches; weight, 24,094 pounds. The gun is rifled with three grooves $\frac{1}{4}$ inch deep, but cut the wrong way, so that the projectile would be rotated by the inclined instead of the radial surface of the grooves. It will therefore have to be bored out to $10\frac{1}{2}$ inches, and will then carry a 156 pound spherical shot. The test proposed by the makers is one round with one shot and 100 pounds of powder.

PRINCEPS SENATUS.—An officer of the Roman Senate, who, under the Monarchy, was a royal appointee for life, *Custos Urbis*, and had precedence among the *Decemviri*. Under the Republic, he was the appointee of the Curies, B. C. 487, the *Paties Minorum Gentium*, previously ineligible, were made eligible, and afterward the senior Ex-Censor held the office *Ex-Officio*. Later, any Senator was eligible, but the office was simply honorary, and did not carry with it the Presidency of the Senate. Finally the title belonged to the Emperor.

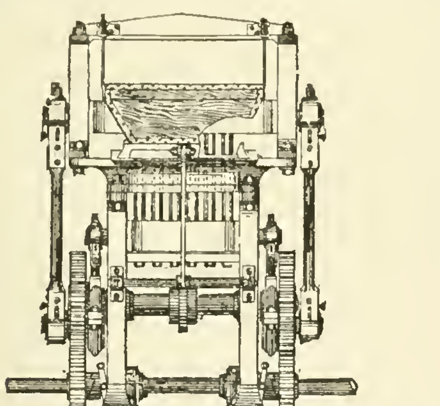
PRINCIPES.—In the Roman armies, Principes were the infantry, who formed the second line in the order of battle. They were armed like the *hastati*, with this difference, that the former had half-pikes instead of whole ones. See *Hastati*.

PRISE-BOLTS.—The projecting bolts at the rear of a mortar-bed or garrison gun-carriage, under which the handspikes are inserted for training and maneuvering the piece. They are formed by the prolongation of the assembling bolts. Also written *Prize-bolts*.

PRISMATIC POWDER.—The adoption of this form of powder by some nations, and production of machinery for its manufacture, necessitated the use of presses of peculiar construction to insure sufficient and uniform density; the press to be so devised as to produce uniform size and shape of grains, and allow their ready withdrawal from the molds; the surfaces such as to allow close packing in a given space. These considerations led to the adoption of a regular geometrical figure: the hexagon offers good shape for piling, the angles being all sufficiently obtuse to prevent breaking or spawling at the edges. Each layer and the whole cartridge is easily made up. Perforations were found necessary to insure better and more uniform control of combustion in the grain. The number of perforations first adopted were seven—one central, the other six at equal distances from the central one although one perforation in the center has been found sufficient.

The ingredients for the manufacture of the powder base are the same as used in the manufacture of ordinary powder. The pulverized materials for 220 pounds are placed in wooden drum lined with sole-leather, with 330 pounds of bronze balls, and subjected to 1,440 revolutions at the rate of 8 or 10 per minute. The powder is then brought to the moistning table of wood surrounded by an upright edge, over which is suspended a graduated glass measure having a pipe of copper and rose at the bottom. On the table a charge of 55 pounds of powder is spread and moistened with $2\frac{3}{4}$ quarts of distilled water. It is then passed from a hopper to an endless canvas belt 20 inches wide, between a lower paper and upper bronze roller, weighing 2,425 pounds, making a revolution in twelve minutes. The bronze roller can be weighed to exert a pressure of 60,000 pounds. The powder is then broken into coarse lumps by wooden mallets, and granulated to two sizes of grains; the first, cannon powder—used for manufacture of the prisms— is passed through a sieve of 0.26 inch diameter of holes.

Ordinary grain powder, made as above, is of a specific gravity of 1.5, and too elastic for the use in the press. By reworking it loses a part of its elasticity, and is then fit for formation of the prisms by the following process: The powder-base, as above, is moistened with 10 per cent. of water, passed through the



spindle press with the prescribed pressure and granulated grain and dust being collected in a receptacle. This mixture of grain and dust is dried in the air or by artificial heat till $1\frac{1}{2}$ per cent. of the moisture remains. It is placed in a mixing-drum—220 pounds of powder and 330 pounds of bronze balls—and subjected to 1,440 revolutions, moistened and pressed as before, giving it a specific gravity of 1.675 to 1.75. It is granulated and separated, the cannon size again dried by air till 6 per cent. in dry weather of moisture remains, and placed in barrels covered with damp cloths for use.

The press for this purpose is constructed to give a pressure of 65,000 pounds per square inch. It consists of a heavy casting on a stone foundation; a main and secondary shaft, one fixed and two movable cross-heads. The main shaft carries a heavy wheel at each end, over which belts conduct the power from the center shafting to the press. It has a clutch operated by a lever for starting and stopping the machine; two pinions on the main operate geared wheels on the secondary shaft, on which two eccentrics and cranks operate respectively, by connecting rods, the lower and upper movable cross-heads. These have each six hexagonal stamps perforated with seven holes which enter corresponding hexagonal molds on the lower cross-head. Six groups of seven needles are fixed in such position that they extend up through the perforations of the lower stamps throughout into the molds and enter the perforations of the upper stamps as the latter descend to press the powder in the molds; these form the perforations in the prisms. The eccentrics and cranks operating the cross-heads are timed so that when the upper stamps have reached their lowest point of descent, the lower ones are moving upward giving the extreme pressure, after which the upper stamps ascend and the lower ones simultaneously push the perforated prisms up from the molds. The lower stamps constitute the bottom of the molds. The molds are filled from a hopper having a table with forward-and-back motion, containing six suitable measures which receive the powder from the hopper; the charging table moves forward and drops the charge in the molds; its edge carries the prisms brought up from the mold to an inclined shelf, whence they are removed. The capacity of the powder measures can be regulated as desired. Two rooms are required for each press; one for the press, the other for the prisms.

Before starting the press, the mold-needles and stamps, and all rubbing surfaces ought to be oiled with a light, pure oil or graphite. All surplus lubricant must be wiped off. The powder to be pressed ought to have at least $5\frac{3}{4}$ per cent. of moisture. The moist prisms weigh about 620 grains each, and must not vary more than 5 grains. The first two sets of prisms should be rejected because of excess of oil. The weight of prisms must be verified. Three men can work a press; a carrier for every press is also required. The height and weight of the prisms must be verified from time to time, and the powder in the hopper stirred from time to time. Loose powder must be brushed away from the stamps and top of the molds; lubricate as often as once an hour. If a needle breaks, stop the press and replace it at once. On dry days, the powder loses moisture: this will be indicated by increased height of prisms or vibrations of the press, in which case moisten with $\frac{1}{4}$ per cent. of moisture, which is done in a drum by a fine rose sprinkler. The prisms pressed by the press contain about 5 per cent. of moisture, and must be dried to about $\frac{3}{4}$ per cent. by exposure to air or on shelves in a suitably arranged drying-room; they are then exposed to a temperature of 120° Fahr. for 48 hours, and are ready for packing.

The prisms are packed in wooden boxes in layers (12 rows of 11, and 11 rows of 9, 6 deep) weighing about 110 pounds to the box. The prisms are regular hexagons 0".992 high and 1".6 width across the angles. The packing-boxes are of inch stuff, and may be tin-lined. Two sheets of felt—the smaller at one end, the other on top—keep the prisms from rubbing against each other in transportation. The boxes have rope handles, and are marked with the weight, kind, place, and date of fabrication of the powder. See *Gunpowder*.

PRISMATIC TRANSIT.—This form of transit, suggested by Steinheil, and designed by Mr. G. N. Saegmuller, was manufactured for the United States Coast Survey. It is intended to be set up in the prime vertical, the telescope pointing east and west. By the use of a prismatic objective, any star passing the meridian will be reflected and seen in the field when the instrument is set up correctly; by turning it in its bearings it will sweep the meridian. The pivot-rings are of phosphor-bronze, and, to avoid flexure as much as possible, these rings are again connected by a tube, so that the telescope body is really double. By one of the three setting-screws the instrument is moved in azimuth. It is provided with a reversing apparatus, which also carries the illuminating lamp. The fine level over the telescope is held by a projection from the reversing apparatus, which secures the great advantage that the level need not be taken off on reversing the instrument; it remains on whether observing in the zenith or horizon. The setting-circle is attached behind the micrometric eye-piece with level alidade, divided on silver, and reading to minutes. It also carries the latitude level, which is chambered and reads to single seconds. This instrument, being very simple and portable, is especially adapted for work in a rough or mountainous country. See *Engineer's Transit*.

PRISON.—In a military sense, a building constructed for the retention of prisoners of war, or for the safe-keeping and punishment of offenders against military law. Sometimes during war, forts and other strong structures are utilized for these purposes. A permanent military prison was established at Fort Leavenworth, Kansas, in 1873. The Department Commander stationed at Fort Leavenworth, is *ex-officio* Commandant of this prison. The other officers of the prison, detailed by the Secretary of War, from the officers of the Army, are a Governor, an Adjutant, a Disbursing officer, Commissary, Surgeon, and Chaplain. Division and Department Commanders may designate this prison as the place of confinement for all prisoners sentenced to be confined for one year or upwards, except such as are convicted of offenses which lawfully subject them to punishment in a State penitentiary. Discharge papers, descriptive lists, orders promulgating or modifying sentences, and statements of conduct since under sentence, are forwarded to the Commandant of the prison with each prisoner sent there for confinement. Before sending convicts to the military prison, a careful medical examination is made of those whose physical or mental condition appears to be such as might be seriously affected by the confinement, or be in danger of ending in permanent disability which might cause them to be discharged before the expiration of their sentence. Special report is made of cases found to be of this description, with a view to avoid unnecessary expense of transportation.

The following were noted prisons during the Civil War, 1861–65, for the retention of Federal prisoners of war. Andersonville, Belle Isle, Castle Thunder, Libby and Salisbury. The prison at Andersonville, was notorious for unhealthfulness and its discipline for barbarity; and in 1865, after the close of the war, Henry Wirz, a Swiss, the chief instrument of ill-treatment, was indicted for "injuring the health and destroying the lives of prisoners by subjecting them to torture and great suffering, by confinement in unhealthy and unwholesome quarters, by exposing them to the inclemency of the winter and the dews and burning sun of the summer, by compelling the use of impure water, and by furnishing insufficient and unwholesome food; for establishing the dead line and ordering the guards to shoot down any prisoner attempting to cross it; for keeping and using bloodhounds to hunt down prisoners attempting to escape; and for torturing prisoners and confining them in stocks." He was found guilty and hanged. Under orders of the Government, the place where the bodies had been rudely buried in long trenches was arranged as a cemetery, and adorned with gravel walks and trees; 12,461 dead soldiers of the Union Army were identified, and their places of burial marked with tablets; 451 were "unknown." Prisons were also established for the retention of Confederate prisoners at Camp Douglas, Utah; Chicago, Illinois; Camp Chase, Ohio; Elmira, New York; Point Lookout, Maryland; and Rock Island, Illinois.

PRISONERS OF WAR.—A prisoner of war is a public enemy armed or attached to the hostile army for active aid, who has fallen into the hands of the captor, either fighting or wounded, on the field or in the hospital, by individual surrender or by capitulation. All soldiers, of whatever species of arms; all men who belong to the rising *en masse* of the hostile country; all those who are attached to the army for its efficiency and promote directly the object of the war; all disabled men or officers on the field or elsewhere, if captured; all enemies who have thrown away their arms and ask for quarter, are prisoners of war, and as such exposed to the inconveniences as well as entitled to the privileges of a prisoner of war. Moreover, citizens who accompany an army, for whatever purpose, such as sutlers, editors, or reporters of journals, or contractors, if captured, may be made prisoners of war, and be detained as such. The monarch and members of the hostile reigning family, male or female, the chief, and chief officers of the hostile government, its diplomatic agents, and all persons who are of particular and singular use and benefit to the hostile army or its government, are, if captured on belligerent ground, and if unprovided with a safe-conduct granted by the captor's government, prisoners of war. If the people of that portion of an invaded country which is not yet occupied by the enemy, or of the whole country, at the approach of a hostile army, rise, under a duly authorized levy, *en masse* to resist the invader, they are now treated as public enemies, and if captured, are prisoners of war. No belligerent has the right to declare that he will treat every captured man in arms of a levy *en masse* as a brigand or bandit. If, however, the people of a country, or any portion of the same, already occupied by an army, rise against it, they are violators of the laws of war, and are not entitled to their protection. The enemy's chaplains, officers of the medical staff, apothecaries, hospital nurses and servants, if they fall into the hands of the American Army, are not prisoners of war, unless the commander has reasons to retain them. In this latter case, or if at their own desire, they are allowed to remain with their captured companions, they are treated as prisoners of war, and may be exchanged if the commander sees fit.

By the laws or recognized principles of war, the entire people of a vanquished town, state, or nation become the absolute property of the victors; but civilization has greatly modified this stern rule, and except when a country is devastated for military reasons, it is rare for non-combatant citizens to be subjected to penalties of conquest, beyond the levying of contributions in money or provisions. The combatants who have laid down their arms become prisoners of war. Their lives and liberty are at the disposal of their conquerors, and even in modern times, their lives are sometimes taken, as, for instance, when Napoleon put the Turkish prisoners to death at Jaffa in 1799; otherwise, prisoners of war are kept in confinement until peace ensues, or they are exchanged for prisoners of their conqueror's nation, held in captivity by their own countrymen. It is unusual to subject prisoners of war to penal discipline; but the loss of liberty and hard fare (for, of course, they are allowed no more than a bare subsistence) render a captivity sufficiently irksome. In ancient times, the treatment of prisoners of war was far more severe. In the Greek wars, it was no uncommon thing to put the whole adult male population of a conquered state to the sword, while the women and children were enslaved. Although the putting to death of prisoners became less frequent, they and their families were commonly reduced to slavery to as recent a period as the 13th century. About that time the more humane custom of exchanging prisoners came into practice. Notwithstanding frequent exchanges, large numbers of prisoners accumulate during war. In 1811 about 47,600 French were prisoners in England.

Money and other valuables on the person of a prisoner, such as watches or jewelry, as well as extra clothing, are regarded by the American Army as the private property of the prisoner, and the appropriation of such valuables or money is considered dishonorable and is prohibited. Nevertheless, if *large* sums are found upon the persons of prisoners, or in their possession, they shall be taken from them, and the surplus, after providing for their own support, appropriated for the use of the army, under the direction of the commander, unless otherwise ordered by the government. Nor can prisoners claim, as private property, large sums found and captured in their train, although they had been placed in the private luggage of the prisoners. All officers, when captured, surrender their side-arms to the captor. They may be restored to the prisoner in marked cases, by the Commander, to signalize admiration of his distinguished bravery, or approbation of his humane treatment of prisoners before his capture. The captured officer to whom they may be restored cannot wear them during captivity. A prisoner of war, being a public enemy, is the prisoner of the government, and not of the captor. No ransom can be paid by a prisoner of war to his individual captor, or to any officer in command. The government alone releases captives according to rules prescribed by itself. Prisoners of war are subject to confinement or imprisonment such as may be deemed necessary on account of safety, but they are to be subjected to no other intentional suffering or indignity. The confinement and mode of treating a prisoner may be varied during his captivity according to the demands of safety. Prisoners of war shall be fed upon plain and wholesome food, whenever practicable, and treated with humanity. They may be required to work for the benefit of the captor's government, according to their rank and condition.

A prisoner of war who escapes may be shot, or otherwise killed in his flight; but neither death nor any other punishment shall be inflicted upon him simply for his attempt to escape, which the law of war does not consider a crime. Stricter means of security shall be used after an unsuccessful attempt at escape. If, however, a conspiracy is discovered, the purpose of which is a united or general escape, the conspirators may be rigorously punished, even with death; and capital punishment may also be inflicted upon prisoners of war discovered to have plotted rebelion against the authorities of the captors, whether in union with fellow-prisoners or other persons. If prisoners of war, having given no pledge nor made any promise on their honor, forcibly or otherwise escape, and are captured again in battle, after having rejoined their own army, they shall not be punished for their escape, but shall be treated as simple prisoners of war, although they will be subjected to stricter confinement. See *Cartel*, and *Parole*.

PRITCHET BULLET. — The English retained a wedge made of wood, which was placed in the base of the Pritchet bullet used with the Enfield rifle, and which prevented the gas from penetrating any fissures that might exist, while at the same time it was driven before the gas into the cavity, expanding the ball.

PRIVATE.—The title applied in the British Army to a common soldier of the Cavalry and Infantry, the corresponding rank in the Artillery being gunner or driver, and in the Engineers the sapper. The pay of a private is one shilling a day in the infantry, and 1s. 2d in the cavalry—exclusive of a free ration or corresponding allowance. A private in the cavalry is sometimes called a trooper. In the United States Army all soldiers below the grade of non-commissioned officers are called privates.

PRIVATEER.—A ship owned by a private individual, which, under government permission, expressed by letter of marque, makes war upon the shipping of a hostile power. To make war upon an enemy without this commission, or upon the shipping of a nation not specified in it, is piracy. Privateering was abolished by mutual agreement among European Nations by the Treaty of Paris in 1856. It is doubtful, however, how far that abolition would stand in a general war, for privateering is the natural resource of a nation whose regular navy is too weak to make head against the maritime power of the enemy, especially when the latter offers the temptation of a wealthy commerce. An effort was made at an early period by the government of the United States to have provisions in treaties with foreign countries which would abolish privateering in case of war; and the laws of the United States are more prohibiting in this respect than those of most other nations. At the time of the mutual agreement among European nations to abolish the custom mentioned above, the government declared its willingness to unite with them, provided a certain clause of the treaty was amended so that the private property of the subject or citizen of a belligerent on the high seas should be exempted from seizure by public armed vessels of the other belligerent, except it be contraband of war. But this was declined, and consequently no arrangement with the United States was included in the treaty.

PRIVY COAT.—A light coat or defense of mail, concealed under the ordinary dress.

PRIZE.—Property captured from an enemy, or an enemy's property captured from a neutral in time of war. Prize-money is distributed in the United States in accordance with the provisions of the Act of June 30, 1864. This statute directs that where the prize is equal or superior in force to the capturer the Captors shall have the whole; where it is inferior in force, the Captors shall have half, and the United States the other half. In the case of Letters of Marque and Privateers, the Captors shall have the whole, unless otherwise stipulated in the commissions issued to such vessels. Strictly speaking, *booty* is the military term, the word *prize* being more frequently used in the Navy. See *Blockade*, *Contraband of War*, *Neutrality*, and *Privateer*.

PRIZE AGENTS.—Officers belonging to an army in the field, who are chosen after a campaign to collect all property belonging to the enemy which has fallen into the hands of the victors. In England all military booty is apportioned as the Sovereign from time to time may direct. Deserters, and those who do not claim their share within six years, receive none. The officers appoint two Prize Agents, by letters of attorney: the Field Officers naming one, and the Subordinate Officers another. The Officer commanding the successful expedition sends to the military authorities a list of the persons entitled to booty. The Agents collect the property, convert it into money at the best advantage, and hand over the proceeds to the authorities, receiving a small percentage for their trouble. A scale of distribution is then made out, and the money is paid after a certain interval. When an army and a fleet join in a capture, the Admiralty calculates the army share, and sends the amount to the military authorities. Prize and booty originally belonged to the Sovereign, and are only distributed to the Captors as an act of grace; for, if the Sovereign pleases, the property can be given back again to the enemy.

PRIZE MONEY.—The value of the property captured from the enemy after its realization by sale. To carry out the rules having reference to prize property, Prize Agents are appointed, selected by the army, to collect all property which has been captured in each of the towns and fortresses through which the conquering army has passed. No oppression is permitted in the matter; all that is demanded is that what, by the rules of war, falls to the possession of the captors be given up. Such property is sold, and finally divided among the army.

PROBABILITY FACTORS.—A table of factors, which multiplied by the width of a zone containing 50 per cent. of the hits, will give the widths of zones containing any other percentage of hits. Thus, if the width of a 50 per cent. zone is 1.00, we would find from such a table that the widths of 20, 40, 60, 80, and 99 per cent. zones are .38, .78, 1.25, 1.90, and 3.82 respectively. From such a table, we would also see that a zone twice as wide as that of 50 per cent. will not contain all the hits, but only a little over 82 per cent.

PROBABLE RECTANGLE.—The relative accuracy of different guns at different ranges is estimated by the dimensions of a rectangle, called the *probable rectangle*. If we determine the lateral and longitudinal *probable zones*, and suppose them to be superposed, we shall have a rectangle which must contain 50 per cent, of 50 per cent, or 25 per cent of the total number of hits. Then by reference to a table of *probability factors*, we can find the proportionate widths of any other zones (containing a different percentage of hits) to one of 50 per cent. as unity. To illustrate take the following example:

Suppose a raft, 25 yards square, is fired at by the 40-pr. R. M. L. at an elevation of 5°, how many rounds may be expected to hit, when the range is accurately obtained? Here, the mean error in range is 17.9 yards and the mean lateral deviation is 9.02 yards. Consequently, the 50 per cent. longitudinal zone $=17.9\times1.69=30.25$ yards in width, and the 50 per cent. lateral zone $=9.02\times1.69=15.23$ yards in width. Hence, the zones are respectively $\frac{25}{30.25}=.83$, and $\frac{25}{15.23}=1.64$ of the width of the 50 per cent. zone. From a table of *probability factors*, we find, that a zone .83 the width of the 50 per cent. one would receive about 42.5 per cent., and one of 1.64 would have 73 per cent. of the total number of rounds fired. Consequently the rectangle formed by the intersection of the zones would receive 42.5 per cent. of 73 per cent., or 31 per cent. of the total fired.

PROBABLE ZONES.—It can be shown by the theory of probabilities, that if each of the three mean errors (range-vertical and lateral) is multiplied by the factor 1.69, we will have the breadth of three zones (of infinite length), each of which will contain 50 per cent. of the hits. If the mean errors in two directions are given, we can find two 50 per cent. zones, and hence a rectangle, in the plane of the zones, which must contain 50 per cent. of 50 per cent., or 25 per cent. of the total number of hits.

PROCEEDINGS.—The proceedings of Courts-Martial of the previous day are usually read over each day by the Judge Advocate. Much time is lost by adopting this measure, and there is no rule directing the Court to read them. All *orders* which have been issued, modifying the detail of a Court, after its original organization, should be included in the proceedings of every case. The *entire proceedings* of the Court in each case should be fully set forth. All orders, motions, or rulings of the Court itself—all motions, propositions, objections, arguments, statements, etc., of the Judge Advocate and the prisoner —the entire testimony of each witness, given in his own language—and, indeed, every feature of the proceedings material to a complete history of the case and to a correct understanding of every point of the same by the reviewing authority—should be recorded at length. The record of proceedings, and the final defense of the accused, should be written upon legal-cap paper of uniform size. The proceedings in each completed case should be immediately signed by the President and Judge Advocate. *Recommendations to Clemency* should not be placed in connection with the sentence, but should be appended to the record. The *original proceedings* of a Court are not the rough minutes kept by the Judge Advocate or Recorder; but those finally authenticated by the signatures of the President and Judge Advocate (or recorder). All documentary evidence submitted to the Court must be attached to the proceedings, lettered in the order of submission, as Exhibits "A," "B," etc.

PROCLAMATION.—A public notice given by the Sovereign to his subjects. The power of issuing proclamations is part of the prerogative of royalty as the fountain of justice. They sometimes consist of an authoritative announcement of some matter of state, or act of the executive government affecting the duties and obligations of subjects. The demise of the Crown, and accession of a new Sovereign, a declaration of war, and the issue of new coin, are all occasions on which a royal proclamation is issued. A proclamation may also be issued to declare the intention of the Crown to exercise some prerogative or enforce some law which has for a long time been dormant or suspended. In time of war, the Crown by a proclamation may lay an embargo on shipping, and order the ports to be shut. But the most usual class of proclamations are admonitory notices for the prevention of offenses, consisting of formal declarations of existing laws and penalties and of the intention to enforce them; such as the proclamation against vice and immorality, appointed to be read at the opening of all courts of quarter sessions in England. Proclamations are only binding when they do not contradict existing laws, or tend to establish new ones, but only enforce the execution of those which are already in being, in such manner as the Sovereign judges necessary.

PROCONSUL.—A Roman Magistrate not holding the Consulship, who was invested with powers nearly approaching those of a Consul, not however, extending over the city and its vicinity. The Proconsul was, at first, one who had held the office of Consul, whose *Imperium* was prolonged to enable him to bring an unfinished campaign to a close. The duration of the office was a year. During the latter period of the Republic, when the Consuls were expected to spend a year of their consulate at Rome, they were generally appointed at its close to undertake, as Proconsuls, either the conduct of a war in some Province, or its peaceful administration. Occasionally, the office of Proconsul, with the government of a Province, was conferred on a person who had never held the Consulship. Under Constantine, parts of certain Dioceses came to be governed by Proconsuls.

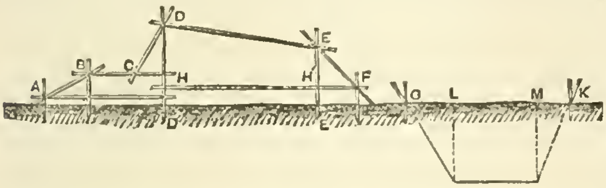
PRODD.—A light cross-bow, used chiefly in field sports, in the sixteenth century. It usually projected bullets.

PROFESSORS OF THE UNITED STATES MILITARY ACADEMY.—The Professors of the Academy, being Staff Officers of the Army, are assimilated in rank to the grades of which they are entitled by law to the pay and allowances. They are respected and obeyed according to their rank and office in the Academy. The uniform of Professors is that of officers of the General Staff of the Army of their assimilated rank, with the letters M. A. on the shoulder-knot. Or they may at their option wear a citizen's blue cloth coat, with buttons of the General Staff of the Army; black dress hat; pantaloons and vest plain, white or dark blue; cravat or stock, black. The uniform of the Chaplain is that prescribed for Chaplains in the Army. See *United States Military Academy*.

PROFILE-BOARDS.—Boards employed in the inspection of cannon for measuring distances in front and rear of base line. Their lower edges are adapted to the shape of the gun, and the upper ones are parallel to the axis of the bore. The distances from the base line of the several parts, and of points at which diameters are to be measured are laid off accurately on the upper edge, and then marked in lines perpendicular to it on the sides and lower edges of the profile. An iron strap is attached to the upper edge to prevent warping, and the whole is well coated with shellac-varnish to keep it from absorbing moisture.

The following instruments are used in connection with the profile-boards: A *rule*, for verifying the marks, of such a length that not more than one fleeting may be necessary, and to be graduated decimally according to the standard. A small *square* of steel, to be used in referring the marks on the board to those on the rule. A *steel straight edge*, long enough to extend across the muzzle-face and several inches on the board, used to ascertain the extreme length from base to muzzle. It is also used for the same purpose at the extreme end of the cascabel. A steel *scratcher*, to mark the gun at points, not otherwise indicated, where diameters are to be measured. See *Inspection of Ordnance*.

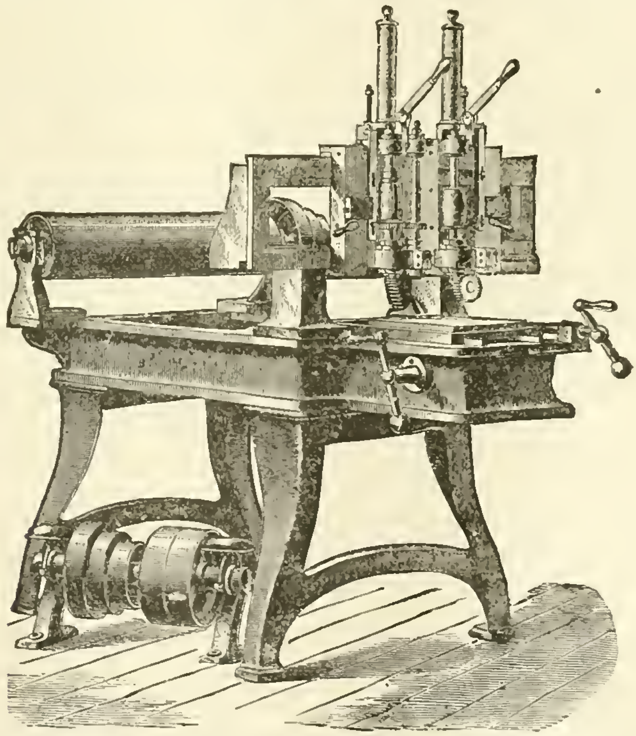
PROFILING.—An operation in the construction of field works which consists in erecting at proper points along the sub-crests, wooden *profiles* which give the form of the parapets at those points, and which guide the workmen in the construction of the works. Profiles are placed at the extremities of a parapet; at points along the sub-crest from twenty to thirty yards apart; at the salients and re-entrants; and at any points where a change of direction or dimensions are to be made. The profiles or poles having been planted at the angles of the work, and the height of the interior crest marked on them, a line is traced on the ground with a pick, showing the direction of the interior crests. When the ground is sensibly level, lines perpendicular to the direction of the interior crest are traced upon it, at suitable distances, from twenty to thirty yards apart, to mark the positions



of the profiles, and the horizontal distances for the thickness of the parapet; the bases of the slopes, etc., are set off on these lines. But when the ground along the direction of the profile is undulating, or slopes in either direction, cords are stretched above the surface, in a horizontal line, between two stout pickets, in the direction of the profiles, and so as to include all of its lines. This cord serves to measure the horizontal distances on, and to find the points of the profile, above and below it, by means of an ordinary plummet. A stout square picket is driven firmly into the ground, where the cord crosses above the pick-line, and a slip of pine, on which the height of the interior crest is marked, is nailed to the picket. The thickness of the parapet is measured on the cord, and a picket driven into the ground to mark the point. The base of the interior slope, and the tread of the banquette, are set off in a similar manner; and a slip of deal is nailed to each of the pickets. The height of the interior crest, and the tread of the banquette, are easily ascertained, from the position of the cord and the interior crest; these points having been marked on their respective slips, the outline of the parapet is shown by connecting them by other slips, which are nailed to the uprights; the banquette slope and exterior slope will be determined by a similar process.

From the profiles thus formed perpendicular to the interior crests, the oblique profiles at the angles can readily be set up, by a process which will suggest itself without explanation. Having completed the profiling, the foot of the banquette, and that of the exterior slope, are marked out with the pick, and also the crests of the scarp and counterscarp. All the arrangements preparatory to commencing the excavation are now complete. See *Field-fortification, Normal Profile, Parapet*, and *Tracing*.

PROFILING MACHINE.—A machine much used in armories, and by which an object of a given contour or outline may be duplicated; or one by which any given profile may be given to a piece by adequate manipulation of the parts, in the absence of the pattern which forms an automatic guide for the tool. In the former case, the machine is used for duplicating templets, gauges, and patterns (now much used in making various machines) in great numbers to an



exact size and proportion, to be afterwards assembled. Fire-arms, sewing-machines, watches, and many other articles are thus made.

The drawing shows a two-spindle profiling machine, as manufactured by the Pratt & Whitney Company, who make a specialty of gun machinery. It is built with or without Parkhurst's device for cutting formers without reversing the fixtures. With this improvement, to produce the forming pattern, the model piece is secured in the place and position afterward occupied by the work to be machined, and the piece to be cut for the forming pattern is placed in the position it will permanently retain. The guide-pin is put in the spindle which usually carries the cutter, and follows the outline of the model piece, while the cutter, in the spindle, which afterward holds the guide-pin, cuts the forming pattern in the exact position it will retain in use. After disconnecting the gearing upon the spindles, reversing the relative positions of the guide-pin and cutter, and smoothing the edge of the forming pattern (if this be necessary), the machine is ready for work. The gearing for moving the table and cross-slide is adjustable by means of double gears, set to prevent back-lash by two independent adjusting screws, and also by a double rack adjusted in the same manner. This arrangement is indispensable to secure perfect accuracy in cutting irregular forms, especially in turning corners. The No. 1 two-spindle machine has an area of table of 10½ by 8 inches, distance between top of table and under side of cross-head 3 inches, and distance between center of guide-pin and cutter also 3 inches. Weight, 1,350 pounds. Speed of countershaft, with 9 by 2¼ inch tight and loose pulleys, 125 revolutions per minute. The No. 2 two-spindle machine has an area of table of 15 by 12 inches, distance between top of table and under side of cross-head 4½ inches, and between centers of guide-pin and cutter 4½ inches. Weight, 2,600 pounds. Speed of countershaft, with 14 by 3 inch tight and loose pulleys, 140 revolutions per minute. The cutter will profile or surface work to the extreme limit of the table area. The height between table and cross-head may be increased, if so required. The machine may be constructed with one to three spindles, running in one adjustable head sliding on the cross-head. See *Edging-machine.*

PROGRESSIVE POWDER.—The excellent results obtained in Italy with what was termed "Progressive Powder," suggested the advisability of making trials of similar powders in some of the United States larger calibers, all of which have resulted satisfactorily. Progressive powder is fabricated as follows: After passing through the first stage of manufacture, and being brought to the condition of mealed powder, it is pressed into cakes which have a density of 1.79; the cake is broken up into irregular grains of from 0.3 in. to 0.6-in. in thickness, as is required, which are not to be glazed. These grains are mixed with 40 per cent. of mealed powder, taken from the same working as that from which the grains themselves are made, and the whole mass pressed into a cake having a less density than the original small grains, say 1.75. The cake is then granulated as may be prescribed. Each grain of the resulting powder is thus a conglomerate grain, consisting of one or more small grains of very dense powder imbedded in a mass of less density, the mean density being 1.75. The theory of the combustion of this powder is that the powder of less density being more quickly consumed, the whole charge breaks up into a much greater number of smaller grains, thereby exposing a greatly increased surface to the action of the flame. In using this powder that size of the regular-shaped grains is employed most suitable to the caliber of the gun, and is mixed with a certain proportion, to be determined by experiment, of the powder of irregular or mammoth grain. See *Fossano Powder,* and *Gunpowder.*

PROJECTILE FORCE.—The *projectile force* is that produced by the combustion of the powder in the piece, causing sudden development of gas, the expanding force of which, acting on the projectile, impels it forward and out of the piece. It is physically impossible to obtain exact uniformity in the charges. In practice there will always be a difference in the weight and shape in the cartridges, and in pushing them home, greater pressure will be applied at one time than at another, thus causing want of uniformity in combustion. The temperature of the piece, arising from previous discharges and from the temperature of the air or rays of the sun; the nature of the projectile and its movement in the bore; the condition of the bore with respect to humidity and foulness—all have more or less influence on the combustion of the powder, and consequently on the velocity and range. Above all, however, is the want of uniformity in the *quality* of powder. In this respect considerable latitude must be allowed in the size and density of grain or pellet, in the manipulation of the ingredients, and in its condition resulting from age, moisture, and handling. With small charges, especially with fine-grained powder, it is possible to so mix the contents of different barrels for any series of shots as to secure a fair degree of uniformity for that particular occasion; but with charges requiring large quantities of powder, this, except to a limited degree, is impracticable.

PROJECTILES.—In a military sense, the term projectile is applied to a mass usually thrown from a firearm by some explosive to strike, or destroy a distant object. To accomplish this, a projectile should have certain hardness, tenacity, and weight. If it be soft and weak compared with the body struck, it will spread out laterally or break into pieces, and presenting an increased surface will meet with a greater resistance, and consequently will penetrate less than if it had retained its original form. High density gives to the mass the least possible volume, whereby the effect of the resistance offered by the air and by the body to be penetrated is diminished. Different materials have been used for projectiles. Stone, lead, wrought-iron, steel, cast-iron, and chilled iron possess peculiar properties which render each advantageous according to the object to be attained.

Prior to the invention of gunpowder, large masses of stone without regard to form were thrown from machines constructed for that purpose. This material was very generally employed until the year 1400; but its want of strength and density, qualities required in a projectile propelled by powder, necessitated its use in large masses and with comparatively small charges. Such projectiles were destructive against unbacked walls of masonry, but broke if ricocheted on earth. As late as 1807, stone balls of enormous caliber were used by the Turks in defending the passage of the Dardanelles.

Lead, as a material for projectiles, possesses the essential quality of density; but it is too soft to be used against very resisting objects, since it is flattened even against water. From its softness and fusibility, large projectiles of this material are liable to be disfigured, and partially melted, by the violent shock and great heat of large charges of powder. Its use is chiefly confined to small-arms and case-shot, which are generally directed against animate objects. These defects of lead may be corrected, in a measure, by alloying it with tin, antimony, etc.

From the first introduction of cannon, wrought-iron projectiles have at different times been tried. This metal has great density and tenacity, but has not a high degree of hardness, cannot be easily worked into the necessary shapes, and when used in large masses becomes very expensive. Steel possesses the qualities required in a projectile, but is very costly and difficult to manipulate.

The adoption of cast-iron for projectiles caused an important advance in artillery. It has great hardness, sufficient density and tenacity; is cheap, easy to mold, and can at slight cost be given exact forms.

Recent improvements in the manufacture of this metal have so greatly increased the strength of projectiles made from it, that they can be used effectively against heavy armor. Cast iron, *chilled* by being cooled rapidly, has its hardness, crushing strength, and density increased. Projectiles so prepared are now employed with excellent results against the most powerful armor, and are found about as effective as those of steel and very much less costly. Compound projectiles, uniting the good and correcting the bad qualities of different metals, have sometimes been used. Thus, at the siege of Cadiz, cast-iron shells filled with lead, forming projectiles of great strength and density, were thrown from mortars to a distance of three miles and three-quarters.

Projectiles may be either *spherical* or *elongated*. Spherical projectiles are commonly used in smooth-bored cannon, and for this purpose possess certain advantages over those of oblong form: 1st. They touch the surface of the bore at only one point, and are therefore less liable to wedge in the bore and endanger the safety of the piece; 2d. The centers of figure and inertia coincide; 3d. The mass is embraced in the least possible volume; 4th. As they turn over in their flight, the surface presented to the resistance of the air is uniform and a minimum; 5th. In ricocheting on land or water, their rebounds are more certain and regular, and less deviation occurs from the plane of fire.

It was known at an early day that the spherical ball was not the one to which, for an equal weight, the air offered the least resistance. In order that any advantage may be gained from an oblong projectile, it must move through the air in the direction of its length; numerous unsuccessful attempts have been made to ensure accuracy in its flight when fired from a smooth-bored piece. One of the simplest plans for this purpose is to place the center of gravity, or inertia, in advance of the center of figure, or resistance. As these points should be in the longer axis of the projectile, the force of inertia and the resistance of the air, acting along the same right line and in opposite directions, will tend to preserve the line of flight. This was tried on a hollow, pointed projectile in the time of Louis XIV.; the cavity was divided into two compartments; the front one was filled with leaden balls and powder, and the rear one with powder only. The flight of these projectiles was uncertain and irregular, some of them bursting in the air, and others striking the object sidewise. Another plan of this kind, proposed by Thiroux, is to make the projectile very long, with its rear portion of wood, and its point of lead or iron, somewhat after the manner of an arrow; but it does not appear that that method has ever been submitted to the test of practice.

Attempts have also been made to give an elongated projectile a motion of rotation around its longer axis: 1st, by cutting spiral grooves on the base for the action of the gas from the charge; 2d, by forming such grooves on the forward part for the action of the air; 3d, by combining he preceding methods in the same projectile; 4th, by causing the air to enter a cavity at the front end, pass through nearly the length of the cylinder, and escape by radial openings at the sides. None of these plans have succeeded in practice, for the reason, perhaps, that the projectile naturally turns over end for end, and the charge and the air do not act with sufficient promptness, energy, and certainty to prevent it. An oblong projectile, thrown under a high angle and with a moderate velocity, can have rotation about its shortest axis arrested by attaching to its rear portion a light body, by means of a chain or cord; the resistance which this body experiences from the air will cause the projectile to move point foremost. Projectiles with wide flanges or wings, operated by springs by which they were extended after the shot left the piece, have been tried, but without success.

Projectiles may be further classified according to their construction and mode of operation, as *solid*, *hollow*, and *case shot*. Solid projectiles produce their effect by impact; they are used in *guns* and in *small-arms*; those for guns are known as *solid shot* or *shot*, and those for small-arms as *bullets*. Such projectiles are required when great range, accuracy, and penetration are sought; they must, therefore, possess great strength and density, and be fired with large charges of powder.

Shells are hollow shot which act both by impact and explosion, for which purpose they contain an explosive and a fuse to ignite it at the proper time. As they have less strength, they are fired with smaller charges of powder than solid projectiles, and are used against animate objects and such inanimate ones as will not cause them to break on striking. The thicker the sides of a shell, the greater its ability to resist the shock of discharge, and the greater the penetration and accuracy; on the other hand, a shell should be capable of containing sufficient explosive or incendiary material to accomplish the proposed end. The number of pieces resulting from an explosion varies with the brittleness of the metal, and is increased by giving to the interior the form of a regular polyhedron. A dodecahedral form has been found advantageous. The most rapid and violent explosive practicable should be employed; the size of the fuse-hole should be as small as possible, and should diminish with the size of the cavity, to prevent the loss of too great an amount of gas.

Case-shot act only by impact; they consist of a collection of small projectiles enclosed in a case or envelope. The envelope is intended to be broken, either in the piece by the shock of discharge, or at any point of its flight, by a charge of powder, inclosed within it; in either case, the contained projectiles continue to move on after the rupture, but cover a larger surface, and attain a greater number of objects. These projectiles can be used with effect only against animate objects situated at a short distance from the point of rupture; they are divided into *grape*, *canister*, and *shrapnel*. Grenades are projectiles that are commonly thrown by the hand, or are rolled down the slopes of a work. They are designed to act only by the force of their own explosion. *Hand Grenades* are thrown against troops in mass; for this purpose any spherical projectiles filled with powder only and weighing not over six pounds are suitable; these can be thrown from 20 to 30 yards; they are provided with a short fuse which is ignited by a match, or, in the act of throwing, by a special device. Projectiles have been designed especially for this service, an example of which is the "Ketchum" hand grenade. This is a small oblong percussion shell, which explodes on striking a slightly resisting object; a guide attached to the rear end causes it, when thrown, to move point foremost. *Rampart Grenades* are intended to be rolled down a breach in its defense, or to be thrown over the rampart, etc. Spherical shells of any size will answer for this purpose; those unfit for firing may thus be utilized. Shells are fired from guns, from howitzers, and from mortars. They are made of cast-iron, and their caliber is expressed in the same manner as solid shot of an equal diameter. The thickness of metal in spherical shells is about *one-sixth* of the diameter, and their weight, when empty, is generally about *two-thirds* of that of the corresponding solid shot. In the United States' Service, there are two kinds of spherical shells; one for guns, and another for mortars. Each consists of the *sides*, the *cavity*, the *fuse-hole*, and the *ears*; and, in gun-shells, the *reinforce*. The sides are thicker in gun-shells than in mortar shells of the same size, to withstand the high charges of powder with which they are fired. The fuse-hole is used for inserting the charge, and to hold the fuse for communicating fire to it. All shells of eight inches or more in diameter have ears to receive the "hooks" used in lifting the projectile to the muzzle of the piece in loading. The reinforce of metal, about the fuse-hole of the gun-shell, gives a greater bearing surface to the fuse, and prevents it from being driven in by the force of the discharge; this reinforce also serves, in a measure, to compensate for the metal taken out of the fuse-hole, and thereby render the shell more nearly concentric. In some services, shells have, in the upper hemisphere, a *charging-hole*, placed at an angle of 45° with the fuse-hole, through which the charge is poured immediately before the shell is used and after the fuse has been inserted. This is not necessary with the fuses used mostly in the United States' Service, as the powder and fuse can be readily introduced at the moment of loading.

A carcass is a thick shell which has three additional holes, of the same dimensions as the fuse-hole, pierced at equal distances apart in its upper hemisphere, their exterior openings being tangent to the great circle perpendicular to the axis of the fuse-hole. The object of a carcass is to set fire to wooden structures, by the flame of an incendiary composition issuing from the holes. This shell has no fuse, and is not intended to be exploded, although a charge of powder may be placed beneath the composition to prevent it from being approached by the enemy.

A stand of grape-shot is composed of nine small cast-iron balls, disposed in three layers of three balls each. The diameter of the balls for grape-shot varies with the size of the piece; being used at longer distances, they are larger than the shot for the corresponding canister. Grape-shot are employed only in the siege and sea-coast services; as now constructed, they cannot be used in rifled pieces.

The envelope for a stand of canister-shot, consists of a tin cylinder, closed at the bottom by a thick plate of cast-iron, and at the top by one of sheet-iron. The plates are kept in place by cutting the ends of the cylinder in strips about 0.5 inch long, which are turned down over the plates. A wire handle is attached to the top plate. To give more solidity to the mass, and to prevent the contained balls from crowding upon each other when the piece is fired, the interstices are closely packed with saw-dust. For a gun, 27 small cast-iron balls are used, arranged in four layers, the top of 6 and the remainder of 7 each: this makes the diameter of the balls about one-third that of the bore. For howitzers, the envelope contains 48 balls, in four layers of 12 each, the balls being smaller than those in a canister for the corresponding gun. Canister-shot are used in all services. For those in which the charge of powder is attached to the projectile, the canister has a block of wood, called a sabot, to which the envelope is nailed at the bottom; the lower plate rests upon this block; the wire handle is omitted. The parts composing a stand of grape or canister begin to separate the moment they leave the piece.

Shrapnel are cast-iron shells, in which, besides the bursting-charge of powder, is placed a number of small balls. Their sides are much thinner than those of ordinary shells, in order that they may contain a greater number of bullets; the thickness must be such that, when supported by the bullets, the case will not be broken by the force of discharge, but will yield readily to a small bursting-charge. The weight of the case, empty, is about one-half, and, when filled, about equal to that of the solid shot of the same diameter. This projectile is prepared by filling the case with leaden musket-balls well packed in; the interstices are then filled with melted rosin; this prevents the fracture of the envelope by the bullets, when the piece is fired. The *chamber* for the powder is afterwards bored out. The case is stengthened by a *reinforce*, and to increase the effect of the bursting-charge, the lower portion of the fuse-hole is closed by a *disc*, of wrought-iron, perforated with a small hole for the passage of the flame from the fuse. A shrapnel may be made to explode at any point of its flight, and, as the bursting-charge should be only sufficient to open the envelope, without scattering the bullets too much, the execution depends on the velocity which the case has at the moment it is broken. This projectile is therefore of more general use than grape or canister, and should be fired with as large a charge as possible. It may be used in all services, but is most effective in the field. A defect of this construction is that the bullets, adhering to one another and to the case, are not always separated by the bursting-charge. The shrapnel adopted in the English Service is known as the "Boxer diaphragm shell." It consists of a thin cast-iron shell, weakened by four grooves down the sides to make it open out more readily; of a wrought-iron *diaphragm* which divides the shell unequally, the upper portion containing the bursting-charge, and the lower being filled with balls of hardened lead, packed in coal dust. A *socket* is screwed into the fuse-hole and passes through the diaphragm; this forms a channel for the introduction of the bullets and coal; the bottom of the socket is then closed by a plug. Into this socket is screwed the fuse, the fire from which is communicated to the powder-chamber through the *fire-hole*. The bursting-charge is inserted at the *loading-hole*, closed by a metal screw-plug.

The advantages to be derived from the use of elongated projectiles having once been established, it became necessary that some means should be devised to make their flight accurate. It has been found that to do this with certainty, a motion of rotation about its longer axis must be communicated to the projectile, and this end has been satisfactorily attained only by cutting spiral grooves, or "rifles" in the surface of the bore of the piece, with which the projectile is connected, and by means of which it starts with a motion about an axis parallel to or coincident with that of the bore. The rotation continues during the flight of the projectile. Without this rotation, an elongated projectile will naturally turn over end for end, and present a constantly varying surface to the resistance of the air. This "rifle-motion," therefore, tends to cause the projectile to move through the air in the direction of the least resistance, thereby increasing the range, and the effect of impact, and, furthermore, giving steadiness to the projectile by distributing the deviating forces uniformly around its line of flight. The more important advantages of elongated projectiles are, that the form may be altered at any time, and the center of gravity can be placed at any desired point; the projectile may be elongated so as to oppose, for an equal weight, a diminished surface to any resisting medium; by this, the range is extended, and a flatter trajectory with greater accuracy and penetration obtained. The chief disadvantages are, increased strain on the gun; greater probability of jamming and injury to the bore; irregularity of ricochet; increased complication and expense of manufacture; and the liability of any soft metal on the exterior to be accidentally injured.

The different systems of projectiles for rifled pieces are classified according to the manner in which they are caused to follow the grooves. The systems are distinguished by some peculiarity of construction, and are generally known by the name of the person by whom designed, or by the place at which first made. The same principles are applicable to different systems, and the same precision of fire may practically be obtained from several. All systems are comprised under three classes: 1st. Projectiles with projecting ribs or studs; or having a peculiar cross-section. 2d. Projectiles having a portion that is expanded by the action of the gases in the bore. 3d. Those more or less of whose surface is compressed by the charge into the form of the bore. The first and second classes are applicable to muzzle-loading pieces; the third to breech-loaders only. The principal points to be considered, as regards the piece and the projectile, are the *surest* and *safest* means of causing the projectile to follow the grooves of the piece. To fulfil these conditions, the projectile should be simple in construction, and of sufficient strength to admit of its use with the largest charge that may be desired; it must not be liable to jam in the bore in loading or firing; and must produce a moderate and uniform strain on the gun. The system that most nearly complies with these requirements, and gives insured accuracy of fire with uniform and high velocities, should be the best. In many systems, one or more of these considerations have been sacrificed to some extent, to secure a closer compliance with others thought to be of greater importance or of easier attainment.

1st Class. Solid flanges, projecting from the body of a projectile and so shaped as to fit the rifling of the bore, were the means first used to communicate the rifle-motion in cannon. In some cases, there was for each groove a rib extending the entire length of the cylindrical portion of the projectile, while in others, sets of rounded buttons were employed. These projections were of the same material as the body of the projectile, and being of a very unyielding nature, frequently led to the bursting of the piece; buttons of zinc, copper, or bronze, firmly secured in mortises in the projectiles, were therefore adopted. The buttons are arranged in rows of two or more so that each row enters freely into a corresponding groove, in loading. When the bore of a gun is a twisted prism, with any plane figure for its base, the projectile, if shaped to fit it, will receive the rifle-motion when fired. The Whitworth cannon is rifled in this manner, the cross-section being a hexagon with rounded corners. Guns have also been constructed with ribs projecting from the bore, fitting into corresponding grooves in the projectile. To the last system belongs the Vavasseur gun, which has given good results; the system preceding has not, however, proved so satisfactory.

The principal advantages of systems of the first class are that the projectiles are strong, and that the required motion is communicated to them with great certainty and regularity. The escape of gas around the projectile, as it causes injury to the bore, is an objection to the class; various experiments have been made to overcome it, the latest being by the attachment of a metal cup to the rear of the projectile, which, by the action of the powder, is expanded and pressed against the sides of the bore. The French studded projectile, employed generally on the Continent with muzzle-loading cannon, and the Woolwich system, similar to it and used in England, are the best representatives of this class.

2d. Class. In projectiles of the second class, the body is composed of a hard metal, as cast-iron, and there is attached to it, generally at the base, a cup, band, or other arrangement of softer metal, which is expanded by the action of the charge into the grooves of the gun, when fired. Expanding projectiles are easy to load, are not liable to overstrain the piece, and those of different systems can generally be fired from the same piece—a point of great importance. Such projectiles do not always withstand the heaviest charges of powder, and are not certain to receive the rifle motion. The use of projectiles of this class is confined more particularly to the United States. The most important are the Parrott, Hotchkiss, and Butler systems.

3d Class. In breech-loading cannon, the receptacle for the charge is of larger diameter than the bore of the piece. The projectile is of the same size as this chamber, and must be reduced to enable it to pass into the bore. Such projectiles are embraced under the third class; the body has a coating of soft metal, which is compressed as the projectile is driven through the bore, the grooves compelling it to follow the direction of the rifling. The same result is sometimes accomplished by one or more rings of soft metal. The chief advantages of this class are, that the projectile is generally certain to take up the rifle-motion; that its axis is steady on leaving the bore; and that the wear of the bore, from gas passing the projectile, or from any irregular movement of the latter, is prevented. The objections are, that the necessary compression of the coating, the sudden closing of windage, and the fouling of the bore, produce undue strain upon the piece; that the velocity of the projectile is reduced by the force expended in compressing it; and that the soft metal forms an extra weight, which is useless in penetrating resisting objects. The German and the French systems are the most prominent types of this class. All small-arms, at the present time, use bullets of this class, which being entirely of soft metal are readily compressed without their general form being injured.

In consequence of windage and of the action of gravity, the axis of the projectile does not always coincide with that of the bore, in firing; this gives rise to inaccuracy of fire. With projectiles of each class means have been devised to overcome this difficulty, partially if not entirely, by the system of rifling, or by the nature of the chamber. These properly relate to the construction of the piece. See *Armor-piercing Projectiles, Armstrong Projectile, Chilled Projectiles, Compression Projectiles, Deviation of Projectiles, Effects of Projectiles, Elongated Projectiles, Expanding Projectiles, Fabrication of Projectiles, Calling Bodies, Form of Projectile, Inspection of Projectiles, Penetration of Projectiles, Preservation of Projectiles, Rockets, Rupture of Shells, Shells, Small-arm Projectiles, Solid Shot, Spherical Projectiles, Steel Projectiles, Studded Projectiles* and *Trajectory*.

PROJECTION.—The representation, on any surface, of the parts of fortification and other objects as they appear to the eye of the observer. It thus includes perspective, and is most simply illustrated by the shadow of an object thrown by a candle on a wall; the shadow being the projection, and the place of the light the position of the eye. The theory of projections is of great importance, both in mathematics, engineering, and geography: being in the former cases, perfectly general in its application; while in the latter only the projection of the sphere is required. Projections of the sphere are of various kinds, depending on the position and distance of the eye from the sphere, and the form of the surface on which the projection is thrown; thus we have the *orthographic, stereographic, globular, conical,* and *cylindrical or Mercator's* projections. Another projection frequently employed is the *gnomonic*. In gnomonic projection, the eye is supposed to be situated at the center of the sphere, and the surface on which the projection is thrown is a plane surface which touches the sphere at any one point (called the *principal point*). It is evident that a map constructed on the gnomonic projection, is sensibly correct only for a circular area whose circumference is at a small angular distance from the principal point. From the position of the eye in the gnomonic projection, it follows that all great circles, or portions of great circles, of the sphere are represented by straight lines, for their planes pass through the eye. The distance of two points on the sphere, when measured along the surface, is least if they are measured along a great circle; and as the distance of the projections of these points on the plane is represented by a straight line, which is the shortest distance between two points on a plane, this projection, if employed in the construction of mariners' charts, would at once show the shortest course. Maps of the earth's surface have been projected by the gnomonic method, the surface of projection being the interior surface of a cube circumscribing the sphere, and the complete series consequently amounting to six maps; but it is not fitted for the construction of maps of large portions of the earth's surface. The gnomonic projection derives its name from its connection with the mode of describing a gnomon or dial. The orthographic and stereographic projections were employed by the Greek astronomers for the construction of maps of the heavens; the former, or *analemma*, being the best known and most used. The stereographic, called *planisphere* by the Greeks, is said to have been invented by Hipparchus, and the gnomonic is described by Ptolemy. The others are of modern invention. In mathematics, the theory of projections is general in its application, and has been employed within the last few years to generalize the ancient geometry, as a powerful aid to algebra. Its basis is the investigation and determination of those properties which, being true of a figure, are also true of its projections, such properties being necessarily dependent, not on the "magnitude," but on the "position" of the lines and angles belonging to the figure. These properties are generally denominated *projective properties*. For instance, the three conic sections, the parabola, ellipse, and hyperbola, are merely various projections of a circle on a plane, and all "positional" properties of the circle are at once, by this theory, connected with similar properties of the three conic sections. The theory is also largely employed in demonstrative mechanics.

PROKING-SPIT.—An early name for a large Spanish rapier.

PROLONGATION OF THE LINE.—A tactical maneuver effected by parallel movements at the right or left of any given number of men on a front division.

PROLONGE.—A strong hemp rope used with field pieces to attach the gun to the limber when firing in retreat, or advancing, instead of limbering up; for the same purpose in crossing ditches; for slinging a piece to a limber; for righting carriages when upset, and for various other purposes. It is usually 26′ 7″ long, and is carried wound around the prolonge-hooks on the trail of the piece. It has a hook at one end and a toggle at the other, with two intermediate rings, into which the hook and toggle are fastened to shorten the distance between the limber and carriage.

PROLONGED FLANK.—In fortification, the flank extension from the angle of the epaule to the exterior side, when the angle of the flank is a right one.

PROMOTION.—The efficiency of any body of men depends upon the energy of the individuals composing it; the root of that energy is emulation; and emulation can only be secured by maintaining a proper current of promotion. The efficiency of a service is thus dependent on the system of promotion adopted; and so important, consequently, does promotion become, that in the present article it is purposed to glance at the rules observed in the principal armies of the world.

In the *Army of France* it is a very common saying that every Conscript has a Marshal's *bâton* in his knapsack. Speaking of the times of the Revolutionary War, this was doubtless true, for battalions chose their chief officers from their own ranks—a Conscript of one year was often a Lieut.-Col. the next, and perhaps a Brig. Gen. the following. In the quieter times of recent years, however, progress is slower; and, although promotion is open to all, and a considerable proportion of the officers do rise from the ranks, yet it is very rarely indeed that an officer who has so risen ever attains a higher grade than that of Captain. Junior commissions are—if the rule of the service were strictly followed—given, one-third to men from the ranks, one-third to cadets from military schools, and one-third by government patronage. In practice it appears that in the artillery and engineers two-thirds of the first positions are given to pupils from the Polytechnique, and the remainder to men from the ranks; while in the Line two-thirds of the officers rise from the ranks, and one-third come from the Military School of St. Cyr. Before officers can be promoted certain service in each rank is required, viz., as 2d Lieutenant, two years; as Lieutenant, two years; as Captain, four years; as Major, three years; and as Lieutenant Colonel, two years. These periods are, however, curtailed in time of war. Promotion takes place in the regiment up to the rank of Captain, two-thirds by seniority, and one-third by selection. From Captain to Major (*chef d'escadron ou de bataillon*), promotion is divided equally between seniority and selection; while to all higher ranks it falls exclusively to selection. The selection is made on reports by the Inspectors General of the several arms—their reports being founded on personal observation, and the testimony of senior regimental officers. To maintain rapidity of promotion there is a fixed age at which officers *must* retire—viz., Lieutenant General, 65; Major General, 62; Colonel, 60; Lieutenant Colonel, 58; Major, 56; Captain, 53; and Lieutenant, 52. These ages do not prevent the officers of a regiment from being the opposite of youthful.

In *Austria* all officers are at first Cadets; but a large proportion of these Cadets are nominated from men in the ranks by their comrades. Promotion goes by seniority, and in the regiment, with occasional selection from other regiments. The organization and officering of the *German Army* are both peculiar. Every German subject, of whatever rank, is bound to serve from the age of 20 to 25; but in practice this service is reduced to a year in the case of professional men. Every officer must serve in the ranks but not necessarily longer than a day. Young gentlemen intended for officers enter the ranks, *aspiranten*. They do duty as common soldiers for from six to nine months, and pass two examinations. Afterward they remain nine months at a division school or twelve months at an artillery and engineer school. They then become eligible for appointment as officers when vacancies occur which, however, they cannot obtain unless recommended by the officers of their respective regiments. Two-thirds of the first commissions are given to these aspiranten, and one-third to pupils from the cadet schools.

In the *Italian Army*, one-third of the Sub-Lieutenants are promoted from the ranks. Of subsequent promotion, two-thirds go by seniority, and one-third by selection. It is always urged against the *British* system of army promotion, that it is too exclusive, and confines the commissions to the upper classes of society; and there is no doubt that promotion from the ranks is much rarer than in almost any other army. But, on the other hand, it is argued, the constituents of the force are very different. Soldiers in Britain are not Conscripts, who necessarily comprise men of all classes and all degrees of education, but are taken as a rule, from an extremely low and very uneducated class of society. Again, Britain has a true middle class, which is wanting in almost every continental nation. Its army is not, therefore, necessarily aristocratic because it is not officered from the ranks. Lastly, the habits of the different classes of society differ so greatly, that unless the soldier be very superior to his comrades, promotion to a commission is a small boon.

With regard to the actual system of promotion which obtains; in the ranks, promotion from Private up to Company Sergeant takes place in the company, and is made by the regimental officers. The promotion of Company Sergeants to be Staff Sergeants is made throughout the regiment. All these promotions are by selection entirely. Of the commissioned officers, the Quartermasters and Riding masters are appointed almost exclusively from the ranks; but they have no further promotion to look forward to—Sergeants and Sergeants-major are occasionally gazetted to Ensigncies or Lieutenancies. The junior combatant officers acquire their commissions either by a competitive examination open to the whole nation, or by previous service in the militia as officers, or in the ranks of the army as non-commissioned officers. The artillery and engineers are officered entirely by Cadets from the Royal Military Academy, whose subsequent promotion is by seniority only. In the cavalry, guards, and line, vacancies are, since the abolition of the purchase system in 1871, filled by "seniority tempered by selection," the selection becoming more strict as the higher ranks are reached. The promotion of officers, up to the rank of Captain, is mainly regimental, and is, at the same time, by seniority; but seniority is, in this case qualified by what has been called negative selection—that is, in other words, the exclusion of those officers who do not prove their fitness for promotion at the periodical inspections and examinations. Above the rank of Captain, for *substantive* or *regimental* rank, seniority is little regarded, and selection is more absolute; but officers may hold at the same time *army* or *brevet* rank, conferred for distinguished service, or for mere seniority, in the general list of the whole army. This brevet rank does not affect the position in a regiment, and adds but a small sum to the officer's pay; but it is of great importance, inasmuch as Colonels rise by seniority alone to be general officers, and Colonel is almost exclusively a brevet rank (the only exceptions being in the artillery and engineers, where Colonel is a regimental rank). Under these rules, it sometimes happens that an officer who has never held higher regimental rank than Captain, may become successively, for good service, Brevet-Major, Brevet-Lieutenant Colonel, and Brevet-Colonel, until he succeeds, in his turn, to the rank of Major General.

In the *United States Army*, promotions in the line are made through the whole Army, in the several lines of artillery, cavalry, and infantry, respectively. Promotions in the Staff of the Army are made in the several departments and corps, respectively. Officers may be transferred from the Line to the Staff of the Army without prejudice to their rank or promotion in the Line; but no officer can hold, at the same time, an appointment in the Line and an appointment in the Staff which confer equal rank in the Army. When any officer so transferred has, in virtue of seniority, obtained or become entitled to a grade in his regiment equal to the grade of his commission in the Staff, he vacates either his commission in the Line or his commission in the Staff. No officer of the Corps of Engineers below the rank of Field-Officer can be promoted to a higher grade, until he has been examined and approved by a Board of three Engineers, senior to him in rank. If an Engineer officer fail on such examination he is suspended from promotion for one year, when he is re-examined before a like Board. In case of failure on such re-examination, he is dismissed from the service. When any Lieutenant of the Corps of Engineers [or Ordnance Corps] has served fourteen years' continuous service as Lieutenant, he is promoted to the rank of Captain, on passing the required examination, but such promotion does not authorize an appointment to fill any vacancy, when such appointment would increase the whole number of officers in the corps beyond the number fixed by law; nor can any officer be promoted before officers of the same grade who rank him in his corps. When promotions in the Ordnance Department of the Army are allowed by law, no officer of the corps, below the rank of Field Officer, can be promoted to a higher grade until he has been examined and approved by a Board of not less than three Ordnance Officers, seniors to him in rank. If an Ordnance officer fail on such an examination he is suspended from promotion for one year, when he is re-examined before a like board. In case of failure on such re-examination, he is dismissed from the service. When any officer in the line of promotion is retired from active service, the next officer in rank is promoted to his place, according to the established rules of the service; and the same rule of promotion is applied, successively, to the vacancies consequent upon such retirement. See *Appointment*, and *Staff*.

PROOF-HOUSE.—A house fitted up for proving barrels of fire-arms. They are extra heavily charged, laid on a bench, primed, and fired by a train of powder into a bank of sand. The average loss in England is four per cent. on 600,000 barrels annually. A second proving takes place when the piece is ready for assembling.

PROOF OF GUNPOWDER. A process pursued in testing gunpowder as regards its quality, strength, and uniformity. The quality is ascertained, both small and large grain, by its general appearance, its firmness, glazing, uniformity of grain, and density; its strength and uniformity, as explained further on. The weight of a cubic foot of government powder varies according to the nature of the powder. The process of *flashing* is also resorted to for testing the cleanliness and intimate mixture of the ingredients. With this view, about 3 drachms of powder are placed on a glass plate, and fired with a red-hot iron, when, if the powder has been properly made, no residue or foulness should be left. In addition to the above proof, the hygrometric test is a very necessary one to be taken of all natures of powder. The usual mode adopted to test the explosive strength or pressure of gunpowder in a gun is thus explained: An 8-inch proof gun is fitted with 3 screw gauges, or "crushers," by which the pressure of the exploding charge is recorded at three points in the bore, namely—in the axis by a gauge screwed through the cascabel of the gun; by a gauge, screwed into the side of the gun at $7\frac{3}{4}$ inches from the end of the bore; and by a gauge screwed into the side of the gun at $15\frac{1}{2}$ inches from the end of the bore. The velocity of the shot, or cylinder, is measured by two chronoscopes. For this purpose four wire screens are arranged in front of the gun at the respective distances from the muzzle of 90 feet, 100 feet, 210 feet, and 220 feet. Nos. 1 and 3 screws belong to No. 1 instrument, Nos. 2 and 4 screws to No. 2 instrument. The velocity of each projectile is, therefore, registered at two points in front of the gun, namely, at 150 feet and 160 feet, by two independent instruments. This affords a complete check on the method of recording the velocity. The "crusher" gauge, or instrument for measuring the pressure caused by the explosion of the charge, consists of a screw-plug of steel, provided with a movable base which admits of the insertion of a small copper cylinder, $\frac{1}{2}$ inch in length, into a chamber. One end of this copper cylinder rests on an anvil, while the other is acted upon by a movable piston. The copper cylinder is centered in the chamber by a small circular watch spring. The action of the apparatus is as follows: Upon the explosion of the charge, the gas, acting on the area of the piston, one end of which is almost flush with the interior of the bore, crushes the copper cylinder against the anvil. The amount of compression which the copper thereby sustains becomes an indication of the pressure. The area of the copper cylinders used for proof of gunpowder is $\frac{1}{12}$ square inch, while the area of the piston is $\frac{1}{8}$ square inch. To form a table of pressure, a series of experiments has been carried out in a testing machine, so as to determine the pressure required to produce a definite amount of compression in copper cylinders corresponding to those used in the instrument. The tabulated results furnish a means of comparison whereby the amount of compression produced in the "crusher" becomes a direct indication of the pressure at that part of the bore where the plug is inserted. The interesting experiments carried out by the committee on explosives have shown that the pressure indicated by each "crusher gauge" is, practically speaking, a true measure of the strain on the gun at that point.

The *modus operandi* of conducting an individual experiment in connection with the proof of gunpowder is as follows: The electric batteries and wire screens for use with the chronoscope having been duly prepared, the operator having satisfied himself that the instruments are in thorough working order, the command is given to "load." Upon this the men at the gun insert a cartridge of 35 lbs. weight and 19 inches length into the bore, and ram it home until a stopper on the stave of the rammer comes in contact with the face of the muzzle. The cylinder, flat at both ends, is then inserted and rammed home in a similar manner. This proceeding insures uniformity, as, owing to the stops on the rammer staves, each charge occupies the same space in the bore. The "crusher" plugs are then screwed into their respective holes, the copper cylinders having previously been fitted into the chamber in the extremity of the plug. All is now ready. The operator adjusts the chronoscopes, and gives the signal to fire. The projectile passes through the wire screens before it buries itself in the earth butt at which it is directed. The operator notes the readings of the instruments. The "crusher" plugs are withdrawn, and the little copper cylinders removed, stamped with the experimental number of the series, and measured in a calipers or micrometer gauge. A reduction in the length of the copper cylinder of $\frac{1}{16}$ inch indicates a pressure of 12 tons on the square inch; of one-tenth and a half, of 16 tons; of $\frac{2}{16}$, of 21 tons; of $\frac{3}{16}$, of 36 tons, etc. Thus, the operator, in each round, records two velocities, which ought to be almost equal, and pressures at three points in the bore. Let us assume that the pressures at the three points are respectively 17.6 tons, 17.9 tons, and 16.3 tons, and that the observed velocities per second are 1430 and 1426 feet at the respective distances of 150 feet and 160 feet from the muzzle. As a flat-headed cylinder of 180 lbs. weight and 8 inches in diameter, traveling at 1400 feet a second, would, owing to the resistance of the air, lose about 15 feet velocity in passing over 150 feet of space, the mean velocity at the muzzle will be 1443 feet. This batch of powder, therefore, would have passed proof within the terms of the specification. Had, however, the pressure recorded at any one point exceeded twenty tons, or the observed velocities been less than about 1405 feet, or greater than about 1465 feet, the powder would be rejected. The instrument invented by Le Boulengé for proving powder, has now nearly superseded that of Navez-Leurs, both in India and in England.

A very valuable paper on "Fired Gunpowder," by Captain A. Noble, F. R. S., and Professor Abel, F. R. S., will be found in the "Philosophical Transactions of the Royal Society" for the year 1875, in which is given the result of certain experiments for ascertaining the different phenomena of fired gunpowder within the bore of a gun, a subject until very lately veiled in obscurity for want of suitable instruments and data on which to carry out the experiments. The different chronographs which have been invented give us the measure of velocity of a projectile at the muzzle of a gun and during its flight, but the velocity of a shot within the bore from the first movement, along certain fixed points until it leaves the gun, has been left to Captain Noble to discover with his beautiful chronoscope, which is able to record the millionth part of a second. This instrument, in conjunction with the "crusher gauge," enables us to ascertain all the phenomena attending the combustion of gunpowder, such as its tension or pressure—its rapidity of ignition—the time occupied in burning different natures of gunpowder, etc. The subject is so interesting that it cannot fail to attract the attention of all scientific men and that of the practical artillerist. The length of the memoir prevents, in a work of this sort, a longer allusion to the results of the experiments than is now given. See *Eprouvette*, and *Gunpowder*.

PROOF OF ORDNANCE.—Guns of all descriptions are proved before being issued for service. Muskets are tested by being fired with heavier bullets and larger charge of powder than they will in the ordinary way be required to carry. Cannon are subjected to a series of tests. First, they are gauged to ascertain that the dimensions are correct, the utmost variation permitted being .3 in. externally, and .033. in the diameter of the bore, but the position of the bore may frequently deviate .25 in. from the line of the piece's axis. The next trial is by firing twice with very heavy charges—the bore being subsequently minutely examined, to detect flaws or crevices in the metal. A cavity exceeding in depth .2 in. if behind the first re-inforce ring, or .25 if before that ring, condemns the piece. After the proof by firing, water is forced at a great pressure into the bore, in order that it may permeate any honeycombs or flaws; the next day the bore is examined by means of a mirror, which casts a strong light into it. Flaws are then easily detected for while the rest of the bore is thoroughly dry, water will continue for some time to weep or run from the holes, and will stand over them in drops. This operation completes the proof. When a gun bursts in proof, the remainder of the guns of the same sort then in proof are subjected to another round.

Gunpowder for proving ordnance should be of the best quality of the kind used in the gun to be proved, giving not less than the standard initial velocity; it should be proved immediately before being used unless it shall have been proved within one year previously, and there be no reason to suspect that it has become deteriorated. The *cartridge-bags* are made of woolen or raw silk, the full diameter of the bore or chamber. They are filled by weight. The shot must be smooth, free from seams and other inequalities that might injure the bore of the piece, and they must be of the true diameter and weight given in the tables. *Guns* and *howitzers* are laid with the muzzle resting on a block of wood, and the breach on the ground or on a thick plank, giving the bore a small elevation. *Mortars* are mounted on strong wooden frames or iron beds, at an elevation of 45°, supported by the trunnions. Each piece should be fired two rounds with maximum charges and projectiles. The bore, vent, and the exterior surface of every piece which is approved, should be well covered with sperm oil immediately after the inspection. Bronze cannons are fired three times with solid shot and a charge of powder *one-third* the weight of the shot. If the piece has been in service, or if it be new, and its bore be of the true size, the shot should be wrapped in cloth or strong paper, to save the bore as much as possible from injury. See *Inspection of Ordnance*.

PROOF-PLUG.—A plug screwed temporarily into the breech of a gun-barrel to be proved.

PROPER.—A term in Heraldry. A charge borne of its natural color, is said to be proper. An object whose color varies at different times and in different examples, as a rose, which may be white or red, cannot be borne proper.

PROPORTIONAL DIVIDERS.—An instrument designed for dividing a line into any number of equal parts; for describing regular polygons in given circles; for reducing or enlarging the area of a drawing, and also for taking the square and cube-root of numbers. The bodies of the legs of these dividers are made of a flat piece of German silver, or brass, with a rectangular opening cut in each nearly the whole length; the ends of the legs are armed with steel points; the longest two are four or five times the length of the shortest ones. The legs are put together with the rectangular openings exactly opposite each other, and retained in their place by clamp plates and a thumb-screw, which can be moved up and down the opening and made tight at any desired point; these clamp-plates and thumb-screw constitute the joint of the dividers, upon which the legs are opened, and it is easy to perceive that if this joint is exactly halfway between the extremity of the points the two ends will open to the same distance, but if the joint is moved nearer one end the opening of the points will bear the same proportion to each other as the longer does to the shorter part. The cheaper form of these dividers have but one set of graduations, by which lines only can be subdivided; the proportions are $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$; that is, if the line across one of the clamp-plates is made to come opposite either of the divisions on the leg, the two ends of the dividers will open in that proportion. The best proportional dividers have one side of one of the legs graduated for dividing lines into $1\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$, $\frac{1}{11}$, and the other side of the leg is graduated for inscribing regular polygons of 6, 7, 8, 9 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 sides in given circles. To use the lines of polygons, bring the line across the clamp plate to coincide with the graduation which is marked with the number that the polygon is to have sides, then open the dividers and make the long steel points take in the radius of the circle, then the distance between the small points will be the length of one side of the

required polygon. The joint of most of the proportional dividers is slipped along the rectangular opening by the hand; but it is frequently quite difficult to bring it exactly to the right place, as a little too much pressure will move the line a little too far, and an opposite pressure may put it too far in the original direction again. For nicety in adjusting the joint to the required point, some proportional dividers are fitted with a bar and micrometer screw, by which the joint can be drawn exactly to the required division. Another plan is to have a rack fitted on the inside of the rectangular opening and a pinion attached to the sliding joint fitting into it; by turning the milled thumb-screw of the pinion the joint is moved up and down in the rectangular opening with great regularity and exactness. Great care must be taken that none of the points of the proportional dividers get broken.

PROPOSALS.—Information in regard to supplies or services for which proposals have been invited by advertisements is furnished to all persons desiring it, on application to such sources as are designated in the advertisement. In case of supplies, they are informed of the kind, quantity, and quality of articles required; place, time, and rate of delivery; conditions of payment, etc. In case of services, they are informed of the nature and extent of the services required; the place where or places between which they are to be performed, and the time allowed for the performance; furnished with or allowed to examine plans and specifications of all buildings, constructions and other works in contemplation, etc. No bidder is informed, directly or indirectly, of the name of any person intending to bid or not to bid, or to whom information in respect to proposals may have been given. All proposals should be inclosed in suitable envelopes, securely sealed, indorsed, and addressed as required by the advertisement, and be delivered to, or received by, the officer to whom addressed before the time appointed for the opening; and no responsibilty should attach to that officer for premature opening of any proposal not so indorsed as to show that it is a proposal, and the particular purpose for which it is made. When an advertisement calls for proposals to deliver supplies or render services at more than one place, a separate proposal should be made for each place, but all may be submitted in the same envelope. The officer whose duty it is to open proposals decides when the time fixed upon for the opening has arrived, and no proposal for that opening is thereafter received as formal. If a bidder wishes to withdraw his proposal, he may do so before the time fixed for the opening, without prejudice to himself, by communicating his purpose, in writing, to the officer who holds it; and when his proposal is reached it is handed to him, or his authorized agent, unread. Proposals are opened and read aloud at the time and place appointed for the opening; and a record of each proposal then and there is made upon an abstract showing fully all its essential particulars. As soon as the proposals have been opened and decided upon, an "Abstract" of them is made, one copy of which, together with one of the duplicates of each proposal offered, is forwarded to the proper Bureau without delay. The "Abstract of Proposals" has a copy of the notice attached, and has separate columns for "No. of proposal," "Name of bidder," "Date of delivery," "Remarks," and two columns (one for quantity and one for price) for each article, variety of article, or package that may be offered; for example under the item of pork, there are two columns (price and quantity) for each of the varieties "Mess," "Prime mess," "Thin mess;" under coffee, two for each of the items "Green, in barrels;" "Green, in bags;" "Roasted, in bags," etc.

The following is the general form of proposal:

The undersigned, engaged in the — business, in response to your — dated the — day of ——, hereby offer for sale to the — Department of the U. S. Army the following stores, viz:

—— —— at —— dollars and — cents per ——, and should this proposal be accepted — hereby bind —— to deliver the stores in strict compliance with the terms of your —— on or before the ——.

(Signature) —— —.

—— ——.

To —— ——,

U. S. A.

On the above proposal is accepted the following:

(Signature) —— ——,

—— ——.

Office U. S. ——,

—— —— .

In all cases where bonds are required from bidders, no proposal is considered unless accompanied by a bond made according to the form prescribed. The condition of the bidder's bond is to the effect that the bidder will not withdraw his proposal within sixty days succeeding the date announced in the advertisement or notice for the opening of proposals; and that, if his proposal be accepted and the contract for which he has bid be awarded him, he will enter into a contract and bond agreeable to the terms of his proposal within such number of days after the day on which he is notified of such acceptance and award as may be designated by the officer representing the United States.

The form of the bidder's bond is as follows:

Know all men by these presents, That we [*name of obligor*], of [*residence of obligor, giving town, county, State, etc.*], as principal, and [*name of surety*], of [*residence of surety*], and [*name of surety*], of [*residence of surety*], as sureties, are held and bound unto the United States of America in the penal sum of —— dollars, to the payment of which sum, well and truly to be made, we do bind ourselves, our heirs, executors, and administrators, jointly and severally, firmly by these presents.

Given under our hands and seals this —— day of ——, 18—.

The condition of this obligation is such that, Whereas the above-bounden [*name of obligor*], in response to a public advertisement and notice dated — —, 18—, and given and published by —— ——, United States Army, has made and presented to —— ——, United States Army, a formal proposal, in writing, whereby he has proposed and agreed to enter into a contract with — ——, United States Army, acting for and representing the said United States, to [*here state in brief the subject of the contract*], according to the terms and conditions set forth in said advertisement or notice:

Now, therefore, if the said [*name of obligor*] shall make and shall not withdraw his said proposal within sixty days from the date of opening the proposals, and shall within —— days from the date on which he may be notified that his said proposal has been accepted and the said contract awarded to him (provided such award be made within the sixty days above mentioned, duly and formally entered into such contract agreeably to the terms of his said proposal, and into such bond for its due performance as shall be required of him, or if his proposal shall not be accepted and such contract not be awarded him, then this obligation shall be void; otherwise, that is to say, if either he shall withdraw his proposal within said sixty days, or fail to enter within said —— days into such contract, if awarded him, and into such bond, to remain in full force, effect, and virtue.

Witnesses:

——— ———, ——— ———, [L. S.]
——— ———, ——— ———, [L. S.]
——— ———, ——— ———, [L. S.]

(Executed in duplicate.)

The following is the form of the Justification of the Sureties:

STATE OF ———,
County of ———, *ss:*

I [*name of surety*], one of the sureties named in the within bond, do swear that I am pecuniarily worth the sum of —— dollars, over and above all my debts and liabilities.

[Signature of surety.]

Before me,

[Signature of officer administering oath, with seal, if any.]

PROSECUTOR.—In Courts-Martial the Judge Advocate is usually the prosecutor; but if an officer prefers a charge, he sometimes appears to sustain the prosecution. No person can appear as prosecutor, who is not subject to the Articles of War, except the Judge-Advocate.

PROTRACTOR.—A mathematical instrument much used in engineering and fortification drawing. Fig. 1, shows the protractor in common use, provided

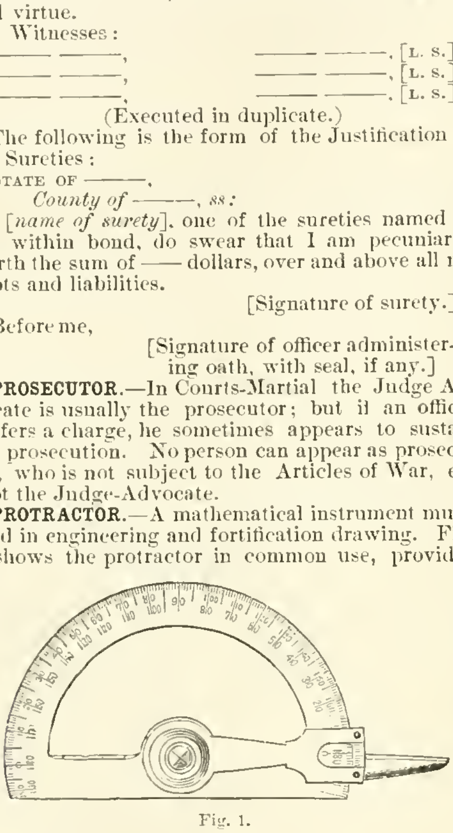


Fig. 1.

with arms and verniers. Crozet's protractor is shown in Fig. 2. It is named from its inventor, an officer of the United States Engineer Corps, and is considered the best among the various protractors yet devised. It may be used with the T-rule or straight edge. The feather edge is always set to the starting point and the line produced without puncturing the paper. The feather edge is the only metallic bearing upon the paper, small ivory projections on the under side of the frame keep the metal from contact with the paper and prevent soiling it.

PROVISIONAL FORTIFICATION.—Broadly speaking, provisional works may be divided into two classes according to the conditions under which they may be expected to be employed. 1st. Works constructed after the beginning of a campaign on sites not previously strategically considered, or which have become important in consequence of strategic developments not anticipated. In such cases neither the topographical nor geological conditions might be fully known, and, which is also of much importance, the extent of the resources of the neighborhood in labor and material might be more or less undetermined. 2d. Works constructed at the declaration of war, or its approach, for a well defined and previously considered object, on sites perfectly well known, and under conditions accurately ascertained before-

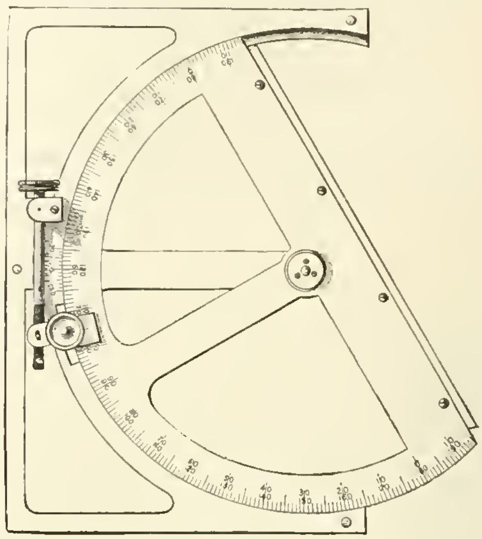


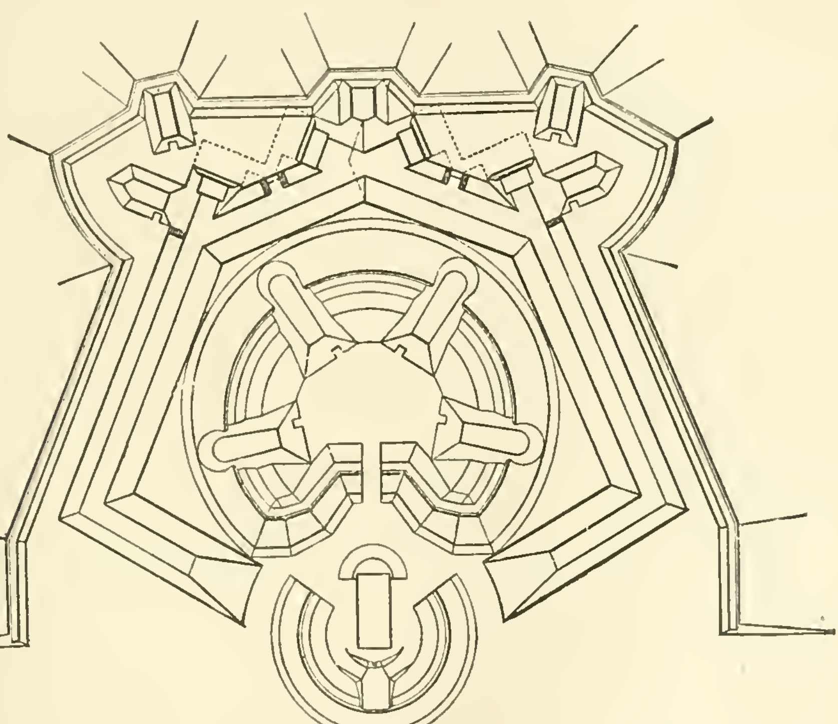
Fig. 2.

hand. As an instance of works of the first class, Plevna may be cited; as instances of the second, Adrianople and Tschataldscha; as an instance of the possible demand for the second class, London. The former class would usually have to be carried out by Military Engineers capable of adapting standard designs to varying conditions and full of resource, so as to be able to make the best use of the time available and the material and labor forthcoming. On the other hand, works of the latter class could be designed in the fullest sense during the calm of peace. Their requirements in labor and material would be exactly known. The resources of the neighborhood would have been accurately gauged, and the how and the whence to supply deficiencies would have been considered. Moreover, if a properly elaborated design existed, the execution might safely be left to civil labor under civil supervision. In the defense of England both classes of fortification would probably come into play. Certain strategic, commercial, or manufacturing centers would appear to need protection under any circumstances, others would call for fortification as soon as the landing place of the invader, or his subsequent plan of operations, had declared itself.

A method of fortification, in which forethought and brain power applied in advance may save enormous and possibly useless, because misdirected, expenditure, appears to be worth very careful study; and there are circumstances which make provisional fortification particularly applicable to England. The sea secures her time and a fair warning. Her resources in labor and the very ordinary materials required are practically unlimited. Her great railway system facilitates the rapid concentration at any spot of labor and material. Moreover, England possesses in her Civil Engineers a very powerful force, which could at a time of need be applied to the defense of the country. There is a very considerable body of young and able Engineers who, if provided with proper designs, are perfectly well able to carry out all the work necessary to fortify a position, and who have great experience in dealing with, and organizing civil labor on a large scale. In any time of real necessity the *personnel* of the Corps would have demands made upon it which its strength could scarcely meet, and it is no small advantage to have this very real "reserve force" to fall back upon. The same may be said of many of the colonies, and it remains to prepare in peace time a complete system of provisional defense, and by modifying it from time to time to keep it abreast of the advancing power of the attack. A paper army is rightly held up to contempt as a species of deception, which no great nations, jealous of the management of its affairs, should tolerate; but a paper system of fortification may, it is contended, form a very real defense. Only this paper system must be thorough, and the brain power applied to it unstinted. A very little reflection serves to show that the design of a provisional work is a task of considerably greater difficulty than that of a field redoubt. The restriction to two or three days, or less, in the case of the latter introduces a very sharp limitation to the possibilities of design. Extend the time to three or four weeks, or even longer, postulate an ample supply of timber, of railway bars, and even perhaps of bricks and cement, and it will be evident that these possibilities have enormously widened, and that very considerable variations of trace, profile, and general arrangement will present themselves for consideration. It is even contended that the design of a good provisional work is more difficult than that of an analogous permanent structure, and that it affords more scope for clever and resourceful engineering.

The drawing shows a plan of a typical provisional work for the defense of a hill top. This design was furnished by Bluhm Pasha to Colonel Ott of the Swiss Engineers. The work is in trace a circular segment (diameter about 60 yards) and four sides of the polygonal ditch are flanked by caponiers with two tiers of fire, formed in the counterscarp at its front ends. These caponiers are well placed for protection from distant artillery fire, but in the event of the enemy gaining and maintaining possession of the ditch their defenders would be sacrificed. Accommodation is provided for eight overbank guns in the work and one in the gorge traverse. The latter is really a segmental lunette partially inclosing a traverse containing a shell-proof casemate. A covered way affording a good line of infantry fire runs around the work, and the front line is broken so as to form two bastioned fronts and also two places of arms at the shoulders, defiladed by four traverses containing casemates. Brickwork is employed in all the casemates and also in the steps leading from the ditch down into the caponiers and up to the covered way. The total length of the line of fire is about 650 yards run, and to man it, therefore, at least an equal number of men would be needed. Casemate cover for 200 men is provided, and magazine accommodation to the extent of about 645 square feet.

The most salient features of the works attributed to Bluhm are thus: 1. The curved trace of the crest of the main work. 2. The polygonal trace of the ditch; the latter usually unflanked. 3. The combination of artillery and infantry fire from the work itself; the employment of the latter only from the covered way. 4. The curved defensible traverse to cover the gorge; the large lateral traverses containing casemates for men and magazines. 5. The employment of brickwork as much as possible for the walls of the casemates and for stepped approaches. The work appears to have several merits. The circular or elliptic trace cannot well be enfiladed: it affords a maximum of interior space with a minimum of parapet; there are no undefended angles. The old objection to circular redoubts—that they tend to too great a dispersion of fire—has now less weight, since a smaller number of breech-loaders is as effective as a comparatively large number of the old rifles. Nor has the other objection—that the circular trace is suited only to direct defense, and that works so designed have no self-flanking power—quite its old force, since the increased range of artillery enables works belonging to a line to afford each other more effectual mutual flank defense than formerly. Moreover redoubts would frequently be flanked by detached batteries in rear of the general line of their positions. On the other hand, it may perhaps be said that the work above described provides insufficient cover for its garrison, that the broad berm at the angles of the ditch affords a good



resting place for an assaulting party to accumulate prior to the final rush for the parapet, and that there is on the whole too little storm-freedom. The latter objection may, however, be partially met by a liberal use of obstacles. See *Fortification*.

PROVOST.—The temporary prison in which the military police confine prisoners until they are disposed of.

PROVOST CELLS.—In the British service, those certified cells under a Provost or acting Provost Sergeant, in which Court-Martial prisoners may be imprisoned up to forty-two days. Also, called Regimental or Garrison cells.

PROVOST MARSHAL.—An officer appointed in every army in the field, to secure the prisoners confined on charges of a general nature. In the British Army he is an officer, with the rank of Captain, appointed to superintend the preservation of order, and to be, as it were, the head of the police of any particular camp or district. He has cognizance of all camp-followers, as well as of members of the army. His power is summary, and he can punish an offender, taken *flagrante delicto*, on the spot, according to the penalties laid down in the Mutiny Act.

PROVOST SEGEANT.—A Sergeant who is charged with the military police of a corps. He is generally given one or two non-commissioned officers as assistants. In the British service he is also charged with the custody of all prisoners in the cells.

PROWLERS.—Armed prowlers, by whatever names they may be called, or persons of the enemy's territory, who steal within the lines of the hostile army, for the purpose of robbing, killing, or of destroying the mail, or of cutting the telegraph wires, are not entitled to the privileges of the prisoner of war.

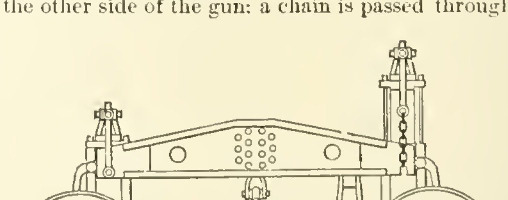
PRUSSIAN BREECH-LOADER.—This method of closing the breech is similar to that of the *Wahrendorf Breech-loader*. The leakage of gas is stopped by a valve and a *papier maché* cup. The sliding block is set up by a wedge tightened by a screw.

PRUSSIAN FUSE.—This fuse might be designated as a *time-concussion-chemical* fuse. It consists of three parts. 1st. The body of the fuse, or fuse-case, which holds the other parts, and is screwed into the eye of the shell, the top being flush with the outer surface. This part has been constructed of both metal (bronze and cast iron) and wood. The interior is divided into two parts, both cylindrical, and with a common axis. The one next the outside of the shell is much the larger in diameter. This case was made the same size for all calibers, but that part destined for the reception of the fuse-composition, is longer for fuses which are to be fired with small charges than for those with which large charges are to be used. 2d. The percussion apparatus consists of a small glass tube, hermetically closed at both ends, partly filled with concentrated sulphuric acid, and wrapped with cotton thread soaked in a composition of 70 parts (by weight) of chlorate of potassa, 10 parts of flowers of sulphur and 20 parts of white sugar, pulverized, sifted, and moistened with alcohol. This covering is put on of such a thickness that the tube can just be inserted in a paper case which serves it as an envelope, and which fits partly into the smaller opening in the fuse-case and partly into a thimble-shaped *breaker* of lead, which is inserted over it in the large part of the opening. 3d. The composition column. The explosive apparatus being in position, there remains between the thimble and the sides of the fuse-case a vacant space, which is filled with compressed meal-powder, filled in by means of a hollow drift, the interior diameter of which is a little greater than the diameter of the thimble. When the composition reaches the top of the thimble, uncompressed mealed powder is filled in to the top of the case. On being fired, the thimble or breaker being supported by the composition around it, is not disturbed. But as this takes fire like an ordinary fuse, and burns down to the bottom of the breaker, it leaves this unsupported; and if the composition is all consumed when the shell strikes, the shock overthrows the breaker, rupturing the glass tube, setting free the sulphuric acid, and exploding the shell. Experiments go to show that, in this fuse, the best material for the fuse-case is beech-wood; and the worst, cast iron.

PRUSSIAN GUN LIFT.—The gun-lift adopted for service in the Prussian Army consists of two telescopic hydraulic jacks, each mounted on a solid base, and carrying suspended from the heads of the two upper jacks a wrought-iron cross-beam, with a double hook depending from the middle for attaching the load. The lower jacks are $8\frac{3}{4}$ inches in diameter, and the upper ones $6\frac{3}{4}$ inches, each having a lift of $3\frac{1}{2}$ feet. They are operated by means of a crank on an axle, which rests in two bearings on the lower jack. A fly-wheel with a handle is attached to each end of the axle; they are used to transport the jack from place to place. The cross-beam is built up of two rolled plates placed vertically, strengthened by angle-irons, and joined together by a top plate riveted to them. A cast-iron block is bolted between the plates at the middle of their length, and a link passes around it and carries the double-hook. Length of cross-beam, 10 feet; weight, 1,430 pounds. Capacity of the lift, 62,000 pounds, raised 7 feet.

Great care must be taken to prepare the foundations for the jacks to set on, so that they shall not yield unequally when the weight is brought upon them, and cause the jacks to upset. If the ground be soft, the foundations may be made of timbers bolted together and resting on piles. The jacks are placed on the bases at the proper distance apart (depending upon the length of the cross-beam, which is usually 10 feet). The cross-beam is brought into position by 24 men, the ends at the foot of the jacks. A chain is passed through the stirrup of the upper jack, and is made fast to the end of the cross-beam, which is raised by pumping the jack, and is rested on a trestle prepared for the purpose. The jack is now lowered, the end of the beam is secured in the stirrup, and the trestle removed. The same operation is performed with the other end, thus bringing the cross-beam into a horizontal position, and the heads of both jacks down. The cross-beam is suspended more quickly and safely by using two trestles; raise both ends of the cross-beam at the same time, rest it on the trestles, lower the heads of the jacks, and suspend the cross-beam in the stirrups, then raise it slightly and remove the trestles.

The cross-beam is placed across the gun, a block of wood of proper shape being first interposed to protect the gun from injury. The first jack is placed 5 feet from the axis of the gun, and the end of the cross-beam is inserted in the stirrup. The second jack is set up in a corresponding position on the other side of the gun; a chain is passed through



the stirrup and made fast to the end of the cross-beam, which is raised by pumping the jack; a trestle is placed under the cross-beam when it is brought to a horizontal position, the head of the jack is lowered, and the stirrup is placed over the end of


PRUSSIA
AND
NORTH GERMANY
SCALE OF MILES
0 25 50 75 100 125
Railroads
See also Map of German Empire
Longitude East
from Greenwich
NORTH SEA
JUTLAND
DENMARK
ZEALAND
FÜNEN
LANGELAND
LAALAND
FALSTER
MOEN
SAMSOE
ANHOLT
FEMERN
AEROE
ALSEN
Great Belt
The Sound
Kiel Bay
G. of Lübeck
HELIGOLAND
(To Britain)
NORDERNEY
AMELAND
SCHIERMONICK OOG.
NEUWERK
ROMOE
SYLTOE
FOHR
AMRUM
NTH. FRIESIAN IS.
SLESWIG
HOLSTEIN
MECKLENBURG
HANOVER
OLDENBURG
HOLLAND
Zuyder Zee
WESTPHALIA
MÜNSTER
LIPPE
BRUNSWICK
SAXONY
THURINGIA
NASSAU
HESSE
DARMSTADT
WALDECK
RHENISH PRUSSIA
COLOGNE
BERG
WESTERWALD
HARZ MTS.
BROCKEN
MEISSNER
Copenhagen
Helsingborg
Elsinore
Stralsund
Rostock
Schwerin
Wismar
Lübeck
Hamburg
Altona
Bremen
Bremerhaven
Cuxhaven
Emden
Oldenburg
Kiel
Flensburg
Sleswig
Hanover
Brunswick
Magdeburg
Brandenburg
Potsdam
Spandau
Charlottenburg
Halle
Leipzig
Erfurt
Weimar
Jena
Gotha
Eisenach
Cassel
Göttingen
Minden
Osnabrück
Münster
Dortmund
Essen
Düsseldorf
Cologne
Bonn
Coblenz
Aachen
Treves
Frankfurt
Wiesbaden
Mayence
Giessen
Fulda
Marburg
Hanau
Coburg
Luxemburg
Saarbruck
R. Elbe
R. Weser
R. Ems
R. Rhine
R. Main
R. Moselle
R. Aller
R. Havel

BALTIC SEA
OLAND
Calmar
Morbylanga
Carlskrona
BORNHOLM
Ronne
ERTHOLMES
Libau
Polangen
Memel
Schwarzort
Curische Nehrung
Curische Haff
Gulf of Danzig
Bruster Pt.
Pillau
Hela
Konigsberg
Tilsit
Niemen R.
Pillkallen
Insterburg
Gumbinnen
Eydtkuhnen
Goldapp
Oletzko
Lotzen
Angerburg
Friedland
Heilsberg
Braunsberg
Elbing
Marienburg
Danzig
Oliva
Karthaus
Dirschau
Stargard
Lauenburg
Leba
Stolpmunde
Stolp
Rugenwalde
Schlawe
Kolberg
Koslin
Belgard
Greiffenberg
Kammin
Stettin
Stargard
Pyritz
Soldin
Landsberg
Kustrin
Frankfurt
R. Oder
R. Warthe
Posen
Bromberg
Thorn
Culm
Graudenz
Marienwerder
Konitz
Schneidemuhl
Inowrazlaw
Gnesen
Goplo L.
Kalisch
Schrimm
Lissa
Glogau
Liegnitz
Breslau
Brieg
Oppeln
Neisse
Glatz
Ratibor
Gleiwitz
Pless
Cracow
Troppau
Teschen
Olmutz
Brunn
Prague
Kuttenburg
R. Elbe
Koniggratz
Gitschin
Aussig
R. Moldau
SCHNEEKOPPE
SUDETEN GEB.
R. Vistula
Warsaw
R. Narew
R. Bug
R. Pilica
R. Warta
POLAND
RUSSIA
AUSTRIA
WEST PRUSSIA
EAST PRUSSIA
POSEN
BRESLAU
LIEGNITZ
OPPELN
BROMBERG
KONIGSBERG
GUMBINNEN
MARIENWERDER
DANZIG
STETTIN
KOSLIN
16
18
20
22
56
52
50

the cross-beam. The slings are passed around the gun and hooked to the double hook. By pumping up the jacks the weight is raised. When the gun-lift cannot be set up over the weight to be raised it may be set up on planks, either in front or rear, and then moved into the required position by means of rollers. The lift is taken down in the inverse manner of setting it up.

Twenty-four men transport the cross-beam by two long handspikes run through holes in the beam for that purpose, and place it on a truck or cart. The fly-wheels are used as truck-wheels for transporting the jacks. The keys which fasten them to the axles are removed, also the handles. The heads of the jacks are secured by ropes, and the bolts of the axle-bearings tightened. The jack is brought down into a nearly horizontal position, and the stirrup is placed over the pintle-hook of a field-limber and secured by a rope. See *Gun-lift*, and *Krupp Gun-lift*.

PRUSSIAN NEEDLE CARBINE.—A breech-loading small-arm, having a fixed chamber closed by a movable barrel, which rotates about an axis at 90° to the axis of the barrel, and vertical in the plane of the axis of the barrel. It is opened by turning a lever back and to the right; in so doing the barrel is moved forward by an eccentric as far as the corresponding arm of a heart-shaped slot in the tang of the receiver will permit the rear guide-stud to go. By the same means the butt of the barrel is swung around to the right, so that the mouth of the chamber may be readily reached with the load. As the eccentric turns, an eccentric plate, which is on the same shaft with it, turns also; and by means of a connecting rod, which is linked at its forward end to the eccentric plate and in rear to the cocking-bolt, slides the latter backward against the pressure of a spiral mainspring surrounding the stem of the needle-bolt, against the face of which the vertical arm of the cocking-bolt presses. This motion is so timed, that at the moment the piece is fully opened, the nose of a spring-sear riding over the beveled shoulder of a fillet on the needle-bolt, catches against its square-face and retains the bolt against the pressure of the mainspring, when, in order to load the piece, the resistance of the hand has been withdrawn. It is closed by returning the lever to its place beneath the barrel; the barrel is first swung around in the prolongation of its original position, and is then drawn back so that a gas-plug projecting from the receiver shall enter the mouth of the chamber. The carbine is fired in the same manner as the Prussian needle-gun, and in case of a failure to ignite the charge, the piece, without opening it, may be re-cocked in the same manner. The arm using a self-consuming cartridge-case, the extracting or ejecting apparatus is not needed. The enormous swell left at the muzzle of this piece, it is supposed, is intended to protect it from the indentations likely to occur in common use in the mounted service. See *Needle-guns*.

PRUSSIAN NEEDLE-GUN.—A breech-loading gun (small-arm), having a fixed chamber closed by a movable breech-block which slides in the line of the barrel by direct action. It is opened by releasing a spring catch by pressing down upon it, and then drawing it back by the thumb. This slides a projecting thumb-piece of the lock-tube out of its square notch in the receiver, and allows the handle of the breech-bolt to be raised to a vertical position and the bolt itself to be withdrawn. The piece may then be closed by reversing the movement of the bolt, and may be locked by turning down the base of the handle against a recoil-shoulder formed for it on the receiver. In the act of closing, the front shoulder of the needle-bolt, around the stem of which the main spring is coiled, catches against the nose of a sear, and pushes the lock-tube out to the rear by means of the main spring included between them. By then pushing forward with the hand, the base of the lock-tube until the spring-catch above it engages with a corresponding notch in the upper surface of the bore of the breech-bolt, the main spring is compressed, so that when the sear is pulled out of the way by the trigger, the needle may be darted forward, and, guided by a small hole in the face of the bolt, find its way through the powder in the cartridge to explode the fulminate lying in the base of the paper sabot which surrounds the ball.

The cartridge being self-consuming, no extracting or ejecting devices are required. The butt of the barrel is chambered, and the face of the breech-bolt is counter-bored at the same angle, so as to make a close fit and to prevent, as far as possible, the escape of gas. The recoil-shoulder on the receiver is inclined to the front, so that as the ends of the barrel and breech-bolt wear off, the bolt may be brought forward to supply their loss. The arm may be cocked independently of the bolt, by first withdrawing, and then shoving forward the lock-tube. The system may be dismounted by withdrawing the bolt, and at the same time pulling hard on the trigger; this causes a change of fulcrum to the rearmost of the scolloped surfaces, into which its upper side is formed, and permits the nose of the sear to be pulled completely out of the way for the passage of the bolt. See *Needle-guns*.

PRUSSIAN RIFLING.—The Prussians early adopted and perfected the *compressing system*, and obtained great accuracy and range with charges of one-tenth the weight of the projectile. The rifling consisted of numerous shallow rectangular grooves. The shot was encased by four rounded lead bands or hoops, held in place by grooves in the shot. With this system the shot is larger than the bore, and is squeezed or planed to fit the bore by the lands of the rifling. The shot must therefore be entered at the breech, into a chamber larger than the rest of the bore; and whatever escape of gas there may be around the breech-closing apparatus reduces its range and velocity.

PRYCK-SPUR.—In ancient armor, a spur having a single spike.

PSILOI.—Among the Greeks, Psiloi were the light armed men who fought with arrows and darts, or stones and slings; but were unfit for close fight. They were in honor and dignity inferior to the heavy-armed soldiers. The Psiloi performed all the duties usually devolved, in the present day, upon light infantry, both before and at the opening of an engagement. See *Oplitai*.

PUBLIC ANIMALS.—The animals in the employ of a Government. In the United States, the following specifications govern in purchasing the horses and mules for the military service:

Cavalry Horses—To be geldings, of hardy colors, sound in all particulars, in good condition, well broken to the saddle, from fifteen to sixteen hands high, not less than five nor more than nine years old, and suitable in every respect for Cavalry service. Whenever it becomes necessary to purchase the half-breed horses of California or Southern Texas, the standard of height may be reduced to not less than fourteen and a half hands.

Artillery Horses—To be geldings, of hardy colors, sound in all particulars, in good condition, square trotters, well broken to harness, from fifteen to sixteen hands high, not less than five nor more than nine years old, and suitable in every respect for Artillery service.

Mules—To be strong, stout, compact animals, sound in all particulars, in good condition, well broken to harness, not under fourteen hands high, not less than four nor more than nine years old, and suitable in every respect for the transportation service of the army.

When work-horses are to be purchased, they should be sound in all particulars, fifteen and one-half hands high and upwards, strong built, well broken to work in harness, not less than four nor more than nine years old. For pack purposes, the standard of height may be reduced to thirteen and a half hands, if the animal be in other respects suitable. The pack mule need not necessarily be broken to harness.

For general transportation purposes of the army, horses cannot be advantageously substituted for mules. For draught purposes in the Northern and Eastern States, and at depots in large cities, and for saddle purposes of wagon-masters, messengers, and expressmen, horses may be advantageously used in place of mules.

The following weights are suggested as the minimum, except for the half-breed horses of Texas and Southern California:

	Pounds.
Artillery wheel-horses	1,200
Artillery swing and lead horses	1,100
Cavalry horses	950
Horses for messengers, etc	950
Draft-horses of the Quartermaster's Department	1,200
Wheel-mules	1,200
Swing-mules	1,050
Lead-mules	850

At the headquarters of every regiment of Cavalry, with every company of Cavalry and battery of mounted Artillery, and with the records of every officer in immediate charge of public animals, a descriptive list of horses and mules is kept, showing the name, age, size, color, and other peculiarities of each animal, how and when acquired, his fitness for service, how long he has been in service, the name of his rider or driver, and the particular use to which he is or was applied.

PUBLIC EXIGENCY.—The term "*Public Exigency*," employed in section 3,709, Revised Statutes, refers to an exceptional and urgent necessity, requiring an immediate supply of articles for military use, or the immediate performance of work or service, such as may grow out of the pressure of an existing state of war, rebellion, or insurrection, or of some particular act of warfare on the part of an enemy, or may be occasioned by any unexpected movement of troops; or such as may consist in the destruction or loss of supplies, structures, etc., by fire or the violence of the elements, by acts of rioters or trespassers, by theft or waste, by the negligence of common carriers or others, by the failure of contractors, etc. Exigencies are sometimes assumed to exist where none have legitimately occurred. By carefully observing the laws regulating contracts, and making prompt provision for the future supplies, etc., of the command, recourse to purchases in open market to meet supposed emergencies may ordinarily be avoided. Information can generally be derived from the proper records as to the average quantity of supplies required in years past, which will provide against the happening of such emergencies; and timely advertisements should be made accordingly. But that statute (the act of March 2, 1861), while requiring such advertisement as a general rule, invests the officer charged with the duty of procuring supplies with a discretion to dispense with advertising if the exigencies of the public service require immediate delivery or performance. It is too well settled to admit of dispute at this day, that where there is a discretion of this kind conferred on an officer, or board of officers, and a contract is made in which they have exercised that discretion, the validity of the contract cannot be made to depend on the degree of wisdom or skill which may have accompanied its exercise.

PUBLIC MONEYS.—All officers of the Quartermaster's Subsistence and Pay Departments, the Chief Medical Purveyor and Assistant Medical Purveyors, and all Storekeepers before entering upon the duties of their respective offices, give good and sufficient bonds to the United States, in such sums as the Secretary of War may direct, faithfully to account for all public moneys and property which they may receive. The President may, at any time, increase the sums so prescribed. It is the duty of every disbursing officer having any public money intrusted to him for disbursement to deposit the same with the Treasurer, or some one of the Assistant Treasurers, of the United States, and to draw for the same only as it may be required for payments to be made by him in pursuance of law, and to draw for the same only in favor of the persons to whom payment is made; and all transfers from the Treasurer of the United States to a disbursing officer are by draft or warrant on the Treasury, or an Assistant Treasurer, of the United States. In places, however, where there is no Treasurer or Assistant Treasurer, the Secretary of the Treasury may, when he deems it essential to the public interest, specially authorize in writing the deposit of such public money in any other public depository, or, in writing, authorize the same to be kept in any other manner, and under such rules and regulations as he may deem most safe and effectual to facilitate the payments to public creditors.

All public money advanced to disbursing officers of the United States must, in accordance with the law, be deposited immediately, to their respective credits, with either the United States Treasurer, some Assistant Treasurer, or Designated Depositary, other than a National Bank Depositary, nearest or most convenient; or, by special direction of the Secretary of the Treasury, with a National Bank Depositary, except—1. Any disbursing officer of the War Department, specially authorized by the Secretary of War, when stationed on the extreme frontier or at places far remote from such depositaries, may keep, at his own risk, such moneys as may be intrusted to him for disbursement. 2. Any officer receiving money remitted to him upon specific estimates, may disburse it accordingly, without waiting to place it in a depository, provided the payments are due, and he prefers this method to that of drawing checks. Any check drawn by a disbursing officer upon moneys thus deposited, must be in favor of the party, by name, to whom the payment is to be made, and payable to "order" or "bearer", with these exceptions—1. To make payments of individual pensions, checks for which must be made payable to "order". 2. To make payments of amounts not exceeding twenty dollars. 3. To make payments at a distance from a depositary. 4. To make payments of fixed salaries due at a certain period. In either of which cases, except the first, any disbursing officer may draw his check in favor of himself or bearer for such amount as may be necessary for such payment, but in the last-named case the check must be drawn not more than two days before the salaries become due.

Whenever a United States disbursing officer serving in two distinct capacities, and having moneys advanced to him from two distinct Bureaus, deposits his funds with the Treasurer of the United States, an Assistant Treasurer, or United States Depositary, separate accounts should be kept of such moneys, and the balance to the credit of each should be reported separately on the weekly lists of disbursing officers' balances. These instructions are intended to apply more particularly to Quarter-masters serving as Commissaries of Subsistence, and *vice versa*. See *Disbursing Officers*.

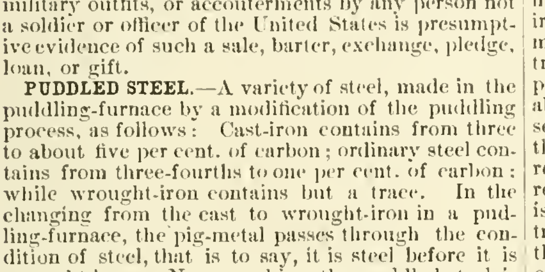
PUBLIC PROPERTY.—It is the duty of all officers to guard the public property for which they are responsible by all means in their power. Whenever information is received that horses, mules, or other property belonging to the United States, are unlawfully in the possession of any person not in the military service, the Quartermaster, or other Staff officer of the Department to which the property belongs, should cause proper proceedings to be promptly instituted and diligently prosecuted before the civil authorities for the recovery of the property, and, if the same has been stolen, for the arrest, trial, and conviction, and due punishment of the thieves, and of all those who aid and abet them by receiving the stolen property, or otherwise.

Upon satisfactory information that United States property, in unlawful hands, is likely to be taken away, concealed, or otherwise disposed of, before the necessary proceedings can be had in the civil tribunals for the recovery thereof, the post or detachment commander should at once order the same to be seized, and hold it subject to any legal proceedings that may be instituted by other parties. Persons caught in the act of stealing public property, or of making way with property recently stolen from the United States, are summarily arrested by the troops, and turned over to the civil authorities for trial. Quartermasters are authorized, when found expedient, after failure of ordinary means of recovery, to offer for recovery of any lost or stolen animal a reward of $25; and, in case of *stolen* animals, an additional reward of $25 for each thief arrested, tried, and convicted, and duly sentenced to punishment.

The clothes, arms, military outfits, and accouterments furnished by the United States to any soldier, cannot be sold, bartered, exchanged, pledged, loaned, or given away; and no person not a soldier, or duly authorized officer of the United States, who has possession of any such clothes, arms, military outfits, or accouterments, so furnished, and which have been the subjects of any such sale, barter, exchange, pledge, loan, or gift, can have any right, title, or interest therein; but the same may be seized and taken wherever found by any officer of the United States, civil or military, and should thereupon be delivered to any Quartermaster, or other officer authorized to receive the same. The possession of any such clothes, arms, military outfits, or accouterments by any person not a soldier or officer of the United States is presumptive evidence of such a sale, barter, exchange, pledge, loan, or gift.

PUDDLED STEEL.—A variety of steel, made in the puddling-furnace by a modification of the puddling process, as follows: Cast-iron contains from three to about five per cent. of carbon; ordinary steel contains from three-fourths to one per cent. of carbon: while wrought-iron contains but a trace. In the changing from the cast to wrought-iron in a puddling-furnace, the pig-metal passes through the condition of steel, that is to say, it is steel before it is wrought-iron. Now, making the puddled steel is simply stopping the common puddling process just at the moment when the decarbonizing mass under treatment is in the state of steel. Several modifications in furnaces and processes have been patented and various fluxes, especially manganese, are differently used by different manufacturers. See *Puddling* and *Steel*.

PUDDLING.—Although the process of puddling is susceptible of considerable modification according to the nature of the pig-metal employed and that of the iron which it is desired to produce, it may be generally stated to include the following operations: 1st. Melting down of the charge with or without the previous heating. 2d. Incorporation of oxidizing fluxes with the charge at a low heat. 3d. Elimination of carbon by stirring the contents of the furnace at a high temperature. 4th. Consolidation of the reduced iron to masses or balls fit for hammering.



The common puddling-furnace is of the reverberatory form, one in which the flame is made to pass over a bridge and then beat down again, or reverberate upon a hearth or surface on which the materials to be heated are placed. It is shown in the drawing, and consists of an oblong casing of iron plates firmly bound together by iron tie-bars, and lined with fire-brick. The fireplace, F, is separated from the hearth, A, by a *fire-bridge*, over which the heated products of combustion with a surplus of oxygen play upon the surface of the molten metal, effecting its conversion, and thence pass through the flue to a lofty chimney, C, in which is suspended a metal damper-plate, by which the draught can be regulated. The fireplace varies in depth with the nature of the fuel employed, being greatest with the hard kinds of coal.

The fire-grate is made of plain wrought-iron bars. A forced draught, produced by blowing air in below the grate is sometimes used. The surface of the grate should be between one-half and one-third of that of the bed or hearth. The charging or fire hole is about a foot above the grate. The bottom of the bed is formed of cast-iron hearth-plates resting upon cast-iron beams. The hearth is covered with cinders or sand, and is terminated at either end by a straight wall or bridge, called respectively the *fire-bridge* and the *flue-bridge*. The roof of the furnace is curved to a flat arch, and is generally made to slope at a small angle towards the flue, which slopes towards the stack. The sectional area of the flue varies with the nature of the fuel, being larger for soft coal. The main working-door is made of brick set in a cast-iron frame; it may be readily lifted and lowered by means of a lever. It is only opened during the introduction of the charge and the removal of the puddled balls. The sill of the door is about a foot above the level of the bed. There is sometimes a second working-door near the flue for introducing the cast-iron, so that it may soften slowly till it be ready for drawing towards the bridge. A small rectangular or arched notch, called the stopper-hole, is cut out of the lower edge of the door for the introduction of the tool used in stirring the metal, and through which the workman can observe the state of the furnace. It may be closed air-tight. The tap-hole, through which the slag, or tap-cinder, is withdrawn from the hearth, is placed below the door-sill. It is plugged up with sand. A portion of the cinder also overflows the flue-bridge, and runs down the inclined surface of the flue to the bottom of the stack, *h*.

When charging the furnace, pieces of metal are successively introduced with a long shovel, and laid one over another on the sides of the hearth in the form of piles rising to the roof, the middle being left open for puddling the metal as it is successively fused. The piles are kept separate, to give free circulation of air round the metal. The working-door of the furnace is now closed, fuel is laid on the grate, and the mouth of the fireplace is filled up with coal; at the same time the damper is entirely opened. In puddling refined metal, or in dry puddling, the furnace is charged with metal alone; but in puddling gray metal—that is, in wet puddling, or boiling, as it is termed—*forge-cinder* is charged along with the metal, and the temperature rises much higher. See *Iron*.

PUGILISM.—The art of defending one's self or attacking others with the weapons which nature has bestowed—viz., the fists and arms. The origin of boxing, or the use of the fists, is likely as old as man himself. We find numerous allusions to it in the classic authors. Pollux, the twin-brother of Castor, in the heathen mythology, was reckoned the first who obtained very great distinction by the use of his fists, conquering all who opposed him, and obtaining, with Hercules, a place among the gods for his sparring talents. The ancients were not, however, satisfied with the use of the weapons of nature, but increased their power by the addition of the cestus. With the ancients, pugilism was considered an essential part in the education of youth, and formed part of the course of training practiced in their gymnasia; it was valued as a means of strengthening the body and banishing fear; but it was practiced in public rather with a view to the exhibition of the power of endurance than for mere skillful self-defense. The earliest account we have of systematic boxing is in 1740, when public exhibitions of Professors of the Art attracted general attention. Up to this period, the science of self-defense had made but little progress, and strength and endurance constituted the only recommendations of the practitioners at Smithfield, Moorfield, and Southwark fair, which had long had booths and rings for the display of boxing. Broughton, who occupied the position of "Champion of England", built a theater in Hanway street, Oxford street, in 1740, for the display of boxing: advertisements were issued announcing a succession of battles between first-rate pugilists, who never quitted the stage till one or other was defeated, the reward of each man being dependent upon, and proportioned to, the receipts. Broughton was for 18 years Champion of England, and with him commences the first scientific era of pugilism. He propounded some rules for the regulation of the ring, and these remained in authority till 1838, when they were materially altered. To Broughton also is due the introduction of gloves for "sparring-matches," where lessons could be taken without injury. The greatest Professor of the Art was Jackson, who was Champion in 1795. He was not only the most scientific boxer of his day, but he gave his art such a prestige and popularity that half the men of rank and fashion of the period were proud to call themselves his pupils. He opened rooms for the practice of boxing in Bond street, and for years these were crowded by men of note. His "principles of pugilism" were, that contempt of danger and confidence in one's self were the first and best qualities of a pugilist; that in hitting, you must judge well your distances, for a blow delivered at all out of range, was like a spent shot, and valueless; that men should fight on most occasions with their legs, using all possible agility, as well as with their hands and that all stiffness of style and position was radically wrong. Jackson is still regarded by many as the best theorist on the "Noble Art," and since his time, it has received no essential improvement. Shaw, the Life-guardsman, who immortalized himself at Waterloo, was a pupil of his, and the prowess which he so brilliantly displayed on the occasion, was owing as much to his scientific training as to his great strength. At this period, pugilism was actively supported by many persons of high rank—the Dukes of York and Clarence, the Earls of Albemarle, Sefton, etc., Lords Byron, Craven, Pomfret. The art of boxing, as an active and healthy exercise, is likely to be maintained; and the display of science between two accomplished boxers is very interesting, while it is deprived of all the horrors of the prize-ring; the rapidity of the blows, the facility with which they are mostly guarded or avoided by moving the head and arms; the trial of skill and maneuver to gain a trifling advantage in position, all give a wonderful interest to the spectator, who can watch the perfection of the art devoid of the brutalities of the ring. The pugilists of the present day are mostly publicans; their friends and the patrons of the "fancy" meet at their houses for convivial evenings, sparring matches, ratting, and the like. It has constantly been urged in defense of pugilism that, were it abolished, the use of the knife would increase and Englishmen would lose their present manly system of self-defense. This may be true, if the use of the fist in self-defense depended on the mercenary exhibition of pugilistic encounters, which, however, is mere assumption.

PULFORD MAGNETIC PAINT.—A paint now universally used instead of anti-corrosion paint for lacquering iron ordnance and projectiles. It is an oxide of iron. This paint is called "magnetic" from the property of being attracted by a magnet.

PULK. A term chiefly used in Russia to denote a tribe or a particular body of men; as, a pulk of Cossacks.

PULLEY.—One of the mechanical powers, consisting usually of a wheel with a groove cut all round its circumference, and movable on an axis: the wheel, which is commonly called a *sheave*, is often placed inside a hollow oblong mass of wood called a *block*, and to the sides of this block the extremities of the sheave's axle are fixed for support; the cord which passes over the circumference of the sheave is called the *tackle*. Pulleys may be used either singly or in combination; in the former case, they are either *fixed* or *movable*. The *fixed pulley* gives no mechanical advantage; it merely changes the direction in which a force would naturally be applied to one more convenient. The *single movable pulley*, with parallel cords, gives a mechanical advantage = 2, for a little consideration will show that as the weight, W, is supported by the two strings, the strain on each string is $\frac{1}{2}$W, and the strain on the one being supported by the hook, the power, P, requires merely to support the strain on the other string. The fixed pulley, is only of service in changing the naturally upward direction of the power into a downward one. If the strings in the single movable pulley are not parallel, there is a diminution of mechanical advantage —*i. e.*, P must be more than half of W to produce on exact counterpoise; if the angle made by the strings is 120°, P must be equal to W; and if the angle be greater than this, there is a great mechanical disadvantage, or P must be greater than W. The following are examples of different combinations of pulleys, generally known as the first, second, and third systems of pulleys. In the first system, one end of each cord is fastened

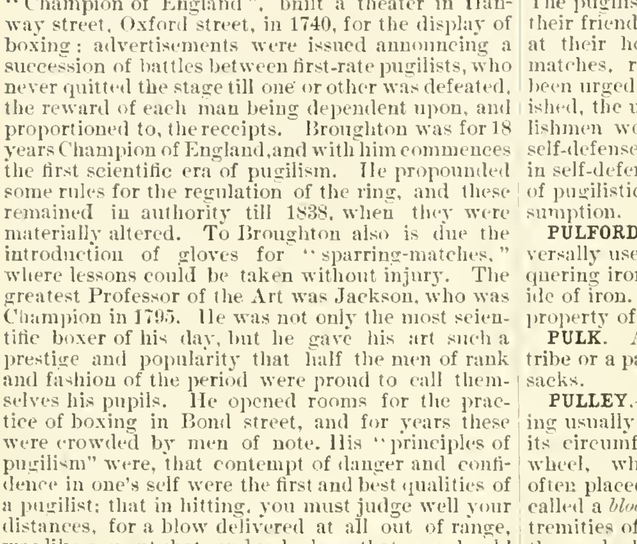
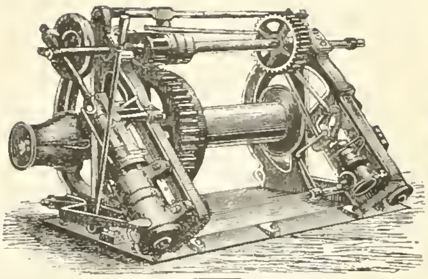


Fig. 1.



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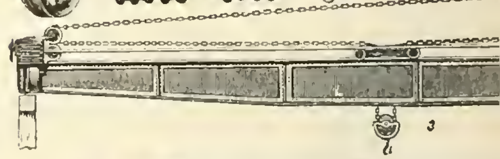

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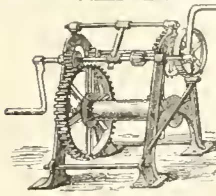

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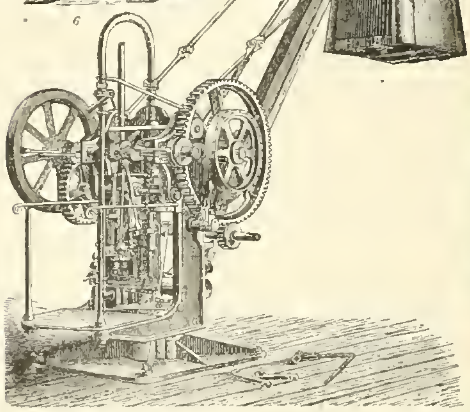

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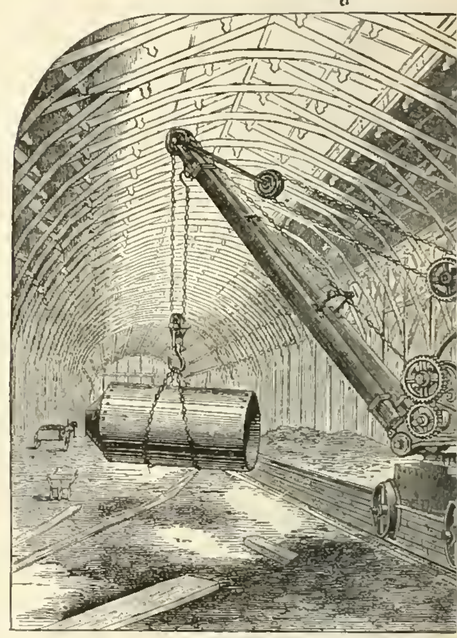

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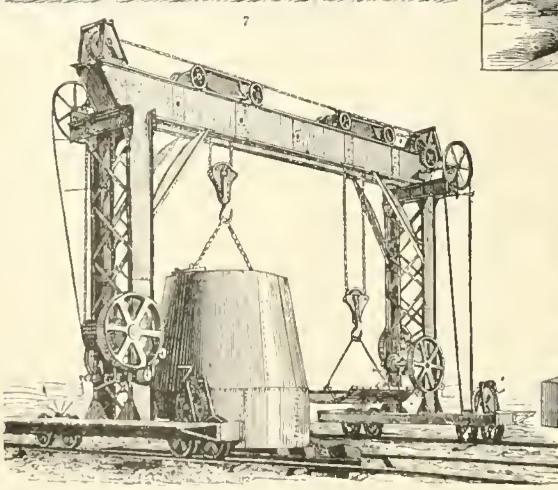

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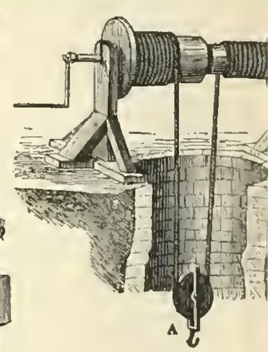

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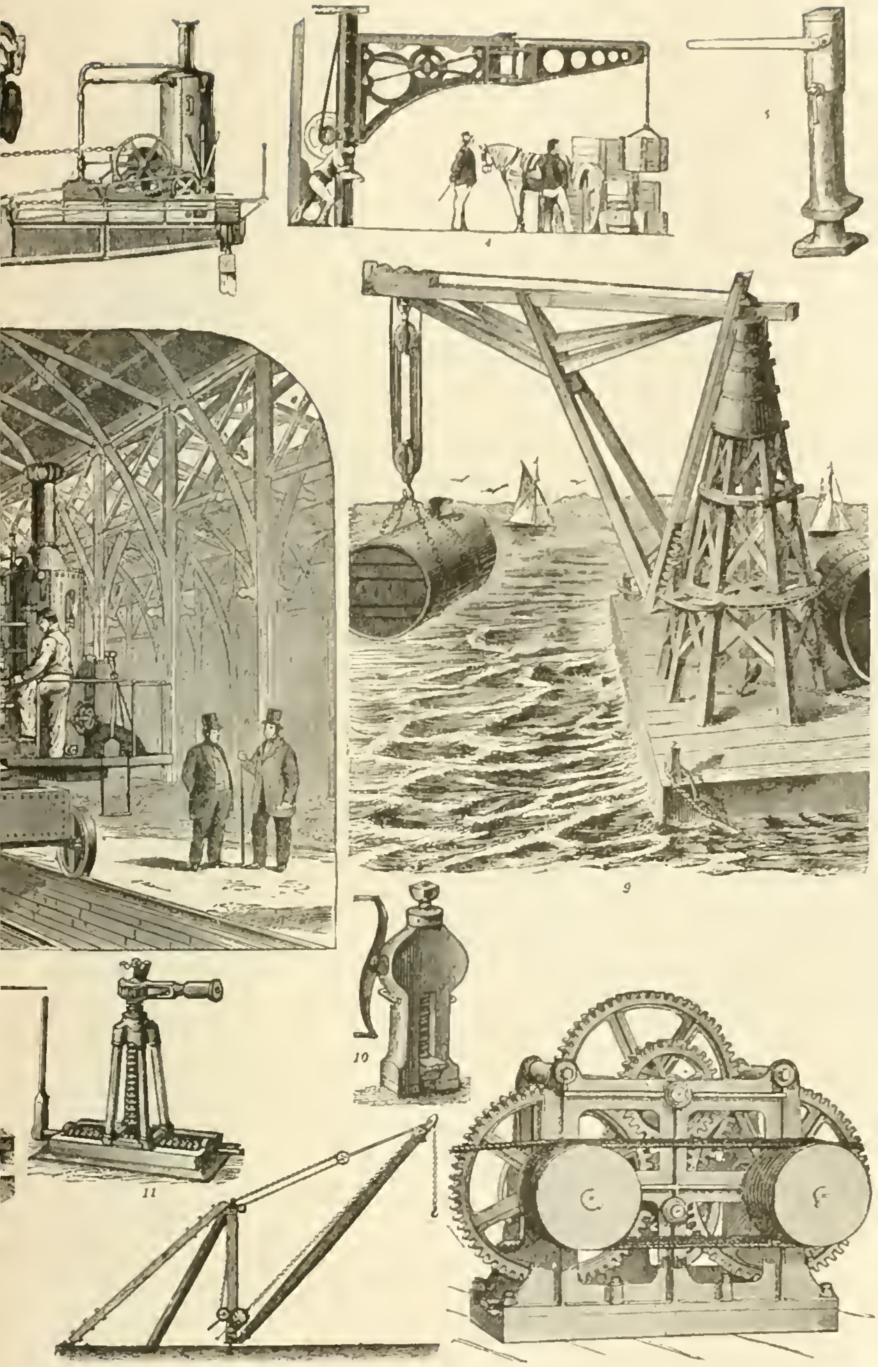
PULLEY, etc. 1. Steam winch. 2. Compound pulleys. 3, 12. Movable cranes. 4. Jointed crane. 5. Hyd
toothed jack. 11. Jack-screw. 12. Movable double compound crane. 13. Compound pulley. 14. Pull

XII—270.



ek. 6. Winch. 7. Stationary steam-crane. 8. Transportable steam-crane. 9. Sea-crane. 10. Cog-
indlass. 15. Platform crane. 16. Friction windlass.

to a fixed support above; each cord descends, passes round a pulley (to the lowest of which the weight W is fastened), and is fastened to the block of the next pulley, with the exception of the last cord, which passes round a fixed pulley above, and is attached to the counterpoise, P. The tension of a string being the same in all its parts, the tension of every part of the string, over two pulleys, is that which is produced by the weight of P, consequently, as the last movable pulley is supported on both sides by a string having a tension P, the tension applied in its support is 2P. The tension of the string is therefore 2P, and the second movable pulley is supported by a force equal to 4P. It may similarly be shown that the force applied by the strings in support of the last or fourth pulley (which is attached to W) is 8P. Hence we see, that according to this arrangement, 1 lb. can support 4lbs., if two movable pulleys are used; 8lbs., if there are 3 movable pulleys; 16 lbs., if there are 4 movable pulleys; and if there are *n* movable pulleys, 1lb can support 2^n lbs. It must be noticed, however, that in practice, the weight of the cords, and of the pulleys, and the friction of the cord on the pulleys, must be allowed for; and the fact that in this system all of these resist the action of the power P, and that to a large extent, has rendered it of little use in practice.—The second system is much inferior in producing a mechanical advantage, but it is found to be much more convenient in general practice, and is conveniently modified according to the purpose for which it is intended to be used. In this system, one string passes round all the pulleys, and as the tension in every part of it is that produced by the weight of P, the whole force applied to elevate the lower block with its attached weight, W, is the weight P multiplied by the number of strings attached to the lower block; the pulleys in the upper block being only of use in changing the direction of the pulling force. This system is the one in common use in mechanical maneuvers in dockyards and on board ship, and various modifications of it—such as White's pulley, Smeaton's pulley, etc., have been introduced; but the simpler forms have been found to answer best.—The third system is merely the first system inverted, and it is a little more powerful, besides having the weight of the pulleys to support the power, instead of acting in opposition to it, as in the former case. By this time, it will have been evident to the reader that the mechanical advantage is not produced by the pulleys, but by the strings, and that the pulleys are merely useful in keeping the strings in a certain position, changing with as little friction as possible the direction of the pull, and affording a convenient means of attaching the weight. Theoretically, the larger the number of movable pulleys in one combination, the greater is the mechanical advantage afforded; but the enormous friction produced, and the want of perfect flexibility in the ropes, prevent any great increase in the number of pulleys. In Fig. 1, we illustrate the pulleys counterpoised, and the manner of employing them in the mechanical maneuvers. 1. Fixed pulley, power and weight equal. 2. One fixed and one movable pulley, power and weight, 1 : 2. 3. One fixed and two movable pulleys, power and weight, 1 : 2 and 1 : 4. 4. One fixed block of three pulleys of different sizes, and one movable pulley of same character, power and weight, 1 : 6. 5. One fixed block with four pulleys of same size, and one movable of same kind, power and weight, 1 : 8. 6. Wheel and axle, three radii in proportion of 1, 2, and 4. 7. Capstan, cord attached to first system of pulleys.

Pulleys without blocks or carriers are properly *sheaves* or *pulley-wheels*, which are mounted in various ways, according to the purpose for which they are designed. The simplest form is that of a wheel with a nearly flat face, over which a band passes. This is the common machine-pulley used on shafting, which is ordinarily supported by hangers from the ceiling of the shop. Couplings and hangers are carefully arranged in all arsenals and armories. Pulleys so mounted are; *Fast*, being firmly attached to their shaft, from which they receive, or to which they communicate, motion; *Loose*, running free on the shaft, to receive the belt and allow it still to traverse without being affected by, or affecting the motion of. the shafting; *Speed*, having a number of faces or grooves of different diameter, so as to communicate varying speeds with a given rate of motion of the belt or cord. This is common in lathes and analogous machines, and is sometimes called a *cone*-pulley. Fig. 2 shows an improved loose pulley, at present used on most machines, with the advantage of saving the wear of pulley, shaft, and belt. The loose pulley is one inch less diameter

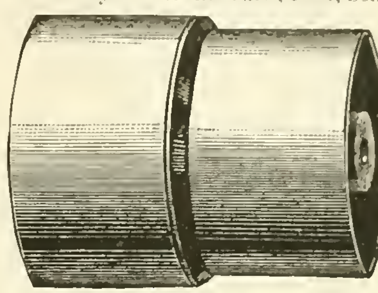


Fig. 2.

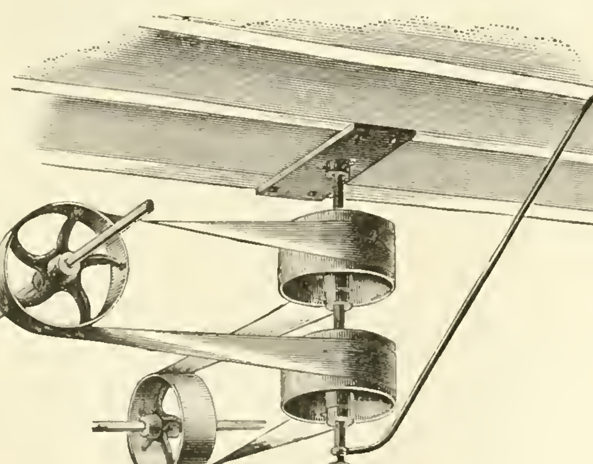


Fig. 3.

than the tight pulley, and thus relieves the tight tension of belt when running idle. A bevel flange connects the pulley faces, and the belt ships with perfect ease. In Fig. 3 is shown what is known as the *mule* pulley, a most useful combination for the general work of the arsenal. Lines of shafting in the same plane, but at an angle, one to the other, to run quickly and noiselessly, should be driven by a belt running over mule pulleys, on a shaft stepped and stayed as shown in Fig. 3. If the mule pulleys are not too small, and if they have long hubs, they will run with little friction and wear. For the sake of an adjustment which is required only in special cases, mule pulleys are commonly placed on expensive arrangements of castings, which, through not permitting the use of pulleys sufficiently large, and through not being properly stayed, cause much trouble and loss of power. These disadvantages are obviated by the arrangement shown in the drawing. The following table gives the weight, principal dimensions, etc., of pulley-blocks, complete, as used in the more common mechanical maneuvers. See *Blocks*, *Mechanical Maneuvers*, *Rope*, and *Tackles*.

PULL-OFF.—In musketry, the test applied to the trigger of all small-arms. The test is regulated so as to require a mean weight of about 7 lbs. to be applied to the finger-piece of the trigger, in order to release the sear-nose from the top-bent; this result is obtained only when the lock and trigger are perfectly clean and free from dried-up oil, or other matter causing obstruction to the free working of the various parts. As a rule, the pull-off of the small-arms in use will be found to be influenced mainly by the condition of cleanliness of the lock and trigger. Should the lock, after having been thoroughly cleaned and oiled, be found to pull-off either light or heavy, *i.e.* below 6 lbs. or above 8 lbs., it may easily be regulated by squaring the sear-nose and top-bent in the tumbler, care being taken to preserve the same angles.

PULSOMETER.—A steam pump of considerable military importance, which requires but little steam for its operation. When the water has been displaced by the steam which follows the water through the opening to the discharge chamber, it will suddenly condense by passing under the water, and the vacuum thereby formed will cause the steam ball to change, shut off the steam, and transmit the pressure to the opposite cylinder, and at the same time induce the water to fill the chamber in place of the condensed steam. Thus will they alternate, keeping up very nearly a continuous stream, as long as there is steam supplied and water to be pumped.

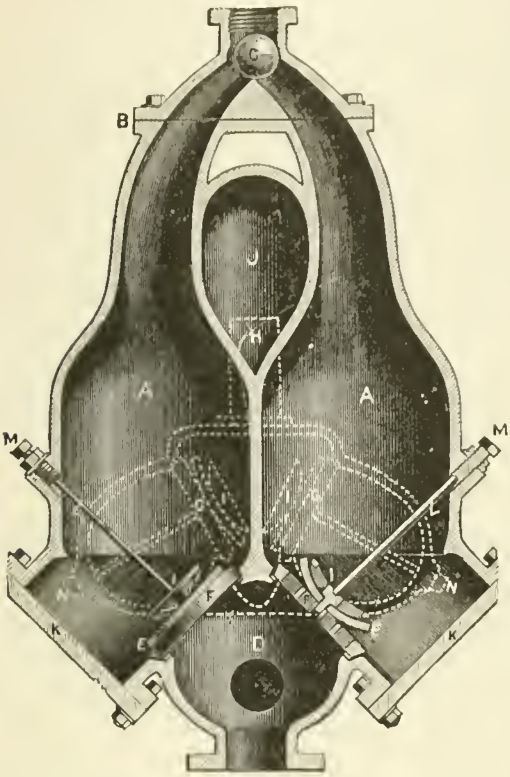
	Kind of blocks.											
	1 sheave.		2 sheaves.		3 sheaves.				4 sheaves.			
Weight of block, complete, pounds	35	30	38	80	100	134	191	201	120	165	226	270
Total length of block over all, inches	22.5	19.5	19.5	25.5	25.5	26	32	31.5	25.5	26	32	31.5
Total width of block over all, inches	8	7.5	7.5	8	8	9	10	12	8	9	10	12
Total depth of block over all, inches	4	3.5	5.25	7	9	10.5	11	11.5	11	13	13.75	14
Greatest diameter of sheaves, inches	8	6.375	6.375	7.25	7.25	7	9	10	7.25	7	9	10
Largest rope used with block, inches	4.75	3.25	3.25	4.75	4.75	6.25	6.25	6.25	4.75	6.25	6.25	6 25

PULLING-JACK.—A variety of *jack* much employed for artillery purposes. To use it, screw one end to some fixed object (that end nearer the pump is preferable); unscrew the valve in the pump by two or three turns with the key, and stretch the jack apart; attach the free end of it to the object to be moved; shut the valve by screwing back the two or three turns that were unscrewed; attach the long lever and pump away at it until the object is moved as desired. When there is not room for the long lever, the pump can be worked by the short lever. If the jack does not start at once, slack the screw in the cylinder close to the pump (which the same key fits) until a drop or two of the fluid comes out; as soon as this occurs, turn the screw immediately back. If the piston or ram will not run out to its entire length or stroke, place the jack in a horizontal position, take out the screw at each end of the cylinder, and fill through both holes with the usual liquid.

The pulling-jack can be used to pull or lift at any angle between the horizontal and the perpendicular, but the direction of its force must be in a straight line, and the force pump always at the lower end when the jack is used in any other way than horizontally. When the pulling-jack is in use, the lever joints must be well oiled and kept free from dirt; when not in use, the piston-rod must be kept in; and when hung up, the end where the pump is must always be downward.

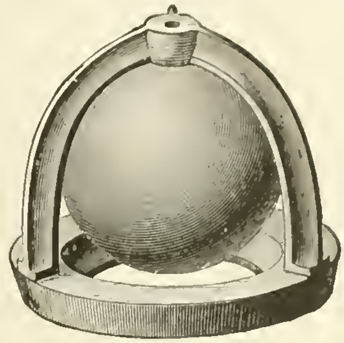
No greater force than that of one man (provided he applies a power of about 150 pounds) need ever be applied to the lever of either the lifting or the pulling-jack, since that force is amply sufficient to work the jack to its full capacity. See *Hydraulic Jack*.

The machine, a section of which is shown in the drawing, consists principally of two bottle-shaped chambers, A, A, joined together side by side, with tapering necks bent towards each other, to which is attached, by means of a flange-joint, B, a continuou passage from each cylinder leading to one common upright passage, into which a small ball, C, is fitted so as to oscillate with a slight rolling motion between seats formed in the junction. These chambers also connect by means of openings with the vertical induction passage, D, which openings are so formed that the valves, E, E, consisting of pure vulcanized rubber, and their seats, F, F, constructed so as to sustain the valves, may be easily inserted. The delivery passage, H, which is common to both chambers, is also constructed so that in the openings that communicate with each cylinder are placed valve-seats, G, G, fitted for the reception of the same style of valves as in the induction passage. I, I, are valve-guards to prevent the valves from opening too far. To facilitate the ready removal of the valves and valve-seats, it will be observed the flanges that cover the openings are slotted to receive the bolts, the nuts of which being loosened they are readily removed and the covers displaced. J, represents the vacuum chamber, cast with and between the necks of chambers A, A, and connects only with the induction passage below the valves E, E. K, K, are flanges covering the openings to the respective chambers, which may be removed for the repair or renewal of valves and seats, when necessary. Vent plugs are inserted into these flanges, for the purpose of drawing off the water to prevent freezing. L, L, are rods extending from the valve-guards to the set-screws M, M, by which the suction seats, valves and guards are tightly pressed to place. N, N, are brass socket-headed bolts by which the discharge seats, valves and guards are drawn down to place. A small brass air check-valve is screwed into the neck of each chamber, A, A, and one into the vacuum chamber



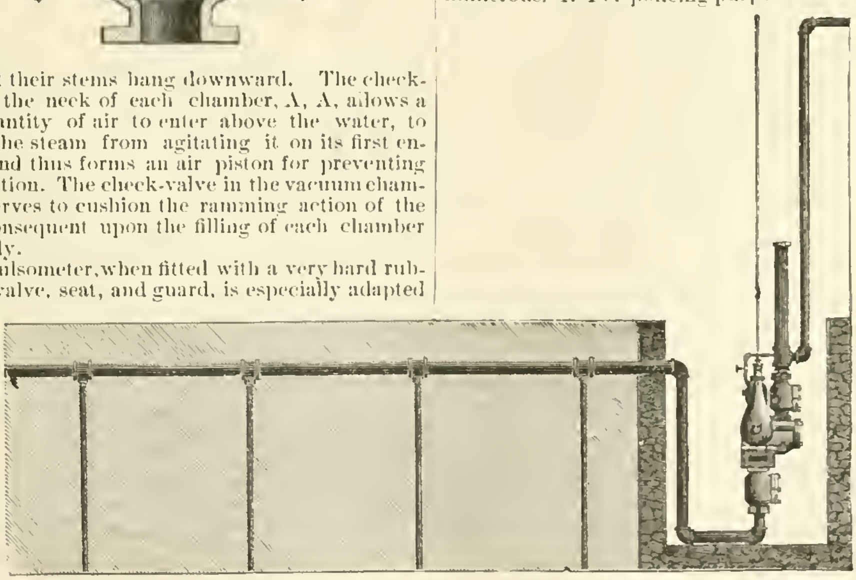
J, so that their stems hang downward. The check-valve in the neck of each chamber, A, A, allows a small quantity of air to enter above the water, to prevent the steam from agitating it on its first entrance, and thus forms an air piston for preventing condensation. The check-valve in the vacuum chamber, J, serves to cushion the ramming action of the water consequent upon the filling of each chamber alternately.

The pulsometer, when fitted with a very hard rubber ball valve, seat, and guard, is especially adapted to coffer-dam work, sinking wells, sewers, excavations, foundations, etc., where all the water to be pumped contains more or less sand, gravel, mud, and other sediment that would clog the grid valve seat and disc valve usually used in the pumps. A pulsometer, 3-inch suction (10 feet), and 3-inch discharge will readily raise water 50 feet out of a well. A branch from the discharge pipe leads into a hogshead or tank, and supplies water to charge the pump before turning on steam to start it, and for furnishing water to the injector for feeding the boiler. The leading of a pipe from a reservoir or water pipe to the middle chamber of the pump for charging will be found very convenient in other situations, especially where the pump is liable to loose its charge from sediment getting under the valves. The chief point to be observed in working the pulsometer on artesian wells is to select a size pump that the well will supply with water. If not a flowing well, a pump of smaller suction than the pipe in the well should be applied. One raising 300 gallons per minute will fail to work on a well giving but 100 gal-

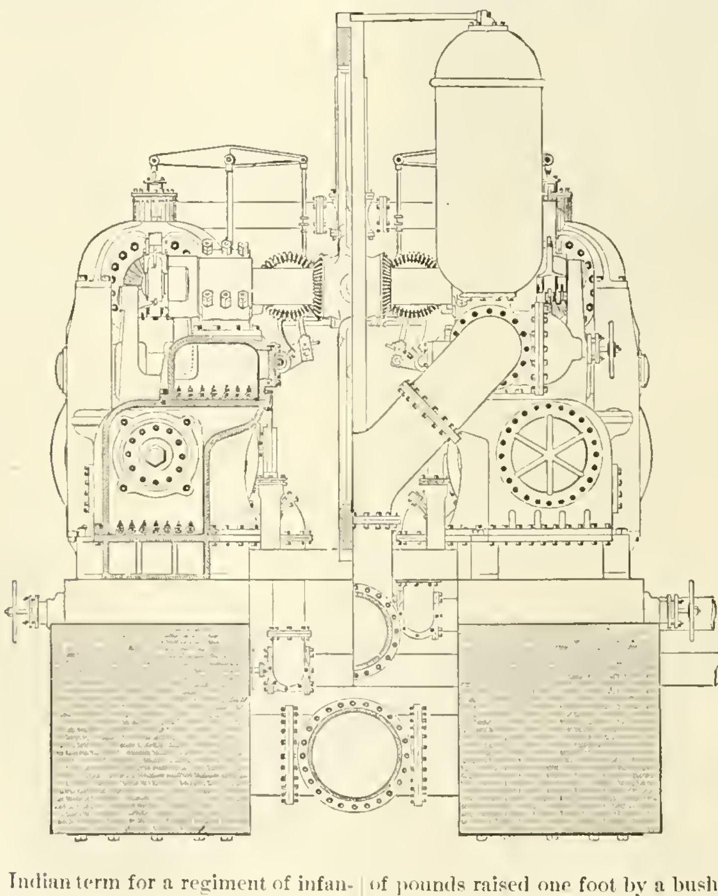


lons. A No. 5 (175 gallons per minute) usually requires a chain of at least five two-inch pipes, connected with a three or four inch main to supply it with water. In cases where the water does not raise to within ten feet of the surface, it will be found advantageous to lower the pump a little in order to obtain the water freely. If the pump is found to be large at times, the remedy may be had by making a connection from the discharge pipe back into the pump and regulated by a globe valve as shown in the above drawing.

The remaining applications of the pulsometer are numerous: 1. For policing purposes and as a fire ex-



tinguisher, it has no equal. The absence of all machinery, its simple arrangement of valves, the easy manner in which they can be replaced without skilled labor, their inability to clog from sediment, and the certainty in which it can be started marks a strong contrast to the ordinary donkey pump. 2. As a pumping engine in garrisons, to be on hand at short notice for pumping out flooded casemates, cellars, excavations, wells, and other inundated places. The pump can be detached from the carriage and lowered to places too low down for suction from the engine, steam being carried to it from the boiler through flexible steam-hose. 3. As a mine pump, there being no exhaust steam to dispose of. It is especially adapted for lifting water from one level to another. For use underground in mines, collieries, etc., where lifts do not exceed 60 to 90 feet, its use has been fully proved. For a greater height one can be used above another. 4. For filling water tanks in foundries, etc., it is very handy, and may be so located as to fill the tanks directly from a contiguous pond, stream, or well, by using the steam from the working engines. By having a flexible steam connection ready for instant application, it would do away with the necessity of water tanks, separate boiler, and the expenses of a special engineer. 5. As an irrigating pump for post and company gardens, its simplicity, strength, durability efficiency and economy are all in its favor. 6. For filling tanks on buildings, for use with elevators, or in case of fire. The pipe leading down from upper tank has hose connections on each floor, from which a hose should be connected and ready to run out to extinguish a fire within a few seconds from time of discovery, and long before an alarm could be made to the department. Hose connections are also made from discharge pipe of pump on the upper floors.



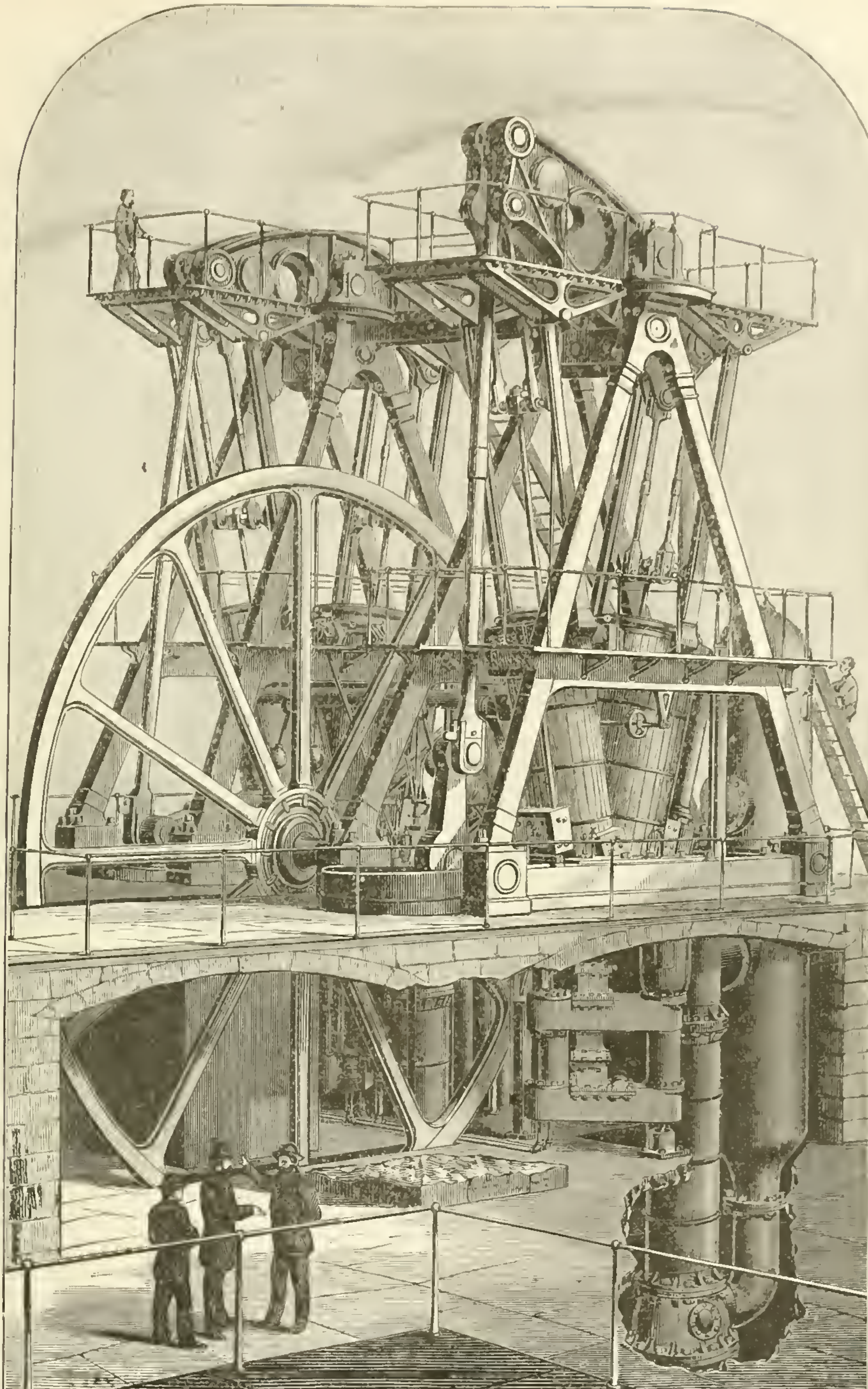
PULTUN.—An Indian term for a regiment of infantry.

PULVERMASSEN. The German name for a kind of baldrick with wooden powder-tubes.

PUMICE.—A mineral found in volcanic countries generally with obsidian and porphyries. In chemical composition, it agrees with obsidian, of which it may be regarded as a peculiar form, rapidly cooled from a melted and boiling state. It is of a white or gray color, more rarely yellow, brown, or black; but so vesicular, that in mass it is lighter than water, and swims in it. The vesicles, or cells, are often of a much elongated shape. Pumice often exhibits more or less of a filamentous structure, and it is said to be most filamentous when silica is most abundant in its composition. It is very hard and very brittle. It is much used in arsenals for polishing wood, metals, lithographic stones, etc., and in the preparation of vellum, parchment, and some kinds of leather.

PUMMEL.—The hilt of a sword, the end of a gun, etc.

PUMPING-ENGINE.—An engine especially designed for pumping, and much used for military purposes. A pump may be driven by an ordinary steam-engine which also drives other machinery, but in the pumping-engine the pump and steam-engine are inseparably connected, and are confined to the act of pumping. There are a good many small machines of this kind which only pump, but they are not commonly called pumping-engines, that term being applied only to large works. The first steam-engines were pumping-engines; that of Newcomen, which was driven by atmospheric pressure (steam being used only to create a vacuum), and Watt's, and the Cornish engine, which used steam as the motive power. There has been much improvement in the duty of pumping-engines since the Newcomen engine. Estimating the work done by the number of pounds raised one foot by a bushel of Welsh coal (94 lbs.), the following notes show the improvement which has been made: Newcomen engine (1769), 5,500 000; the same improved by Smeaton (1772), 9,500,000. Watt's engine (1778 to 1815), 20,000,000. Cornish engine (1820), 28,000,000; the same (1826), 30,-



THE LEAVITT PUMPING-ENGINE

BUILT BY

I. P. MORRIS & CO.,

PORT RICHMOND IRON WORKS, PHILADELPHIA.

000,000; same (1828), 37,000,000; same (1829), 41,000,000; same (1839), 54,000,000; same (1850), 60,000,000. Consolidated mines, highest duty (1827), 67,000,000. Fowey consols, Cornwall, highest duty (1834), 97,000,000. United mines, highest duty (1842), 108,000,000. Among the largest pumping-engines in the world are the three which were employed in the drainage of Haarlem Lake in Holland. Each engine worked several pumps, and had an average duty of 75,000,000 lbs., raised one foot by 94 lbs. of Welsh coal. One of these engines is described as follows: two steam cylinders are placed concentrically, the diameters being 144½ and 84¼ inches. They are united at the bottom, but there is a space of nearly 1½ in. between the inner cylinder and the top. The areas of the pistons are as 1 to 2.85, and are connected to a common cross-head or cap by one principal and four small piston-rods. This engine works 11 pumps, each of 63 in. (5¼ ft.) diameter. The measured delivery of all the 11 pnmps at each stroke is 63 tons. The steam is cut off in the small cylinders at from one-quarter to two-thirds the stroke, and after expanding through the remainder it is further expanded in the large cylinder.

The drawing shows in section the horizontal compound-cylinder pumping-engines, of the type designed by Mr. H. F. Gaskill, an American. The novel featnre by which this type of engine is distinguished is the location of the high-pressure cylinder on the top of the low-pressure cylinder, giving short steam commnnication. This arrangement requires the pistons in the two cylinders to move in opposite directions. These are connected with each other, and the pressure of steam upon them is transmitted to the plunger of the pump in the following manner: The latter is set in line with the low-pressure cylinder, and so receives the thrust produced by the pressure in that cylinder directly. The low-pressure piston is provided with two rods, which are extended to the length of ten feet to the cross-head by which they are connected to the rod of the pump plnnger. Midway in their length, another cross-head is secured upon them, which runs on a gnide. The rod from the high-pressure piston is keyed into a cross-head corresponding to this. The connection between these cross-heads is made by means of a short vertical beam and connecting links, through which also the force exerted in the high-pressure cylinder is transmitted. A shaft carrying a fly-wheel revolves in bearings which are set upon the delivery chambers of the two pumps. The two engines are connected through this shaft by means of cranks set on either end of it, at right angles with each other, and connecting rods from these cranks to the upper ends of the beams. The cranks determine the length of the stroke, control the movements of the pistons and plungers, maintaining those of the two engines and pumps in a constant relation with each other, and give motion to the valve gear. The steam is admitted to the high-pressure cylinders by double-seated poppet-valves. A cut-off mechanism is introduced into the motion of these valves, which is adjustable to cut the steam off at any point in the length of the stroke. The point of cut-off may be fixed by hand, or by the action of the governor when the latter is thrown into gear. The governor is constructed to be operated by changes in the pressure of water in the delivery main, and acts to correct these changes by varying the point of cut-off, and thus the speed of the engine, in accordance with the variations in the demand for water. The communicating valves between the high and low pressure cylinders and the exhaust valves are gridiron slides.

The engraving on the preceding page gives a perspective view of a pumping-engine, having a remarkable capacity and duty, built by the I. P. Morris Company, Philadelphia. It is a compound beam engine, the steam cylinders of which are inclined outwardly at the top to connect with opposite ends of the working beam. The cylinders are jacketed on the sides and heads, steam of boiler pressure being used in the jacket of the high pressure cylinder, and steam of a reduced pressure in the other jacket. The drainage from these jackets is ordinarily returned directly to the boilers. The steam and exhaust valves are gridiron slides giving large openings with small movements. The valves are actuated by cams, which are driven by gearing from the crank-shaft, and a centrifugal governor adjusts the cams, operating the steam valves of the high pressure cylinder so as to vary the point of cut-off and maintain a constant engine speed. The pnmp is driven by a connecting rod attached to one end of the working beam. The pump consists of a plunger, to which is attached a bucket with valve opening upward. There are seven receiving valves, and four delivery valves, in addition to the valve in the bucket, the water being discharged from the pump through two delivery pipes, above and below the bucket respectively. The pnmp valves consist of loaded rubber discs with central guiding stems. The original valves were of metal, double beat, and the introdnction of tbe present form has greatly increased the pnmp's efficiency.

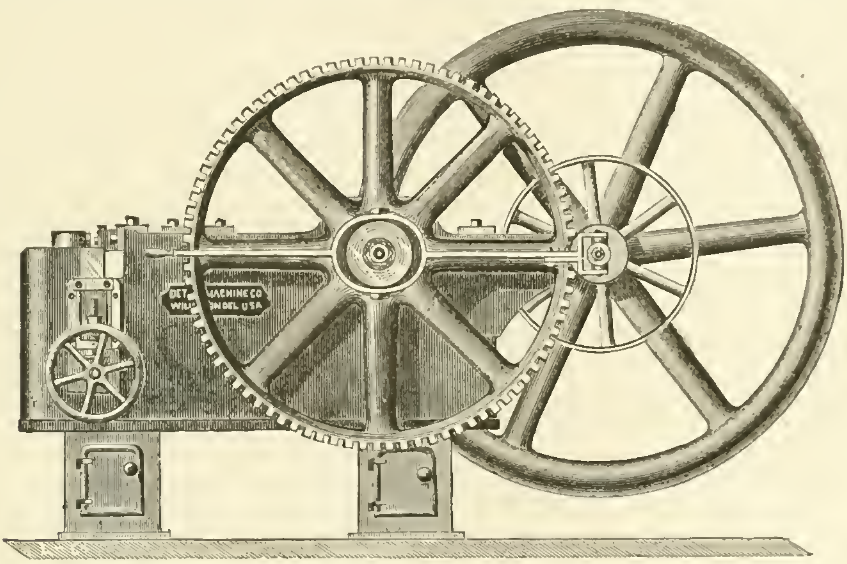
The following are the results of the *duty trial* of this engine:

Pounds of wood used to start fires, 400. Pounds of coal put into furnaces, 3,500. Pounds of coal withdrawn from furnaces at end of trial, 27. Ponnds of coal wholly consumed $(400 \times 0.4 + 3{,}500 - 27) = 3{,}633$. Pressure on main by gauge (lbs. per sq. inch), 64. Water level in well below gauge (ft.), 29.05. Water pressure (lbs. per sq. in.), $29.05 \times 0.433 + 64 = 76.6$. Area of pump bucket (sq. in.), 536.0465. Revolutions of engine, 12,337. Dnty of engine, (ft-lbs., per 100 lbs. of coal),

$$= \frac{536.0465 \times 8 \times 12{,}337 \times 76.6 \times 100}{3{,}633} = 111{,}548{,}925.$$

PUNCHING.—When any heavy beam of wrought-iron—one, say, twelve or fourteen inches square—is struck by a heavy shot at high velocity, the beam snaps short off, as though it were cast-iron. The same shot, striking a wrought-iron plate backed in the usual manner of armor, penetrates or perforates it in a manner similar to the action of a hand-punch on a sheet of iron laid on a block of wood. The effect is entirely local; the hole is made without bending or twisting the plate in one case, or the sheet in the other. The same projectile, propelled with a low velocity, will bend the beam and produce the ordinary fracture of wrought-iron, and in case of the plate, the latter will be distorted, strained, and loosened from its fastenings. A simple way of explaining these phenomena is as follows: In the case of the high velocity the effect is wholly *local*, because the surrounding material has not *time* to propagate the vibration of impact throughout the mass. In other words, the cohesion of the material is not sufficient, in the time allowed, to overcome the inertia of the surrounding mass. The *distribution* of the effect in the other case is due to the low velocity, wherein a certain length of *time* is consumed in accomplishing the blow. During this interval, all surrounding particles of iron have time to sustain the point struck; the force of the blow is thus spread over a large surface, and the cohesion of the particles is undisturbed, since each particle is enabled to contribute the force of its attraction towards uniting the whole. These two distinct effects are called, respectively, *punching* and *racking*. The work done by a shot is represented by its weight multiplied by the square of its velocity at the moment of impact; from which it will be seen that a small projectile moving with great velocity is capable of doing the same amount of work as a large projectile with low velocity. The *character* of the work is, however, as above explained, entirely different. In case of a given projectile, whatever power is employed in racking the side of the vessel does nothing towards penetration, and *vice versa*.

The theory in favor of punching is, that the vital parts of the vessel and the active enemy within—the men, guns, and machinery—are reached at once. A projectile piercing the armor of a vessel carries with it portions of the broken plate, which, together with bolts, nuts, and fragments of wood from the backing, form a species of *langrage*, the effect of which is not less to be feared on a crowded deck, or in a turret, than the explosion of the most formidable shell. But to produce this result the projectile must penetrate entirely through. A projectile moving with a punching velocity has only local effect, penetrating without racking the armor. If it goes but partly through, it does no damage either to the ship or to the enemy within. Therefore, whether from the greatness of range, the thickness of the armor, or want of power in the gun, entire perforation cannot be effected, it is only a waste of ammunition to use it in simply indenting armor. Although a spherical projectile may have, upon starting, greater velocity than a rifle projectile of equal caliber, and consequently may have greater punching power stored up in it at this part of its flight, nevertheless, owing to its greater cross-sectional area, in proportion to its weight, it will lose its velocity more rapidly, and the rifle projectile will soon overtake it in its flight and go far beyond



it in range. At the distances that iron-clads usually engage land batteries, smooth-bore projectiles would possess no punching power; therefore for this kind of work rifles are the only suitable armament for such batteries. They should be powerful enough to do the work effectually. When heavy enough for this, all additional weight is rather a detriment than an advantage, from the fact that light guns are less cumbersome, can be fired more rapidly, are more easily replaced, when disabled, and less costly in ammunition. They likewise stand greater relative charges and yield higher velocities with safety. The 8-inch rifle, carrying a projectile 185 pounds in weight, fired with a charge of 35 pounds hexagonal powder, is the minimum caliber that can be successfully used against the present style of sea-going iron-clads. See *Racking*.

PUNCHING-MACHINE.—The enormous development of our iron manufactures has necessitated the use of machine tools in the place of those made for the hand, and none of the very ingenious inventions for this purpose have played a much more important part than the *punching-machines*, for without them the labor of drilling holes in iron plates for such objects as armor-plates, steam-boilers, iron-ships, bridges, and other great works, would have been so great as to have effectually prevented them from being undertaken. The punching-machine invented by Messrs. Roberts and Nasmyth, with recent modifications and improvements, is in very general use in all our great engineering works and arsenals; its essential parts are the punch, lever, and the spring. The punch is simply a piece of tough, hard steel of a cylindrical form, and of the size of the intended holes; it fits into a socket, which is suspended over a fixed iron plate or bench, which has a hole exactly under the punch, and exactly fitting it. In the socket which holds the punch is a coiled iron spring, which holds up the punch, and allows it to descend when the power is applied, and returns it when the pressure is relieved. The lever, when in action, presses on the top of the punch, and the plate of metal which is to be perforated being placed on the iron bench, receives the pressure of the punch with sufficient force to press out a disk of metal exactly the diameter of the punch, which falls through the hole in the iron bench. The lever is moved by a cam on a very powerful wheel, which presses upon it until it can pass; then the lever being relieved, the punch is drawn up by the spring in its socket, ready to receive the action of the cam when the revolution of the wheel again brings it to bear on the lever. The punch itself is always solid, differing entirely in this respect from the hand-tools. This useful machine will perforate thick plates of iron, such as are used for ship-building, almost as quickly as a workman with an ordinary hand-punch could perforate thin plates of tin; the holes made are quite true, and are ready to receive the rivets. The drawing represents the improved machine, having sufficient power to punch an inch hole through half inch iron; it is driven by an eccentric and sliding box, giving $1\frac{3}{4}$ in. movement to the punch bar; it has a clutch on the eccentric shaft for stopping it without shifting the belt.

There are both fast and loose pulleys on the driving shaft, so that the countershaft is not needed. The weight of the machine is 6,850 pounds.

PUNCTO.—A term applied to the point in fencing.

PUNIC WARS.—The name commonly given to the three great wars waged for supremacy between Rome and Carthage. The Latin word *punicus*, or *pœnicus*, was the name given by the Romans to the Carthaginians, in allusion to their Phenician descent. The Romans, who believed, not without reason, that the Carthaginians never sincerely meant to keep any treaty of peace, employed the phrase *punica fides*, "Punic faith," to denote a false and faithless spirit.

PUNISHMENTS.—Sentences awarded by Courts-Martial or Commanding Officers for crimes committed by officers or soldiers. They are detailed in the Articles of War. They consist of death by hanging or shooting, according to the offense, and of flogging. These are the punishments for the most aggravated and flagrant form of offenses. The minor punishments include imprisonment, loss of good-conduct stripes, degradation of rank, loss of appointments, extra drill, stoppage of pay, and confinement to barracks. An officer can be sentenced by General Court-Martial to death (in time of war), cashiering, or dismissal from the service, according to the crime he is guilty of. In the British service, military punishments include death by shooting, if for any offense against discipline—or by hanging, if for a disgraceful offense; for serious crimes in the field against discipline, flogging, not exceeding 50 lashes, with the cat-o'-nine-tails, for minor offenses, degradation of rank, imprisonment, extra drill, stoppage of grog, loss of good-conduct pay, stoppage of leave, etc. Death, degradation, and loss of leave are the only punishments of those named above which can be inflicted on an officer. An officer can only be punished by sentence of a Court-Martial; he may be cashiered, dismissed the service, deprived of his regiment or ship; or, in the navy, reduced in rank by being placed at the bottom of the list of officers of his grade. In certain of the German armies, punishment is inflicted on the men in the form of strokes with a cane or with the flat of a saber. The punishments established by law or custom for United States soldiers by sentence of Court-Martial, according to the offense, and the jurisdiction of the court, are: death; stripes for desertion only; confinement; hard labor; ball and chain; forfeiture of pay and allowances; and dishonorable discharge from service, with or without marking. It is regarded as inhuman to punish by solitary confinement, or confinement on bread and water exceeding 14 days at a time, or for more than 84 days in a year at intervals of 14 days.

PUPPET-HEAD.—A sliding device on the upper part of the bed of a lathe or boring-machine. It holds the back center, and may be fixed at any required distance from the front center. See *Lathe*.

PURCHASE.—A mechanical power to increase the power applied. The names are various; some indicate a difference in character; others merely in application. Among them are: *whip, whip-upon-whip, luff-tackle, luff-upon-luff, runner, double-runner, barton, jeer, viol, gun-tackle;* as well as *winch, gin, jack, derrick, crab, capstan, windlass*, etc. See *Block, Pulley*, and *Tackle*.

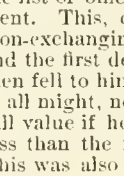
PURCHASE-SYSTEM.—A highly unpopular and much-misunderstood arrangement in the British army; by which a large proportion—more than half—of the first appointment of officers and their subsequent promotion used to be effected. It dates from the first formation of an English standing army, and was formally recognized in the reign of Queen Anne. The system itself was very simple. A price was fixed by regulation for each substantive rank, viz.:

	Price.	Difference.
Lieutenant-colonel................	£4500	£1300
Major......................	3200	1400
Captain................................	1800	1100
Lieutenant............................	700	250
Cornet or Ensign	450	

When any officer holding one of these regimental commissions desired to retire from the army, he was entitled to sell his commission for the price stipulated in the above table £4,500 in the case of a Lieutenant-colonel. This sum was made up by the senior Major, who was willing and able to purchase, buying the rank of Lieutenant-colonel for £1,300; the senior Captain, willing and able to purchase, buying a Majority for £1,400; a Lieutenant purchasing his company for £1,100; a Cornet or Ensign becoming Lieutenant on payment of £250; and lastly, by the sale to some young gentleman of an Ensigncy or Cornetcy for £450. In practice, fancy prices higher than the above were usually given, according to the popularity of the regiment, and vested interest in these over-regulation prices caused most serious complications whenever the Government made any change affecting the promotion of Purchase Officers. The value of commissions in the Guards was also greater; but as they constitute but a few regiments, and are mostly officered from the Nobility, they do not need particular description. No commission could be purchased by one officer unless another officer vacated his position by its sale. Death vacancies, vacancies caused by augmenting any regiment, vacancies resulting from the promotion of Colonels to be Major Generals, were filled without purchase, usually by seniority. No rank above Lieutenant-colonel could be purchased.

It is alleged with truth that purchase enabled the rich man to step over the head of the poorer but perhaps better qualified Non-purchasing Officer; and that money decided where merit should be the only guide. These disadvantages, however, it is replied, were not unmixed. Purchase, it is argued, introduced into the army men of a very high class in society, who gave a tone to the whole of military life. A great proportion of these wealthy men entered with the intention of merely spending a few years in the army. This tended to keep the officers young—a great advantage; and, further, provided in the country, among its gentlemen, a body of men well adapted for commands in the militia and volunteers. Moreover, selection exercised arbitrarily, as it must be when the men from whom the selection is to be made are scattered all over the world, away from the selecting power, is liable to create dissatisfaction. Under purchase, exchange was a common thing; for the rich officers, for private reasons of locality, etc., were glad to change frequently from regiment to regiment, entering in each case at the *bottom* of the list of officers of their rank in their new regiment. This, of course, was an advantage to the Non-exchanging Officer, as it pushed him to the top; and the first death or other non-purchase promotion then fell to him. An officer who had not purchased at all might, nevertheless, sell his commission for its full value if he had served 20 years, or for a sum less than the regulated price after shorter service. This was also a spur to promotion. On the whole, though exposed to the disadvantage and annoyance of being passed over by younger officers, the non-purchasing, *i.e.* the poor officers benefited pecuniarily by the purchase-system. This is proved by the slow progress officers made in corps where purchase did not exist, as, for instance, in the Royal Marines. Few would counsel the formation of a new army with such a system as purchase; but on the other hand, it had its advantages in its workings. Purchase did not exist in the artillery, engineers, marines, 19th to 21st regiments of cavalry, 101st to 109th regiments of foot. The purchase-system was abolished by Royal Warrant in July, 1871; and by the regulation of the Forces Act of the same year, Parliament laid down a scheme for the gradual compensation of officers who had lost the selling rights. Under that scheme it is expected that a sum-total amounting to nearly £8,000,000 will be required.

PURFLED.—A term in Heraldry, used with reference to the lining, bordering, or garnishing of robes, or ornamentation of armor. Often written *Purflewed*.


Purpure.

PURPURE.—In Heraldry, the color purple, expressed in engravings by lines in bend sinister. It is of infrequent occurrence in British Heraldry.

PURSUIT.—A victory, by which the enemy is only forced from the battle-field, is for the most part but a half success, if such it might be called, as the losses under fire are but very small compared to those arising from the demoralization of a broken and dispersed army. A prompt and vigorous *pursuit* is the only means of insuring complete success. Defeated and disorganized, the only hope that remains to the enemy is that he may have time to rally and concentrate his scattered troops. The only way to frustrate this hope is to pursue these disorganized masses, which are in no condition to resist a very inferior force if it assails them in good order. Under these circumstances we may separate our army into corps, forcing the enemy thus upon divergent lines of retreat, and preventing all co-operation between them. In doing this, we must, however, be very careful not to drive the enemy in such directions as will lead to his concentration on any one point.

If the enemy retires in good order, covering his line of retreat from our attempts to turn it, nothing remains to be done but to push him back with our entire force; keeping close upon his heels, and giving him no time to take advantage of defiles or other strong points to check us, so as to make us lose time, and give the opportunity to him to receive reinforcements. When he attempts to do this we should hold him in check on the main road, whilst we attempt to turn his flank, and endeavor to gain his rear. By this promptitude and vigor of action our forces will hardly be retarded, but will be always in position to turn any point upon which he attempts to make a stand, and thus force him to fall back continually as we push forward.

When we have come up with the enemy, we have one of two courses open to us: either to throw ourselves across his line of retreat, or else to leave this open to him, whilst we take a position on his flank. This last course is usually the more prudent, for, however weakened, it is a very dangerous thing to reduce an enemy to despair, and thus call forth heroic efforts, where but a moment before there was nothing but discouragement and a willingness to get away at any cost, even honor. With great superiority of force, by barring the way to the rear, and pressing on vigorously in front, we may hope "*to bag*" the entire army; in all other cases, it is more certain to limit ourselves to operating on the flank, and thus secure a part, with but little loss to ourselves, but with great demoralization of the enemy.

Having dispersed and demoralized the enemy's forces, the more difficult problem remains of holding the conquered territory. This becomes the more difficult when the enemy's territory has no fortified places that we have been able to seize, and thus hold as rallying points for our own troops. All that remains then to be done is to occupy strong strategical and populated points, by detachments of sufficient strength to keep the enemy quiet. This brings about numerous inconveniences: first, as these points must be strengthened by field works, and, in the second place, the main army must be greatly weakened by the detachments that this system renders necessary. In the mean time the enemy's broken forces having retired towards the interior, are there reorganized, recruited, and concentrated, until, at last, an equilibrium between the two contending forces is brought about, and the struggle is recommenced to go, perhaps, through the same phases.

These inconveniences may, in a great degree, be avoided by having a *reserve* force in rear of the movable army, charged with the sole duty of holding the territory occupied. This reserve, which should not be further than a few days' march from the front of operations of the movable forces, should be dispersed over as great an extent, parallel to this line, as practicable; thus enlarging the base of operations, collecting supplies on a greater extent, and keeping a larger amount of population quiet. This reserve may be composed of new levies, and, being held in all points subordinate to the active army, it will be ready to co-operate with it in any way deemed best.

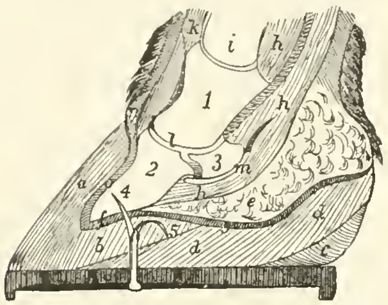
PURSUIVANT.—The third and the lowest order of heraldic officers. The office was instituted as a novitiate, or state of probation through which the offices of Herald and King-at-Arms were ordinarily to be attained, though it has been held that a Herald or King-at-Arms may be made *per saltum*. There are four pursuivants belonging to the English College of Arms: *Rouge Croix*, the oldest, so named, from the cross of St. George; *Blue Mantle*, instituted either by Edward III. or Henry V., and named in allusion to the robes of the Order of the Garter, or perhaps to the color of the arms of France; *Rouge Dragon*, deriving his title from King Henry VII.'s dexter supporter, a red dragon, assumed in allusion to his descent from Cadwaladyr; and *Portcullis*, named from a badge of the same Monarch. There are six pursuivants in the heraldic establishment of Scotland, known by the names of *Dingwall*, *Bute*, *Carrick*, *Ormond*, *Kintyre*, and *Unicorn*—titles which, as well as those of the Heralds, seem to have originated in the reign of James III. The Scottish pursuivants take precedence according to seniority in office.

In ancient times, any great nobleman might institute his own pursuivant with his own hands and by his single authority. The Dukes of Norfolk had a pursuivant, called *Blanch Lyon*, from the white lion in their arms; the pursuivant of the Dukes of Northumberland was styled *Esperance*, from the Percy motto; and Richard Nevil, Earl of Salisbury, had a pursuivant called *Egle Vert*. We even find Sir John Lisle in 1442 making Thomas de Launey his pursuivant, by the title of *Blanch Sanglier*. The ancient costume of a pursuivant of the King was a surcoat, embroidered with the Royal Arms, and worn with one sleeve hanging down in front, and another behind. In 1576 Rouge Croix was severely censured for wearing his coat as a Herald. In later times, however, a pursuivant's coat is worn exactly as a Herald's, the latter officer being distinguished by the collar of SS.

PURVEYOR.—An officer who is charged with superintending the civil affairs of army hospitals, as the payment of men, procuring provisions, medical comforts, bedding, etc. The Purveyor acted independently of the Medical Officer, and was responsible through the Purveyor-in-Chief to the Secretary of State for War. The Department consisted of a Purveyor-in-Chief, Principal Purveyors, Purveyors, Deputy-Purveyors, and Clerks. The Purveyor-in-Chief ranked with a Colonel in the army, and had a salary of £547 per annum, rising to £730 after long service. In 1868, the Department was merged with others in the Control Department; and on the abolition of the latter in 1875, its functions passed to the Commissariat and Transport Department. In the United States Service, the Chief Medical Purveyor is the chief purchasing and disbursing officer of the Medical Department; and under the direction of the Surgeon General, he is charged with the supervision and distribution of all medical and hospital supplies. See *Medical Department*.

PUSH-PICK.—An implement, flat and pointed, used to place the frames and sheeting, when constructing a mine.

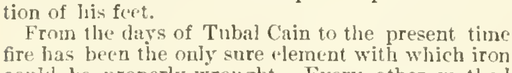
PUTNAM NAIL.—A hot-forged and hammer-pointed horse-shoe nail recently introduced, and regarded by the military authorities as the best machine-made nail manufactured at the present time. These nails are forged separately from the rods, the iron when nearly at a welding heat being drawn out under four hammers, by use of petroleum gas (thus avoiding all sulphur), by which means a firmer, tougher, and more compact nail is made than is possible by any other process. In the pointing as well as in the making, an endeavor has been made to follow the old hand process as nearly as possible. All lameness, temporary, or even permanent, often results from a sliver or thin shell of the nail entering the quick when driven into the hoof, causing great inconvenience and sometimes pecuniary loss, but in these nails great stiffness and ductility has been maintained, the fiber of the iron is kept uninjured, and it is impossible to cause them to sliver. The drawing represents a section of a horse's foot, and shows the frequent effect of driving *cold-cut* horse-nails that are liable to sliver in driving. 1, is the coronet bone; 2, is the coffin-bone; 3, is the navicular bone; 4, is one blade of a *slivering* nail, passing through the quick, or sensitive sole, into the coffin bone; 5, is the other blade of the nail passing out of the wall of the hoof for clinching. The other



parts may be represented as follows:—*a*. The wall. *b*. The sole. *c*. The cleft of the frog. *d d*. The frog. *e e*. The fatty frog, or elastic cushion. *f*. The sensitive sole. *g*. The sensitive sole. *h h h*. The tendons of the muscles which bend the foot. *i*. Part of the pastern-bone. *k k*. The tendons of the muscles which extend the foot. *l*. The coffin-joint. *m*. The navicular joint. *n*. The coronary substance. *o*. The sensible laminæ, or covering of the coffin-bone.

It requires but little observation and reflection to arrive at the conclusion as to the kind of nails to be used in the horse's foot, whether a mangled piece of iron, rendered dangerous by improper manipulation, or one made from the rod at a welding heat, where all the fibers remain intact, and afterwards hammer-pointed. The foot is an important member of the animal's body, and demands the greatest care and attention, for when it becomes injured or diseased, no matter how perfect the other parts may be, the horse's services are diminished or altogether lost. Hence the value of a horse depends upon the condition of his feet.

From the days of Tubal Cain to the present time fire has been the only sure element with which iron could be properly wrought. Every other method has resulted in producing articles of great inferiority where strength and durability are required, and in no place are these two requisites more necessary than in the horse's shoe-nail. The ancients used only charcoal in the working of iron, thus avoiding all sulphurous gases, hence the superiority of their weapons. The old Damascus blades owe their superiority in part to the use of asphalt when being forged, thus avoiding the presence of sulphur, which is so ruinous to all kinds of iron and steel. Profiting by this knowledge, the manufacturers of this nail have abandoned the use of coal and coke in the



forging, and use only pure carbon gas made from petroleum, and are thereby enabled to obtain a much higher temperature in the working of the iron. The Putnam nail is drawn down to a point from the rod of iron, as shown in the drawing, and receives about sixty quick, successive, sharp blows, at a welding heat. It is then scaled by the water process, no acids being used, and afterwards hammer-pointed. It is to all intents and purposes the same as the old-fashioned hand-made and hammer-pointed nail.

PUTTY-POWDER.—A material consisting of peroxide of tin, in great use for polishing small-arms and metal work. It is also used as a coloring material for white glass, and for the white enamels of porcelain, etc. It is made by melting tin; as the surface oxidizes, the scum, which is the peroxide, is raked off, and when cold, is reduced to a fine powder, which is white in color, and the particles are extremely hard. See *Polishing*.

PYRGI.—Movable towers, used by the Greeks in scaling the walls of besieged towns. They were driven forward upon wheels, and were divided into different stories, capable of carrying a great number of soldiers and military engines.

PYRITES.—A common name for the ancient *wheel-lock*, used before the invention of the flint-lock.

PYROBOLI.—Fireballs, used both by the Greeks and Romans. Frequently called *Malleoli*.

PYROMETER.—A term originally applied by Muschenbroek, in 1731, to an instrument which he invented for measuring all the changes produced in the dimensions of solid bodies by the application of heat. It is, however, now applied to any instrument the object of which is to measure all gradations of temperature above those that can be indicated by the Mercurial Thermometer. Desaguliers gives a description of Muschenbroek's instrument, as improved by himself, in his *Experimental Philosophy*. Numerous pyrometers have since been invented, amongst which may be noticed those of Ellicott (described in the *Philosophical Transactions* for 1736 and 1751), Graham (in Do. for 1754), Wedgwood (in Do. for 1782, 1784 and 1786) and Guyton (in the *Annales, de Chimie*, tome 46). None of these instruments, however, gave accurate results for very high temperatures; and it was not till the year 1821 that Professor Daniell announced the invention of his pyrometer, which has supplanted all others, and for which, in an improved form, he received the Rumford Medal from the Royal Society.

The method *by shrinkage* having been adopted for the insertion of the tube of the 8-inch breech-loading rifle, it at once became important to provide some reliable means for measuring, from time to time, the expansion of the cast-iron casing while undergoing heating. It was deemed most desirable, also, in connection with these measurements, to determine accurately the corresponding temperatures, in order to acquire trustworthy data, which might serve for reference in future operations of this nature. The instruments prepared for the above purposes were as follows :

1. For the measurement of the expansion. In this operation, since the instrument would require to be inserted within the bore of the heated casing, it was deemed necessary to employ a measuring tool of such poor conducting material as would undergo itself as little change from the heat as possible. Accordingly, a number of wooden measuring-rods, with steel points screwed into the ends, were constructed. The lengths of these rods were then adjusted by a vernier rule, reading to 0''.001, so as to form a series, gradually increasing by 0''.005, from 22''.00 to 22''.09, or to a little beyond the required expansion. The length of each measuring-rod was stamped upon it, and a stiff wire attached to it at the middle, by which to handle it in taking a measurement. By means of these rods, using a longer and longer one till one was found that would just enter the casing, the measurements of the interior diameter of the heated casing were rapidly, and, it is thought, quite accurately made. The lengths of the measuring-rods, as verified by the vernier rule, immediately after being withdrawn, showed no sensible change. This mode of measurement was devised by the South Boston Iron Company.

2. For the measurement of the temperature. For the determination of the temperature it was decided to employ a pyrometer of the form usually known as the hydro-pyrometer; in which the temperature is as-

certained by exposing to the action of the heat which is to be measured a definite weight of some metal, as platinum, steel, copper, etc, and then quenching the same in a known weight of water, and noting the rise in temperature of the latter. From this data, and the specific heat of the metal employed, the initial temperature of the metal, which is the temperature required, can be readily obtained. Thus, if a piece of platinum weighing 1,000 grains should, when immersed in 2,000 grains of water at a temperature of 60° Fahrenheit, raise the temperature of the latter to 90°, then 90° − 60° = 30°, multiplied by 2 because the weight of the water is twice that of the platinum, gives 60°, the temperature to which a weight of water equal to the platinum would have been raised. To obtain from this the initial temperature of the platinum, in Fahrenheit degrees, we multiply by 31¼, the specific heat of water as compared with platinum, that of the latter being 1, and to the result add the temperature of the water. Therefore $(60 \times 31\frac{1}{4}) + 90 = 1965$ is the temperature required. The principle may otherwise be stated as follows: A body of known weight W is raised to a final temperature T, and then plunged into a quantity of water of weight W′ and temperature t, which is contained in a copper vessel called a "calorimeter." As T is supposed to exceed t, the water gains in temperature by the immersion of the body, and finally attains a maximum temperature A, which is noted. In the change from t to A, the water has gained a quantity of heat equal to $W'(A - t)$, and the body immersed has lost a quantity equal to $Wx(T - A)$; x being the specific heat of the body, that of water being equal to 1. Equating these two quantities we have

$$W'(A - t) = Wx(T - A)$$

Solving in reference to T, we obtain

$$T = \frac{W'(A - t)}{Wx} + A$$

This method of pyrometric measurement was first adopted by Clement-Desormes and Schwarz, for the measurement of the heat of furnaces; it was afterward employed by Regnault in the determination of the specific heats of various substances, liquid and solid, and by Dr. Siemens in some delicate experiments upon the varying electrical conductivity of telegraph wire under different degrees of temperature. The above equation assumes that the only exchange of heat is between the water and the heated body, which is not actually the case. The heat of the body is not given up exclusively to the water in the calorimeter, but partly to the calorimeter itself, to the thermometer, the mixer, and such other instruments as may be employed in the experiments and come in contact, directly or indirectly, with the heated body. A The equation for the most general case can be easily written down, since it is only necessary to express that the quantity of heat given up by the heated body is equal to that gained by the water, the calorimeter, thermometer, mixer, etc.

Let W denote the weight of the body; T its initial temperature; x its specific heat; W′ the weight of the water in the calorimeter; w' the weight of the calorimeter; x' its specific heat; w'' the weight of the mixer, and x'' its specific heat; w''' the weight of the thermometer-tube immersed in the water; x''' its specific heat, and w^{iv} the weight of the mercury in the thermometer-tube, and x^{iv} its specific heat.

Then

$$Wx(T - A) = (W' + w'x' + w''x'' + w'''x''' + w^{iv}x^{iv})(A - t)$$, and

$$T = \frac{(W' + w'x' + w''x'' + w'''x''' + w^{iv}x^{iv})(A - t)}{Wx} + A$$

In the above expression the coefficient of $(A - t)$ is called the *water equivalent of the calorimeter*, and evidently represents a mass of water such that, supposing it to receive exclusively all the heat given up in the experiment, a thermometer placed in it would indicate the variation of temperature actually observed. To determine this value for the particular case under consideration, take the following schedule:

Parts.	Material.	Weight, ozs.	Symbol.	Specific heat, at 572° F.	Symbol.	Thermal capacity.	Numerical value.	
Ball.	Copper.	5.012	W.	.1013.	x.	Wx.	.50772	
Water	....	34.192	W′	1.	......	W′		34.192
Calorimeter	Copper	11.23	w'	.1013	x'	$w'x'$		1.1376
Mixer	Brass.......	1.51	w''	.1002	x''	$w''x''$		.1513
Thermometer-tube............	Glass	.25	w'''	.199	x'''	$w'''x'''$		.0498
Mercury in thermometer-tube............	....	.30	w^{iv}	.035	x^{iv}	$w^{iv}x^{iv}$		.0105
							.50772	
$W' + w'x' + w''x'' + w'''x''' + w^{iv}x^{iv} =$							....	35.5412

From which we determine—

$$\frac{W' + w'x' + w''x'' + w'''x''' + w^{iv}x^{iv}}{Wx} = \frac{35.5412}{.50772} = 70.$$

for the water equivalent of the pyrometer, or the value of each degree in the difference between the temperature of the water before and after the immersion of the heated copper. The expression for the temperature thus becomes $T = 70(A - t) + A$. See *Thermometer.*

PYROPHORE STIRRUP.—A stirrup in very ancient times provided with a lantern, which gave light and warmed the feet of the rider.

PYROTECHNY.—The art of making fireworks, and of unknown antiquity. It was practiced among the Chinese from the earliest times, and has attained with them a perfection unknown in other countries. So much is this the case, that they treat as insignificant the most brilliant of other displays. In their fireworks they introduce many surprises, such as figures of men and animals darting out, but they are somewhat deficient in the mechanical arrangements. Fireworks, as the name is now understood, were hardly known in Europe until the discovery of the composition of gunpowder, and for a long time only very simple pyrotechnic contrivances were used. At present they may be divided into two kinds—the simple hand-pieces, such as squibs, crackers, rockets etc.; and the other, the fixed contrivances which have often very ingenious mechanical arrangements for making some of their parts revolve rapidly when being discharged. The materials used are gunpowder, sulphur, charcoal, saltpeter, filings of steel, iron-copper, etc., and several salts: such as nitrate of strontian, acetate of copper common salt, etc. The ingredients of fireworks are usually filled into paper cases, made by rolling pasted paper round a cylinder of wood, of the proper diameter, until the case is of sufficient thickness, and then cutting the paper tube so formed into the required lengths for squibs, Roman candles, small rockets, and similar articles; they seldom exceed ten inches; one end of each is closed by drawing a piece of string tightly round, so as to pinch it in, or *choke* it, as it is technically called, and then dipping it into melted resin, which effectually seals it. The combustible ingredients are filled in at the open end, and, if necessary, are rammed down with a wooden ramrod; the opening is afterward covered with a piece of touch-paper, to prevent the composition falling out, and to ignite it by. The effects produced by fireworks are either streams of fire issuing straight out of the cases, and much varied with sparks in the form of stars, etc., and colored with brilliant colors, or wheels of beautiful sparks produced by making the cases revolve rapidly. Revolving pieces are made by coiling the paper tube, when not too tightly filled, around a flat wooden center; the force with which the combustion of the materials is carried on, is sufficient to make the board revolve with great rapidity. Small wheels of this kind are called *Catherine wheels*. *Squibs* or *serpents* are made by filling tubes, eight to ten inches in length, with a composition of 1 lb. of niter, 2 oz. of charcoal powder (rather coarse), 4 oz. of gunpowder, 4 oz. of sulphur, and 6 oz. of steel filings. The last is an important ingredient in many fireworks, producing brilliant, feather-like coruscations, which are the more beautiful the larger and cleaner the filings are. *Rockets* are tied to a wooden stick. When they are about to be discharged, this stick is stuck in the ground, and in that position the igniting point of the rocket is downward; when lighted, it rushes into the air with great velocity and reaches a considerable height, discharging as it goes a brilliant stream of sparks. Rockets require a hollow center all down the tube; without this they will not rise. At the end of their course, they often discharge very brilliant clusters of golden, ruby, emerald, sapphire-like stars, or showers of golden or colored rain, or of fiery serpents. This is produced by a supplementary part, called the *garniture* of the rocket, consisting of a shorter and broader paper tube, called the *pot*, attached to the end of the fusee part of the rocket, and filled with a composition made into paste with pure alcohol, and cut into stars, or granulated into small, round bodies for drops. The serpents for rockets are small fusees, with the same composition as squibs; they are so packed as to ignite all at once. The white stars are made of niter, 16 parts; sulphur, 8 parts; gunpowder, 3 or 4 parts; nitrate of strontian added, makes them ruby red; sulphur or acetate of copper, and sulphate and carbonate of barytes, green; zinc filings give a blue color. *Yellow stars* and *yellow showers* are made of niter, 16 parts, 10 of sulphur, 1 of charcoal, 16 of gunpowder and 2 of lamp-black. A deeper and richer golden color is produced by a very slight variation in the composition—viz., 2 parts less of sulphur and charcoal, and 4 additional of gunpowder. Many other ingenious devices are used by masters in the art of pyrotechny, but they are too numerous and too technical to come within the limits of this work. The *Roman candle* is a favorite firework; it is a tube which is held on the ground, and discharges upward a continuous stream of blue or white stars or balls. *Bengal lights* are cases of about an inch or more in diameter, filled with a composition of 7 parts niter, 2 of sulphur, and 1 of antimony. These are much used as signals at sea; they diffuse an immense glare of bluish-white light. *Chinese* or *jasemine fire*, which is used by itself or in combination with other mixtures, consists of 16 parts of gunpowder, 8 of niter, 3 of finely-powdered charcoal, 3 of sulphur, and 10 of small cast-iron borings; the last must be finer or coaser in proportion to the bore of the case to be filled. The compound devices in fixed fireworks, such as are seen at public entertainments, are very complicated in their structure, and are varied more or less by every artist. One nice point in the arrangement is to insure simultaneous ignition of all the various parts. See *Fireworks*.

PYROXYLE—PYROXYLIN.—The action of nitric acid on such vegetable substances as saw-dust, linen, paper, and cotton, is to render them very combustible. In their natural state these substances are almost entirely composed of *lignine*, the constituents of which are *oxygen*, *hydrogen*, and *carbon*; nitric acid furnishes *nitrogen*, a substance which enters into the composition of nearly all explosive bodies. Pyroxyle or gun-cotton has the composition indicated by the symbol $C_6H_7(NO_2)_3O_5$, or $C_6H_7N_3O_{11}$, and is formed by the action of concentrated nitric acid on cotton. The reaction consists in the substitution of nitrogen and oxygen in feeble combination for part of the hydrogen in the cotton or cellulose, and is therefore similar to the one by which nitro-glycerine is produced. The equation illustrating the reaction may be thus written:

$$C_6H_{10}O_5 + 3\ HNO_3 = C_6H_7(NO_2)_3O_5 + 3\ H_2O$$

Cotton or cellulose. Nitric acid. Nitro-cellulose or gun-cotton. Water.

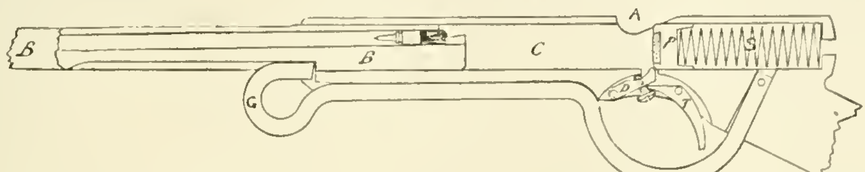
A number of these substitution products are known, but only one is used as an explosive agent. Some of the others are largely employed for making collodion.

Pyroxyle was discovered by Prof. Schönbein, and published to the world in 1846. His method of preparing it consists of mixing three parts of sulphuric acid, sp. grav. 1.85, with one part of nitric acid, sp. gr. 1.45 to 1.50; and when the mixture cools down to between 50° and 60° Fahr., clean rough cotton, in an open state, is immersed in it; when soaked, the excess of acid is poured off, and the cotton pressed tightly to remove as much as possible of what remains. The cotton is then covered over and left for half an hour, when it is again pressed, and thoroughly washed in running water to remove all free acid. After being partially dried by pressure, it is washed in an alkaline solution made by dissolving one ounce of carbonate of potash in a gallon of water. The free acid being thus expelled, it is placed in a press, the excess of alkaline solution expelled, and the cotton left nearly dry. It is then washed in a solution of pure nitrate of potash, one ounce to the gallon, and being again pressed, is dried under a temperature of from 150° to 170°. The sulphuric acid has no direct action on lignine, its use in the preparation of pyroxyle being to retain the water abstracted from the cotton, and prevent the solution of the compound, which would take place, to a greater or less extent, in nitric acid alone. See *Gun-cotton*.

PYRRHIC DANCE.—The most famous of all the war-dances of antiquity, said to have received its name from one Pyrrichos, or, according to others, from Pyrrhus or Neoptolemus, the son of Achilles. Critical scholars, however, content themselves with a general inference deduced from the substantial harmony of the various mythical or legendary accounts given of its origin—viz., that it was a Doric invention. It was danced to the flute, and its time was both quick and light, as may be seen from the Pyrrhic foot, composed of two shorts (⏑⏑), and the Prokeleusmatic, or challenging-foot, of two double shorts (⏑⏑⏑⏑). According to Plato, it aimed to represent the nimble motions of a warrior either avoiding missiles and blows, or assaulting the enemy; and in the Doric States, it was as much a piece of military training as an amusement. Elsewhere, in Greece, it was purely a mimetic dance, in which the parts were sometimes represented by women. It formed part of the public entertainment at Panathenaic festivals. Julius Cæsar introduced it at Rome, where it became a great favorite. The *Romaika*, still danced in Greece, is said to be a modern relic of the ancient Pyrrhic dance; but if Dr. Corrigan's description of it (*Ten Days in Athens*, 1861) is correct, it is not easy to see the resemblance.

Q

QUACKENBUSH AIR-GUN.—The most perfect and effective gun of its class, at present made. Being a hard-shooter,and easily manipulated,it is well suited for practice at short range; and is very extensively used by recruits when learning the principles of aiming and firing. The drawing shows its working parts. Pulling the trigger releases the piston (P), which is then thrown foward by the spring, expelling the air from the chamber (C), through the barrel (B), with great force, carrying the dart or bullet before it. *To load* the gun, the barrel (B) is pushed into the cylinder (C), which re-sets the piston, compresses the spring, and allows the dart or bullet to be inserted through the opening (A), after which the barrel is drawn forward to the stop as shown. It will be observed that the spring guard (G) can be drawn back instantly to remove the barrel for packing, etc.; and that the whole length of the barrel is effective, there being no waste space to occasion a loss of air. The barrel is easily pushed into the chamber, by placing the muzzle upon the floor or against some firm object. See *Air-gun*.



QUADI.—An ancient people living in south-east Germania; of the Suevic race, and inhabiting that part of what is now Bohemia, Lower Austria, and Moravia, which lay between the Sarmatian mountains and Hercynian forests and the Ister or Danube. They were Allies of the Marcomanni, their neighbors on the north-west. The Roman Emperor Tiberius established a kingdom of the Quadi, and made Vannius, one of his generals, King. In 174 B. C. the Quadi, rose against the Empire in confederation with other Germanic races, and it was only after stubborn resistance that they were overcome.

QUADRANT.—In gunnery, an instrument, generally made of brass, for ascertaining or adjusting the elevation of ordnance, particularly mortars, which have no tangent scale. The quadrant is graduated into degrees and parts of a degree,having a movable index, with a spirit-level and vernier attached to it. When the instrument is used, the limb or bar of the quadrant is inserted into the bore of the piece; the index which is attached to the graduated arc is then fixed to the particular elevation required, and the piece elevated or depressed until the spirit-level is horizontal, which is shown by the air bubble running to the center. Another pattern quadrant to that hitherto in use has been introduced. It differs from the one generally known in being altogether of a stronger form; the bar or limb has been reduced to 12 inches in length; the base is broader, and is fitted with a stop to prevent its slipping into the chamber. The counterbalance weight is arranged so as to ensure the quadrant lying flat on the bottom of the bore of the piece. A *Gunner's Quadrant* is an instrument employed, like the spirit-level quadrant, to give angles of elevation or depression when there are no sights to a gun, or when they cannot be used. It differs from the spirit-level quadrant in having no spirit-level,but a plumb-line which is suspended from the right angle.

QUADRANT ANGLE.—The angle which the axis of the piece, when laid, makes with the horizontal plane. It is termed, *quadrant elevation* or *quadrant depression*, according as the piece is laid above or below the horizontal plane.

QUADRATE.—In gunnery, a term meaning to ascertain if a piece of ordnance is properly placed on its carriage, and the wheels are of equal height.

QUADRILATERAL.—In military language, an expression denoting a combination of four fortresses, not necessarily connected together, but mutually supporting each other; and from the fact that if one be attacked, the garrisons of the others, unless carefully observed, will harass the besiegers, rendering it necessary that a very large army should be employed to turn the combined position. As a remarkable instance, and a very powerful one, may be cited the Venetian Quadrilateral (Austrian till 1866), comprising the four strong posts of Mantua, Verona, Peschiera, and Legnago. These form a sort of outwork to the bastion which the southern mountains of the Tyrol constitute, and divide the north plain of the Po into two sections by a most powerful barrier. Napoleon III., in 1859, even after the victories of Magenta and Solferino, hesitated to attack this quadrilateral.

QUADRILLE.—Small parties of horse richly caparisoned, etc., in tournaments and at public festivals. The quadrilles were distinguished from one another by the shape or color of the coats which the riders wore.

QUAKER-GUNS.—Old wooden pieces of ordnance which were made to resemble the real artillery, and placed in the embrasures of forts, in order to deceive the enemy.

QUARREL.—The missiles used for all cross-bows, with the exception of the *cross-bow a galet*, were called *quarrels* or bolts: and often written *quarry*. One kind of quarrel (*vireton*) was feathered so as to regulate the movement by giving a rotatory motion. Another kind (*matras*) ended with a round knob, which killed without shedding blood. See *Articles of War*, 24.

QUARTE.—In tactics, a word of command given in the bayonet exercise: as *quarte parry*, which is executed as follows: Move the piece quickly to the left, the small of the stock passing under the left elbow, the piece covering the left shoulder; the barrel to the left, bayonet in front of, and higher than the shoulder, the left forearm on the right of the piece, the elbow touching the right wrist, the fingers on the stock.

QUARTER.—1. In Heraldry, a subordinary consisting of the upper dexter fourth part of the shield, cut off by a vertical and a horizontal line meeting in the center of the shield. When two or more coats are marshaled together on a shield divided into squares for their reception, such divisions are also called quarters. See *Quartering*.

2. In war, the sparing of the life of a vanquished enemy, which by the laws of war is forfeit to the victor. The expression seems to be derived from the use of the word "quarter" to designate the lodging of the particular warrior; to *give quarter* to a prisoner being to send him to his captor's quarter for liberation, ransom, or slavery. The refusal of quarter is a terrible aggravation of the horrors of war, and is only at all justifiable towards an enemy who has been guilty of atrocious cruelty himself, or of some flagrant breach of faith.

It is against the usage of modern war to resolve, in hatred and revenge, to give no quarter. No body of troops has the right to declare that it will not give, and therefore will not expect, quarter; but a commander is permitted to direct his troops to give no quarter, in great straits, when his own salvation makes it *impossible* to cumber himself with prisoners. Troops that give no quarter have no right to kill enemies already disabled on the ground, or prisoners captured by other troops. All troops of the enemy known or discovered to give no quarter in general, or to any portion of the army, receive none. Troops who fight in the uniform of their enemies, without any plain, striking, and uniform mark of distinction of their own, can expect no quarter.

If American troops capture a train containing uniforms of the enemy, and the commander considers it advisable to distribute them for use among his men, some striking mark or sign must be adopted to distinguish the American soldier from the enemy. The use of the enemy's national standard, flag, or other emblem of nationality, for the purpose of deceiving the enemy in battle, is an act of perfidy by which they lose all claim to the protection of the laws of war. Quarter having been given to an enemy by American troops, under a misapprehension of his true character, he may, nevertheless, be ordered to suffer death if, within three days after the battle, it be discovered that he belongs to a corps which gives no quarter.

QUARTER ARMS.—A term in Heraldry, meaning to place the arms of other families in the compartments of a shield, which is divided into four quarters, the family arms being placed in the first quarter; when more than three other arms are to be quartered with the family arms, it is usual to divide the shield into a suitable number of compartments; and still the arms are said to be *quartered*.

QUARTER BLOCKS.—Small blocks used for various purposes in mechanical maneuvers. They are usually 20 inches long, 6 inches wide, and 2 inches thick.

QUARTER GUARD.—A guard mounted in camp, immediately on the arrival of each corps on its ground. It is placed in front of the center of the camp, at about eighty paces from it and is charged with special duties

QUARTER HUNG.—A term employed when speaking of a gun whose trunnions have their axis below the line of bore.

QUARTERING.—In Heraldry, the bearing of two or more coats on a shield divided by horizontal and perpendicular lines, a practice not to be found in the earlier heraldry, and little in use till the 15th century. Arms may be quartered for various reasons. 1. To indicate dominion. A Sovereign quarters the ensigns of his different States. The earliest instance of quartering in England is found in the paternal arms of Eleanor, daughter of Frederick III., King of Castile and Leon, and first wife of Edward I., as represented on her tomb in Westminster Abbey—the Castle of Castile occupying the first and fourth quarters, and the Lion of Leon the second and third. The arms of England and Ponthieu are similarly quartered on the same monument, and on the crosses erected to queen Eleanor's memory. The received rule regarding the quartering of the ensigns of different states is, that precedence is given to the most ancient, unless it be inferior in importance. Feudal

arms are sometimes quartered in the same way by subjects. 2. Arms of augmentation, or special concession accorded to a subject by his Sovereign, by way of honor, are sometimes granted to be borne quarterly with the paternal arms. These contain a portion of the royal insignia, and have precedence of the paternal coat. 3. The most unusual reason for quartering is to indicate descent from an heiress who has intermarried into the family. Where there is but one heiress, her coat occupies the second and third quarter of the shield, and the paternal arms the first and fourth. Where there are more than one, they are marshaled in the successive quarters in the order of the intermarriages. Where more than four coats have to be marshaled, the number of vertical lines is increased, and the divisions, though more than four, are still called quarters. Where there is an odd number of coats, the last quarter is usually filled up by repeating the first. One of the quarters may itself, be quartered, when the heiress was entitled to bear a quartered coat; the shield is then said to be counter-quartered, and its primary quarters are called *grand quarters*. Quarterings are not allowed to be added to the paternal coat without the sanction of the heraldic authorities. The expression "quarterings" is often loosely used for *descents* in cases where there is no right to quarter from representation. The eight or sixteen quarterings which are sometimes ranged around the Scottish funeral escutcheon, and which are still important for many purposes in Germany, have no reference to representation, but simply purity of blood for four or five generations; *i. e.*, that the father and mother, the two grandmothers, and four great-grandmothers, as also in the case of sixteen quarterings, the eight great-great-grandmothers, have all been entitled to coat-armor. See *Quarter*.

QUARTERLY.—A term in Heraldry, meaning in quarters or quarterings: as, to bear arms quarterly.

QUARTERMASTER.—A regimental Staff Officer, of the relative rank of Lieutenant, whose duty is to look after the assignment of quarters, the provision of clothing, forage, fuel, and all other Quartermaster's supplies; and when on the march he superintends the marking out of camp. He is appointed by the Colonel of the regiment, subject to the approval of the Secretary of War. He vacates his Staff position when promoted to the rank of Captain, or at the discretion of the Colonel. In the British service, the regimental Quartermaster rises, with few exceptions, from the ranks. His duties are to superintend, assign to their respective occupants, and have charge of, quarters, barracks, tents, clothing, etc., used by the regiment. He is also regimental storekeeper. The Quartermaster has no further promotion to look forward to; but after 30 years' service in all including 10 as an officer he may retire with the honorary rank of Captain. He receives 10s. 2d. a day in the cavalry, and 8s. 2d. in the infantry, rising by length of service to 15s. 2d. and 13s. 2d.; with slightly different rates in the guards, engineers, etc. He is not required to join the Mess

QUARTERMASTER AND COMMISSARY OF CADETS.—An Officer of the Army, detailed by the Secretary of War, and assigned to duty as Quartermaster and Commissary of Cadets at the U. S. Military Academy.

He is charged with all matters relating to clothing, equipment, and subsistence of the Cadets, including purveying and supervision of the Cadets' Mess.

A Board of Inspectors, consisting of three officers appointed by the Superintendent, examines and compares with approved patterns all articles of Cadets' clothing, and materials for making the same; and also examines all other supplies furnished by the Quartermaster and Commissary of Cadets, and reports to the Superintendent, at such times as he appoints on the quality and suitableness of the articles; but the Superintendent may assign an officer to inspect clothing and shoes furnished for issue. No clothing or other article is issued or sold to the Cadets without being first inspected and approved. After every muster this Board carefully audits the accounts for clothing, and all other authorized charges against Cadets.

QUARTERMASTER GENERAL. A Staff Officer in the United States Army, who has the rank of Brigadier General, and is at the head of the Quartermaster's Department. In the British army he is a Staff Officer of high rank, whose duty it is to arrange the marches, quarters, and internal arrangements of the army to which he belongs. Every army has some officer of this Department; from a brigade with a Deputy Assistant Quartermaster General, receiving £173 7s. 6d. a year, besides regimental pay, up to a complete army under a Commander-in-Chief, with a Quartermaster General, who is usually a general officer, and receives £691 19s. 7d. per annum, besides his other pay. At headquarters there is a permanent Quartermaster General, responsible for all the movements of the army, the organization of expeditions, camps of instruction, etc. He receives £1,500, besides his pay as a general officer, and has a Sub-Department at the War Office, with clerks, etc. He is under the officer commanding in chief, and the Adjutant General.

QUARTERMASTER'S DEPARTMENT.—Department is charged with the duty of providing the means of transportation, by land and water, for all troops, and all material of war. It furnishes the horses of the artillery and cavalry, and horses and mules for the trains. It provides and distributes clothing, tents, camp and garrison equipage, forage, lumber, and all material for camps and for shelter of troops and of stores. It builds barracks, storehouses, hospitals; provides wagons and ambulances and harness, except for cavalry and artillery horses; builds or charters ships, steamers, and boats, docks, and wharves; constructs and repairs roads, railways, and bridges; clears out obstructions in rivers and harbors, when necessary for military purposes; provides, by hire or purchase, grounds for military encampments and buildings; pays generally all expenses of military operations not by law expressly assigned to some other Department; and, finally, it provides and maintains military cemeteries, in which the dead of the army are buried.

The following are general depots of the Quartermaster's Department in the United States, and the officers in charge thereof report directly to the Quartermaster General: New York, Philadelphia, and Schuylkill Arsenals, Washington, D. C., Jeffersonville, Ind., and San Francisco, Cal. All other depots are under the orders of the Commanding Generals of the Military Departments in which they are situated. The Commander of the Military Division of the Pacific, however, for all purposes of his command, has authority over the depot of San Francisco as over Department depots; but in matters relating exclusively to the collection and manufacture of military supplies, the officer in charge of that depot communicates directly with the Quartermaster General of the army.

The present organization of the Quartermaster's Department consists of one Quartermaster General, with the rank of Brigadier General; four Assistant Quartermaster Generals, with the rank of Colonel; eight Deputy Quartermaster Generals, with the rank of Lieutenant Colonel; fourteen Quartermasters, with the rank of Major; and thirty Assistant Quartermasters, with the rank of Captain.

QUARTERMASTER SERGEANT. A Non-commissioned Officer who assists the Quartermaster in his various duties. He ranks among the regimental Non-commissioned Staff, and is appointed by the Colonel of the regiment upon the recommendation of the Quartermaster. In the British service, he receives daily 4s. 5d. in the cavalry, 4s. in the artillery, 2s. 11d. in the infantry of the line.

QUARTER OF ASSEMBLY.—A rendezvous or place where the troops meet to march from in a body.

QUARTERS.—1. The encampment on one of the principal passages round a place besieged, to prevent relief and intercept convoys.

2. In military affairs, quarters are generally the positions assigned to persons or bodies of men. In a more special sense, the quarters in the army are the places of lodging assigned to officers or men, when not actually on duty. At all posts and stations where there are public quarters in buildings belonging to the United States, officers may be furnished with quarters in kind in such public buildings by the Quartermaster's Department. There is allotted by the Quartermaster at the station, under the direction of the Commanding Officer, to each officer such number of rooms as is allowed to his grade by the Regulations of the Army. When assigned to duty without troops, or temporarily and involuntarily awaiting orders, under competent authority, officers are entitled to the prescribed allowance of quarters. But in no case is an officer furnished with quarters at two different stations at the same time. Application should be made to the Quartermaster on the arrival of the officer at the place where quarters are to be provided. See *Allowance of Quarters*.

QUARTER-SIGHTS.—In gunnery, divisions marked on the upper quarters of the base-ring, commencing where it would be intersected by a plane parallel to the axis of the piece, and tangent to the upper surface of the trunnions. These sights are used for giving elevations up to 3°. The mode of elevating the gun is by bringing the division on the base ring expressing the required degree of elevation and the notch on the *side* of the muzzle in direct line with the object; the gun will then have the proper degree of elevation. To lay the gun point-blank, the lowest notch on the base ring and that on the side of the muzzle are brought directly in line with the object, and though the gun may have been laid point-blank with reference to the object, it may have several degrees of elevation or depression with regard to the ground or plane of the horizon.

QUARTERS OF REFRESHMENT.—The place where the troops that have been much harassed are put to recover themselves, during some part of the campaign.

QUARTER STAFF.—Formerly a favorite weapon with the English for hand-to-hand encounters, being a stout pole of heavy wood, about 6½ feet long, shod with iron at both ends. It was grasped in the middle by one hand, and the attack was made by giving it a rapid circular motion, which brought the loaded ends on the adversary at unexpected points.

QUATERNIONS.—The name given by its inventor, Sir W. R. Hamilton, to one of the most remarkable of the mathematical methods of calculi, which have so enormously extended the range of analysis, while simplifying its application to the most formidable problems in geometry and gunnery. It would be inconsistent with our plan to give even a complete though elementary analytical view of this calculus; but it is possible, by means of elementary geometry and algebra alone, to give the reader a notion of its nature and value. For this purpose, it will be necessary to consider some very simple, but important ideas with reference to the *relative position* of points in space. Suppose A and B to be any two stations, one, for instance, at the top of a mountain, the other at the bottom of a coal-pit. *Upon how many distinct numbers does their relative position depend?* This can be easily answered thus: B is so many degrees of longitude to the east or west of A, so many degrees of latitude to the north or southof A, and so many feet above or below the level of A. Three numbers suffice, according to this mode of viewing the question, to determine the position of B when that of A is given. Looking at it from another point of view, suppose A to be the earth, B a fixed star. To point a telescope at B, we require to know its altitude and azimuth, its latitude and longitude, or its right ascension and declination. Any of these pairs of numbers will give us the *direction* of the line AB, but to determine absolutely the position of B, we require a *third* number—viz., the length of AB. Hence, it appears that any given line AB, of definite length and direction, is completely determined by *three* numbers. Also, if the line *ab* be parallel and equal to AB, it evidently depends on the same three numbers. Hence, if we take the expression (AB) to denote (*not*, as in geometry, the length of AB merely, but) the length and direction of AB; we see that there will be no error introduced, if we use it in the following sense:

$$A + (AB) = B;$$

i.e., if beginning with A, we take the step represented by (AB), we shall find ourselves at B. From this it follows at once that, if C be any third point,

$$A + (AB) + (BC) = C;$$

i.e., beginning at A, and taking the successive steps (AB) and (BC), we are finally brought to C. But we have also

$$A+(AC)=C,$$

by taking the step from A to C at once. Hence, with the present signification of (AB), etc., we see that

$$(AB) + (BC) = (AC),$$

which shows that lines, *when their length and direction are both considered*, are to be added or compounded according to the same law as velocities or forces. In this sense, a line is called by Sir W. R. Hamilton a *vector*. Again, we have evidently

$$A + (AB) + (BC) + (CA) = A,$$

because the three successive steps bring us back to the starting-point. Hence

$$(AB) + (BC) = -(CA),$$

and therefore (AC) = −(CA), or the sign (only) of a vector is changed if its direction be reversed. The rules for the addition, and, therefore, for the subtraction, of vectors are thus extremely simple; and, without any further preface, we are in a position to solve a great many geometrical problems, some of which are of no common difficulty. A comparatively simple one must suffice; let us prove Euclid i. 33 *i. e.*, if AB be parallel and equal to CD, AC is parallel and equal to BD. In vectors, given (AB)=(CD), prove (AC)=(BD). We have at once, by going directly from A to C, and then by the course A, B, D, C,

$$(AC) = (AB) + (BD) + (DC).$$

But (AB) = (CD) = −(DC) by what we have just proved. Hence the first and third terms of the expression for (AC) are equal and of opposite signs, and therefore

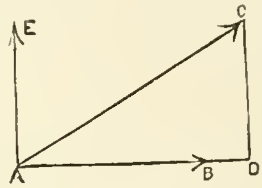
$$(AC) = (BD),$$

This example has been chosen from its simplicity, and gives an extremely inadequate idea of the grasp which vectors take in common geometry.

So far, we have not advanced much beyond common geometrical methods; but we *now* come to the step in which quaternions proper are introduced, a vector being merely a degraded species of quaternion. This new step contains Hamilton's answer to the question, answered over and over again during the last 50 years in forms of the most uncouth complexity, "*How to express the product, or the quotient, of two vectors, or directed lines.*" In other words, keeping to one part of the question only, what is the nature of the factor q in the equation

$$(AC) = q(AB),$$

where A, B, C are any three points? Let us first consider *on how many independent numbers does it depend?* It might at first sight appear to depend upon *six*, for (AB) and (AC), as we have already seen each contain *three*. But let us analyze the process of passing from the one vector to the other, much as we have already analyzed the vector step of passing from one point to another. To simplify the idea of the process, let us suppose it to be effected by a species of rotation. First, then, in



order that (AB) may be turned so as to coincide in *direction* with (AC) it must be turned about an axis perpendicular to the plane of the triangle ABC, and through an angle BAC. Now, the *direction* of a line always depends on *two* numbers, as we have seen above; hence, we will have *two* for the direction of the axis, and *one* for the angle through which AB is turned. But AB and AC are not, in general, of equal length; hence, after their directions have by turning been made coincident, AB must be compressed or stretched till its *length* is the same as that of AC. Thus, a *fourth* number is required for the complete description of the process, and, therefore, q depends upon *four independent numerical quantities*; hence its name, quaternion. A similar investigation, but somewhat less elementary, shows that the *product* of two vectors also depends on four distinct numbers. This will be proved analytically further on in the article. Now, suppose AB and AC to be *equal* to each other, and at right angles; and suppose

$$q(AB) = (AC);$$

i.e., suppose that q turns AB through a right ange in a given plane without altering its length. Apply the operation denoted by q, a second time, and we have

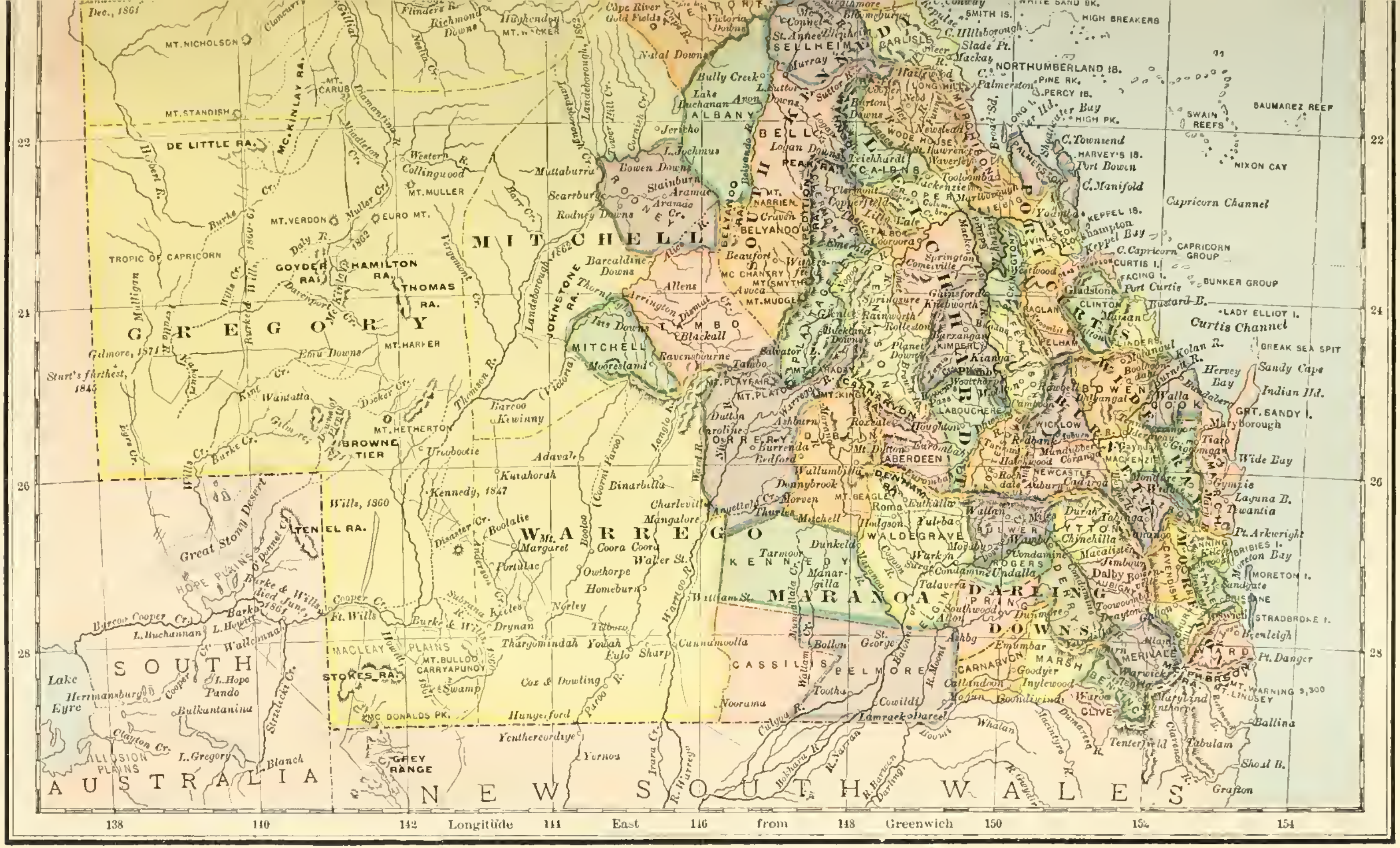
$$q. .q\,(AB = q(AC). \quad q$$

Now q(AC) must represent a vector equal to AC in length, but turned through a right angle in the plane BAC. It must therefore be in the direction of BA produced through A, and equal in length to AB. Hence, by a previous remark, it may be expressed by

$$-(AB), \text{ or by } (BA).$$

Hence, $q.\,q(AB) = -(AB)$, or $q.q = -1$.

The particular quaternion, therefore, which turns a vector through 90° without altering its length, has its square equal to −1. Though, of course, they are essentially a real geometrical conception, this result shows how closely quaternions are connected with what are called imaginary quantities in analytical geometry and algebra. Now it is found, by a careful examination of all the consequences involved, that we are at liberty to represent by a vector of unit length, perpendicular to the plane of two equal lines at right angles to each other, the quaternion which, employed as a multiplier, changes one of these lines into the other. This result we must assume; as its proof, though not in any sense difficult, would require the free use of analytical symbols to condense it within our assigned limits. Hence three vectors, each of unit length, and each perpendicular to the other two, have the property that the product of any two, taken in the proper order, is the third. For illustration, suppose these to be drawn eastward, northward, and upward, and let them be represent-


SOUTH AUSTRALIA
NEW SOUTH WALES
GREGORY
MITCHELL
WARREGO
MARANOA
DARLING DOWNS
Capricorn Channel
Curtis Channel
138 140 142 Longitude 144 East 146 from 148 Greenwich 150 152 154


QUEENSLAND
British Miles
0 50 100 150 200
Geographical Miles
GULF OF CARPENTARIA
CAPE YORK PENINSULA
PACIFIC OCEAN
GREAT BARRIER REEF
Torres Strait
Cape York
Cooktown
Cairns
Cardwell
Townsville
Burke Town
Normanton
Cook's Passage, 1770
Flinders Passage
Herald Passage
Trinity Opening
Endeavour Opening
Osprey Reef
Holmes Reefs
Willis Group
Magdelaine Cays
Coringa Is.
Wellesley Is.
Mornington I.
Plains of Promise
Barkly Plains
Nonda Country
Gregory Ra.
Kirchner Ra.
Richardson Range
Mitchell R.
Flinders R.
Gilbert R.
Palmer R.

ed (according to Hamilton's notation) by i, j, k, respectively; we have the following equations among them:

$$i. j = k,\ j. k = i,\ k. i = j;$$

where it is to be observed that the order of the alphabet is maintained throughout. Also, as before, we see that $i^2 = j^2 = k^2 = -1$.

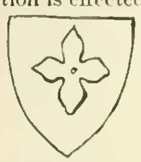
Considering them for a moment as handles to be laid hold of to turn the whole system about one of them, we see that i turns j into the position of k; that is, the operation i may be effected by a lefthanded quadrantal rotation about the eastward line i. What, then, is the result upon the vector i of the rotation symbolized by j? Laying hold of the northward line j, use it as an axis of left-handed quadrantal rotation, and the effect on the system will be not only (as above, $jk = i$) to make the upward line an eastward one, but to make the eastward line a *downward* one; in symbols,

$$j. i = -k.$$

Comparing this with

$$i. j = k.$$

we see that in quaternions, *the commutative law of multiplication does not hold; i. e.*, that the product depends not only on the factors, as in arithmetic and algebra, but upon the *order* in which the multiplication is effected. This is, of course, a little perplexing to the beginner, but is easily got over; and the mere consideration of this fact is often sufficient for the proof of theorems regarded in general as of no ordinary difficulty.



Quatrefoil.

QUATREFOIL.—A heraldic bearing meant to represent a flower with four leaves. It is not represented with a stalk unless blazoned as *slipped*, in which case the stalk joins the lower leaf.

QUEEN.—In its primary signification, the King's Consort, who has in all countries been invested with privileges not belonging to other married women. The English Queen, unlike other wives, can make a grant to her husband, and receive one from him. She can sue and be sued alone, and purchase land without the King's concurrence. The statute of treasons makes it treason to compass her death, or to violate her chastity, even with her consent, and the Queen consenting, is herself guilty of treason. If accused of treason, the Queen is tried by the Peers of the Realm. A duty, amounting to one one-tenth of the value of fines on grants by the Crown, was in former times due to the Queen, under the name of queen-gold. Charles I. purchased it from his Consort, Henrietta Maria, in 1635, for £10,000, but it was not renewed at the restoration. The Queen's Consort is exempt from paying toll, and from amercements in any court. She has a household of her own, consisting of six Ladies of the Bedchamber, a Lord Chamberlain, Vice-chamberlain, Mistress of the Robes, Master of the Horse, and three Equerries, as also her Attorney General and Solicitor General, distinct from those of the King, who are entitled to take a place within the bar along with the King's counsel, and prosecute suits in law and equity for the Queen. It has been the usual practice to Crown the Queen Consort with solemnities similar to those in the coronation of the King. In the case of the *Queen Dowager* is the widow of the deceased King. She retains most of the privileges which she enjoyed as Queen Consort, nor does she lose her dignity by re-marriage; but it has been held that no one can marry the Queen Dowager without permission from the King, on pain of forfeiture of lands and goods. On the marriage of a King, or accession of an unmarried Prince, Parliament makes provision for the Queen's maintenance, in case of her survivance. An income of £100,000 a year, with two residences, was settled on the Queen of George III.; and the same provision was made for the late Dowager Queen Adelaide, at the commencement of the reign of William IV. The Queen-Dowager, when mother of the reigning Sovereign, is styled the Queen-Mother. Until the time of George II, Queens Consort bore the arms of the King impaled with their paternal coat, with the King's dexter and their paternal sinister-supporter; since that period, they have used both royal supporters. It is not usual to place the arms of the Queen Consort within the garter.

The *Queen Regnant* is a Sovereign Princess who has succeeded to the kingly power. In modern times, in those countries where the Salic law does not prevail, on failure of males, a female succeeds to the throne. By an act of Queen Mary, the first Queen-Regnant in England, it was declared "that the regal power of this realme is in the Queen's majestie as fully and absolutely as ever it was in any of her most noble progenitors Kings of this realme;" and it has since been held that the powers, prerogatives, and dignities of the Queen Regnant differ in no respect from those of the King. The husband of the Queen-Regnant is her subject; but in the matter of conjugal infidelity, he is not subjected to the same penal restrictions as the Queen Consort. He is not endowed by the constitution with any political rights or privileges, and his honors and precedence must be derived from the Queen. A Queen Regnant is the only woman who is in her own right entitled to bear her arms in a shield and not in a lozenge. She is also entitled to the exterior ornaments of helmet, mantling, crest, and motto, and may surround her shield with the garter, and the collars and ribbons of all other Orders of Knighthood of which she is Sovereign.

QUEEN ANNE'S POCKET-PIECE.—An ancient 18-pounder cannon at Dover, England. This piece is more than 28 feet in length.

QUEEN'S ALLOWANCE.—An allowance in England, in aid of the expenses of the officers' mess. It is applied towards reducing the cost of wine and diminishing the daily expenses of the mess, in equal proportions, viz., one-half for wine and one-half for mess expenses. This grant is also known as *Regent's Allowance*.

QUEEN'S COLOR.—In the British service, the color carried on the right of the two colors of a battalion of infantry. It is, in the line, the great Union or Union-jack, with the Imperial crown in the center, and the number of the regiment in gold Roman characters below the crown. In the guards, the Queen's color is crimson, with various devices on it.

QUEEN'S REGULATIONS. — Those collections of orders and regulations in force in the English Army, which serve to guide commanding and other officers in all matters of discipline and personal conduct. Financial matters are left to the War Office regulations. The Regulations for the army were first collected in 1788, since when several editions have been issued, the last being in 1873. The current Regulations are supplemented, corrected, and canceled by numerous circulars and addenda; so that they never represent the whole body of military rules for many days together.

QUEUE. A tail-like twist of hair formerly worn at the back of the head by soldiers.

QUEUES D'HIRONDE.—In fortification, lines composed of projecting tenailles, or works, which, from the facility with which an enemy can enfilade their long branches, are considered extremely defective, and consequently are seldom employed.

QUICK-MATCH.—Cotton yarn, of several strands, saturated and covered with an inflammable composition. It is used for communicating fire from point to point in fireworks, etc. The following materials are required in manufacture: *Mealed powder; cotton yarn* wound in loose balls of convenient size (say 1 pound, which will measure about 1,000 yards), such as is used for candle-wick. When doubled and slightly twisted in the fingers it should be about .07 inch in diameter. *Gummed brandy* or *whisky*, in the proportion of 1 ounce of gum to ½ gallon of spirits. The gum is first dissolved in the smallest quantity of hot water or vinegar, and afterward mixed with the whisky. *Strips of paper; thread.* One thousand yards of quick-match require 1 pound of cotton yarn, 8 pounds of mealed powder, $1\frac{1}{4}$ gallons of spirits, and $2\frac{1}{2}$ ounces of gum arabic. Weight when dried, 9 pounds. The following utensils are used in preparing the quick-match: *Wooden* or *copper bowls; 1 quart measure; funnel* or *frame; reel.* Steep the balls of yarn in the gummed whisky until they are quite thoroughly saturated. Make a good paste of mealed powder, by mixing 1 quart of gummed whisky to 2 pounds of powder, and put a layer of it about $\frac{1}{2}$ inch deep in the bowl; on this spread a coil of the cotton by unrolling the ball and distributing it equally on the surface of the paste until there are 5 or 6 yarns over one another; put another layer of the paste, and proceed in this manner until the bowl is full, taking care not to entangle the strands; the last layer of this paste should be a little deeper than the others. After the cotton has been 3 or 4 hours in the bowl, wind it on a reel, or stretch it on nails 40 or 50 feet apart, making it pass through a funnel, or the hand, filled with the paste, and taking care that the several turns of yarn do not touch each other. Before it is dry dredge it with mealed powder; let it dry slowly, then cut it off from the reel or nails and put it in bundles. During the winter quick match should be made in a warm room. Match thus prepared should be hard and stiff, and the composition should hold firmly on. One yard burns, in the open air, 13 seconds. By using *vinegar*, a match is made which burns less rapidly, in the proportion of 4 to 5; and with pure water, in the ratio of 4 to 6. *Alcohol* makes a quicker match, but it cannot be gummed, and the composition does not stick. A slow kind of match is made by adding sulphur to the mealed powder. With $\frac{1}{6}$ of sulphur, one yard of match burns 22 seconds; with $\frac{1}{4}$, 33 seconds; with $\frac{1}{3}$, 53 seconds; with $\frac{1}{2}$, 162 seconds. Quick-match carefully inclosed in tubes burns much more rapidly than in the open air, and more so in proportion as the tubes are made smaller. To communicate fire very rapidly, it is inclosed in paper tubes, called leaders. See *Fireworks.*

QUICKNESS OF BURNING.—The relative quickness of burning of two different powders may be determined by burning a train laid in a circular or other groove which returns into itself, one-half of the groove being filled with each kind of powder, and fire communicated at one of the points of meeting of the two trains; the relative quickness is readily deduced from observation of the point at which the flames meet.

QUICKSTEP.—A lively, spirited march frequently played by military bands.

QUICK TIME.—In tactics, the length of the direct step in *quick time* is 28 inches, measured from heel to heel; the cadence is at the rate of 110 steps per minute, or 2 miles 1613 yards in an hour. See *Cadence* and *Step.*

QUILLED.—In Heraldry, a term used in describing a feather, to indicate that the quill differs in tincture from the rest.

QUILLON.—The ordinary cross-guard of a sword. See *Cross-guard.*

QUILTED GRAPE.—The old pattern grape-shot, which consisted of a round iron plate or bottom, having an iron pin in its center, around which the small shot were piled, quilted with canvas, and tied, so as to appear in form something like a bunch of grapes.

QUINAN BREECH-SIGHT.—An improvement on the pendulum hausse. It is fixed in a socket on the right side of the breech. The scale has a spirit-level, by means of which it is made vertical. The front sight is a short tube with cross-hairs fixed in it. The advantages claimed over the hausse are increased steadiness and accuracy.

QUINTE.—An important guard in fencing. Usually the fifth.

QUINTIN.—An instrument used in the ancient practice of tilting on horseback with the lance. It consisted of an upright post, surmounted by a cross-bar turning on a pivot, which had at one end a flat board, at the other a bag of sand. The object of the tilter was to strike the board at such speed that the rider was past before the bag of sand, as it whirled round, could hit him on the back. Also written *Quintain.*

QUIRITES.—A term applied, in ancient Rome, to the citizens as distinguished from the orgnaized soldiery.

QUISCHENS.—The old term for *Cuisses*, the pieces of armor which protected the thighs.

QUITTING GUARD.—The Articles of War provide that any officer or soldier who quits his guard, platoon, or division, without leave from his superior officer, except in a case of urgent necessity, shall be punished as a Court-Martial may direct. Quitting any post or duty without having received any previous order for that purpose, is severely punished in the army.

QUIVER.—A case or sheath for arrows, formerly worn by archers or bowmen.

QUOIN.—A large wedge, used in place of an elevating screw under the chase of mortars and the breech of short howitzers, to keep them in the proper position when elevating. It has a handle on the large end, by which it is moved.

R

RABINET.—A small piece of ordnance formerly in use. It weighed but 300 lbs., and fired a small ball of $1\frac{3}{8}$ in. diameter, with a very limited range.

RACERS.—Circular rails of metal located in the ground on which the trucks of traversing platforms run. The racers used with wooden platforms are made of wrought-iron, laid with the upper surface raised. For wrought-iron traversing platforms on which heavy muzzle loading rifled guns of less size than the 10-inch stand, flanged racers of wrought-iron are used, but for the guns of a larger size steel is substituted for wrought-iron.

RACHAT DES CLOCHES.—Formerly, in France, when a fortified place was taken, the bells became the property of the Master General of Artillery, which were usually redeemed by the inhabitants of the place at a certain price; it was necessary that the place should be attacked by artillery in order to secure this right over the bells.

RACK.—A straight bar, with cogs or teeth placed along it, so as to correspond with similar cogs or teeth placed on a wheel, thus: If the bar is not movable, the wheel is attached to a traversing frame, and as it revolves, is moved along by the resistance of its teeth to those on the bar. It was in this way that the formation of a railway was first projected, the rail and the driving-wheel of the engine to be both furnished with corresponding teeth. In mechanics, rack-work has innumerable applications.

RACKAROCK.—The name given to a blasting powder formed by the union of two ingredients, one a solid and the other a fluid, both being absolutely inexplosive until combined by the consumer. Many attempts have been made to prepare ingredients that would form an effective explosive immediately upon mixture, but nearly all the plans proposed have proved impracticable from difficulty or danger. The Rendrock Powder Co., of New York, have on the market a powder named as above, the invention of Silas R. Divine. It has been most effectively used in a great variety of operations in tunneling and mining, and has proved to be an explosive of great power—rivaling nitro-glycerine in that respect—and safer than most other high explosives, even after the separate ingredients have been combined ready for use in blasting. In manufacture, transportation, and storage, there can of course be no danger, as the materials are kept separate until wanted for immediate use. A dry oxygen-yielding salt, in a finely-pulverized condition, is packed in cylindrical muslin bags, which form the cartridges. These are dipped into a suitable fluid hydrocarbon—preferably nitrated, as, for instance, nitro-benzole—and allowed to absorb a certain amount, which can be made definite by timing the immersion, or by weighing the cartridges before they are dipped, and arresting the absorption when they have acquired the requisite increase in weight. The porous envelope or cartridge of muslin is an ingenious device. The idea of making explosives by putting the oxygen salt in porous cartridges and then saturating them, seems simple enough after it has once been done, the same as Howe's idea of putting the eye of the needle near the *point*, instead of in the blunt end, seemed simple after it was once disclosed, but the perfection of the invention in both cases was only reached after hard study. Like the invention of the sewing-machine needle, it became necessary to reverse the old processes. The old way in explosives was to make the cartridge fluid-proof—the new way is to make it porous. It allows the free percolation of the fluid to the powder, and when the interstices of the envelope are filled with an oil or fluid that will not mix with water, it resists the entrance of the latter to the soluble salt inside. When the muslin cartridges were first used, they were fully saturated, and removed from the fluid in a dripping condition, and the excess of oil squeezed out by wringing the cartridges. This method was tedious and laborious. At length it was found that by allowing a little time, a small quantity of fluid would equally diffuse through the whole mass of powder contained in the cartridges by capillary attraction. It is desirable not to oversaturate the powder, as there may be too much hydrocarbon for complete combustion with the oxygen furnished by the dry salt. An excess of hydrocarbon will cause more smoke when the powder is exploded, and will not give so high a result dynamically.

In practice, the cartridges are placed in a wire basket and lowered into a pail or vessel containing the fluid, and allowed to remain a certain number of seconds, depending upon the diameter of the cartridges.

For $1\frac{1}{4}$-inch cartridges, about 6 seconds.
" $1\frac{1}{2}$- " " " 8 "
" $1\frac{3}{4}$- " " " 10 "

The cartridges saturated as above, if cut open after saturation, will present in the center of the cross section, an area about the size of the end of a lead pencil which is not wet, but which will be wet if the cartridges are allowed to stand a few minutes before using, as the oil will equally diffuse by capillary attraction. When this mode was first adopted the wire basket containing the cartridges was hung on a spring balance and alternately dipped and withdrawn until the desired increase in weight was obtained.

Mr. A. C. Rand proposed to secure the right proportions by immersion for a certain definite time for each size of cartridge. This plan was successful in practice, and has been in constant use since its adoption. Another mode of securing proper proportions of dry salt and combustible liquid has been introduced by the manufacturers of Rackarock. This is to mix a very volatile liquid like carbon disulphide, with a fixed oil like nitrobenzole, and allow the cartridges to become completely saturated. Then they are allowed to remain in the open air until the volatile ingredient has evaporated, leaving the proper amount of fixed oil in the powder. This mode has also been successful in practice. With reference to the use of nitrated hydrocarbons, it may be stated that the greater the quantity of oxygen that is contained the less the relative weight of the oil that is to be mixed with the oxygen yielding salt. When the hydrocarbon is present in such quantity that the carbon can only be burned to carbonic oxide instead of carbonic acid, the mechanical result is not so great, and more smoke is evolved on explosion. The cartridges when properly prepared are practically waterproof, and remain good for some days in wet drill-holes, as the oil repels the water and prevents its permeating the powder through the muslin. The consistence of the prepared powder is like that of damp brown sugar, and it may be closely packed in the drill-hole, especially if the muslin is slit before the cartridges are dropped in and rammed.

The specific gravity of the powder is from 1.7 to 2 and its density allows the concentration of great power in a small space. It gives the highest results in hard compact rock, and is much used in tunnels, drifts, and shafts, where the rock is firmly bound. The gases produced during combustion are not sickening like those from nitroglycerine and the dynamites.

The sensitiveness of Rackarock can be increased or decreased by special means employed by the manufacturers, and one variety that has been largely used will not explode with a fulminating cap without confinement. In the open air at common temperatures the powder will be scattered about without exploding when a fuse and cap are inserted in a cartridge and fired. But when confined in a drill-hole the powder receives an impact from the detonating primer that causes the whole mass to explode.

RACKING.—It has been shown that the penetration of a projectile depends more upon velocity than weight, and that the elongated is a better form than the spherical for mere penetration or *punching*. It must, however, be remembered that very heavy shot, fired with velocities which might not enable them to penetrate or punch holes in iron armor, may still do great damage, especially if many are fired successively, by breaking bolts and shaking the whole fabric; also, that a spherical shot, having a larger diameter than the elongated projectile, may often do more damage in cracking or shattering a plate, than the latter in *punching* it, the *work* done by the ball being distributed over a larger area. The same argument will apply to the case of two elongated projectiles, having different diameters, striking a target with the same force, as measured by *work*. Hence there are two general methods of attempting the destruction of iron-clad vessels, termed respectively *racking* and *punching*. The American shave shown a preference for the racking system, which requires heavy projectiles of large diameters, fired with low velocities, to destroy and shake off the armor by repeated shocks without penetration, and thus to expose the vessel to the effects of ordinary projectiles. It is believed that the two forces may prepare the way for each other, so as to produce a more formidable result than when they are independently exercised. The defect of the light-shot system when the range is very long or the armor very thick, and of the heavy-shot system when the range is even very short and the armor is laminated, or so constructed as to suffer little from racking and shaking, is the waste of power in producing local effect, that is fruitless because it is incomplete. By combining the two systems, the light fast shot may weaken the armor by the loss of substance and continuity, until the heavy shot can carry in a large section of it bodily; and at the same time the general straining and cracking of plates produced by the heavy shot will make punching all the easier.

The theory in favor of the *racking* system is, that heavy projectiles may be fired with low velocites without straining the gun; that blows given in this way waste no power in punching mere holes, but that the entire work will be expended in straining, loosening, and dislocating the armor and breaking its fastenings, tearing it off and exposing unprotected spots easily vulnerable to shells, at the same time racking and breaking the ribs and sides of the vessel to such extent as to render her unseaworthy. For producing these effects the 15-inch gun, throwing solid cast-iron balls, is quite as formidable as the powerful rifle expending costly bolts; but the accuracy of fire from the rifle is so greatly superior to that from the smooth-bore, as to leave a large margin in its favor. Spherical shot, and slow shot of any form, will do very little execution under water. The concussion from racking blows, although it may not seriously injure the vessel, stuns and temporarily paralyzes many of the crew, and spreading terror to all, greatly interferes with the efficient working of the ship and of her armament. See *Armor-plates* and *Punching*.

RACKING DOWN.—An operation performed with the aid of *rack-lashing* in laying a gun or a mortar platform, for the purpose of securing the flanks and the ribands of the platform together, so as to prevent them from moving.

RACK-STICK AND LASHING.—A piece of two-inch rope, about 6 feet long, fastened to a picket about 15 inches long, having a hole in its head to receive the rope. Rack-lashings are used for securing the planks of a gun or mortar platform, between the ribands and the sleepers.

RACKUMITICK.—A large javelin skillfully used by the Hottentots. With this weapon, they venture to attack the elephant, the rhinoceros, and even the lion.

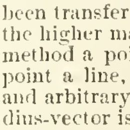
RADIAL DRILL.—An upright machine, designed for drilling a series of holes without changing the position of the work. The value of a radial drill in the armory consists, primarily, in the readiness with which the drill can be moved to the work, or shifted over the various parts of the work, requiring to be drilled. In the use of radial drills having the swinging arm at one fixed and unalterable height above the floor plate, the work must either be blocked up to suit the height of the machine, or extension pieces must be used to lower the drill to the work. In Sellers' machines the swinging arm is raised and lowered by power, and thus quickly adjusted to the proper height, so that the work to be drilled has only to be brought under the drilling machine in any convenient position and height, and the drill is then quickly set to suit the height of the work, thus saving much time. Too much stress cannot be laid on this feature of these drills. As the saddle carrying the swinging arm is so fitted and of such a length as not to require any bolting to place, this adjustment of height is rendered simple in the extreme. The feed motion is obtained through adjustable feed discs. It has a wide range through two series, one for the single gear, the other for the double gear, and can be put on or off instantaneously by a tap of the hand on a lever close to the hand-wheel. All the adjustments of the machine are quickly made, the shifting of the back gear into or out of use being as readily done as on any well-made turning lathe. A convenient clamp is arranged at the bottom joint of the swinging arm to enable the radial arm to be secured in position; but if the drills used are correctly formed and run true, the arm needs no clamping to place.

RADII OF RUPTURE.—In military mining, to effect an explosion of the surrounding ground, a charge of gunpowder is used, which, according to its strength, and the nature of the ground, and the depth at which it is placed, more or less affects the quantity of earth to be displaced. Such an explosion raises and scatters a portion of the superincumbent earth, and causes a hollow or crater. Besides this effect, an internal commotion is caused, capable of injuring or destroying shafts or galleries in the immediate neighborhood. The distances from the charge to which this commotion extends are called *radii of rupture*.

RADIUS.—1. In fortification, a term applied to a line drawn from the center of the polygon to the extremity of the exterior side. There are the *exterior*, the *interior*, and the *right radii*. 2. In geometry, the radius is a straight line drawn from the center to the circumference of a circle. In trigonometry, the radius is taken as unity, and the sines, cosines, etc., are expressed in terms of it. In astronomy the same term is employed in a slightly different sense; and to prevent confusion it is changed to *radius-vector*. The radius-vector is a straight line drawn from the center of force to the position of a body which describes its orbit round the center; if the orbit is a circle, the radius-vector is invariable in its length, but constantly changes if the orbit be any of the other conic sections. From astronomy the term has been transferred to what are callad *polar equations* in the higher mathematics. To express a curve by this method a point is taken for the *pole*; through this point a line, the *axis*, is drawn, indefinite in length and arbitrary in direction; then as one end of the radius-vector is at the pole, its inclination to the axis, and its length at this inclination, will give a point in the curve. Equations of curves, when thus expressed in terms of the radius-vector, and its inclination to the axis, are called *polar co-ordinates*, and are generally much simpler in form than when expressed by rectangular *co-ordinates*.

RAFTS.—Baulks of timber lashed together to form a bridge for crossing a river or stream, when more perfect means are not at hand. From their low degree of buoyancy, however, they are seldom employed. Fir, pine, hazel, poplar, juniper, larch, and willow, being the lightest woods, are the best for making timber rafts. Rafts of timber should not be used in rivers where the velocity of the current exceeds 6 feet per second, or 4 miles per hour. Good rafts can be made of casks or barrels, and form a better bridge than baulks of timber. See *Bridges*.

RAGULED.—In Heraldry, jagged or notched in an irregular manner. A *raguled cross* is one made of two trunks of trees without their branches, of which only the stumps appear. Also written *Raggued*.



Raguly.

RAGULY.—In Heraldry, a term applied to an ordinary whose bounding lines are furnished with serrated projections.

RAID.—A hostile or predatory incursion, especially an inroad or incursion of mounted men; any sudden and rapid invasion by a cavalry force.

RAILLON.—The French term for a short arrow or quarrel.

RAIL PLATFORM.—This platform for siege-mortars consists of three sleepers and two rails for the cheeks of the mortar-bed to slide on, instead of the deck-plank, and is very strong, and easily constructed and laid. The pieces being notched to fit, are driven together at the battery, the distance between the center lines of the rails being equal to that between the center lines of the cheeks. The earth is excavated eight and a half inches, the depth of the sleepers, and the bottom made perfectly level. The directrix being exactly marked by stakes, the platform is placed in position, its center line coinciding with a cord stretched between the stakes marking the line of fire. The earth is filled in as high as the upper surface of the sleepers, and firmly rammed; and the stakes are driven in the rear angles formed by the sleepers and rails, and one at the rear end of each rail.

RAILROADS.—Railroads have played an important part in recent wars. Beginning with the Crimean war of 1855, and ending with the late wars in Europe, the military student will be struck with the importance of this class of communications in the efficient supplying of an army, and in the concentration of troops. By their use, numbers are concentrated and supplied in a space of time which was not dreamed of in the beginning of the present century. It is safe to predict that, in all future wars in civilized countries, the railroad will be the line of communication for an army. If a system of railroads already exists, this system will be used ; if not, temporary lines of railroad will be constructed. It has now become an important part of an officer's education to understand the principles of construction, and the working, of railroads, to know how they can be preserved, and how they may be destroyed. The construction of a railroad for military purposes differs from that intended for peaceful traffic only in the degree of its very great excellence. Economy and rapidity are the most essential qualities looked for in the construction of a military railroad. The principal things in its construction are the grading and the laying of the track. Grades and curves are necessary evils incident to railroads, and a proper selection of them requires an exercise of good judgment, in many cases. Sometimes, the track may be laid on the natural surface of the ground, or with so little filling and excavation as to amount to the same thing. The placing of the cross-ties, the spiking of the rails, and the general finishing of the road are better done, when men used to this kind of labor can be procured. Usually there can be found among the troops, a great many who have a practical knowledge of this class of construction, and these men can be profitably used as foremen and superintendents of the working parties.

The successful working of a railroad requires an efficient superintendent, as much as it requires sufficient rolling-stock and good locomotives. A good man for superintendent can generally be obtained from some of the railroad companies, but he has the defect, as a rule, of knowing nothing of the peculiarities of military service. Nevertheless, his experience and knowledge will be of great service to the military officer in charge of the road, and the working may thus be made successful. From the numbers employed upon the railroads in the United States, there will be no difficulty, in future wars, in the government obtaining as many men as may be necessary, who will be thoroughly cognizant of the duties that may be required of them. In the beginning, there will be some friction and irregularities, but these will wear off, and an efficient corps of trained men can soon be formed. It would be better, however, if "time were taken by the forelock," and a skeleton organization formed in advance. Engineer officers should pay particular attention to this part of their profession, and on short notice organize bodies of workmen whose special duties will be those assigned to construction, working, and preservation of railroads. And since the other officers of the army, are more or less liable to be assigned to duties connected with the preservation, as well as the construction, of these roads, it is equally incumbent on them to acquire this knowledge and be able to put it to a practical use.

The movement of troops by railroad may be divided into five distinct parts, viz:— 1 The march to the point where the troops are to get into the cars. 2. The embarkation. 3. The journey. 4. Leaving the train at the end of the journey. 5. The march from this point to the place of camping. A careful examination made beforehand of each portion of the movement will add greatly to the soldier's comfort, and prevent much confusion, delay, and annoyance. Elaborate rules are laid down, both in the Prussian and French services, for moving troops by rail, and it is recommended that these be read by officers who desire to inform themselves on this subject. A line of railroad used as a line of communication of an army with its base, is protected in a great measure by the army itself. It is, however, liable to injury from cavalry raids of the enemy, and from the acts of a hostile population, if they be present. The parts most liable to be destroyed or injured are the bridges and tunnels. Guards should be stationed near these points, and be protected by field-works or block-houses. The general track of the road should be carefully watched by trackmen and patrols. Cavalry detachments should scour the approaches in every direction, to give timely notice of approaching raids, and to arrest suspicious persons in the vicinity of the railroad.

The destruction of a railroad, or an injury inflicted upon it so that it cannot be quickly repaired, may form, at times, the special duty of any officer. There are two general cases; one, where the injuries inflicted are to prevent its use by an enemy ; and the other, where it is desired to do as much injury as possible, and render the work irreparable, compelling an actual reconstruction of the road. The first consists in removing parts of the rolling-stock and hiding them, or, where rails cannot be obtained, in removing the track at various intervals.

The following is a method of removing the track to render the road temporarily useless: Select a part of the track laid on a high embankment. Tear up the rails of the extremities of the part to be removed. Line the outside of the track with men for the whole length of the portion to be taken up, and have the men to face inwards. At a given signal the men seize the rail next to them; and, at another signal, all lift the rail, raising it and the ties to a vertical position, when they let the whole fall over the embankment. If the road is ballasted, the men must provide themselves with levers to lift the track. The portion thrown over the embankment cannot be replaced until the rails are unfastened from the ties, and this takes time. The second case consists in removing the rails and bending and twisting them so as to render them unfit for use in repairing the road; in burning or blowing up the bridges; destroying the tunnels; disabling the rolling stock, etc. Locomotives can be temporarily disabled by removing parts of the machinery. They may be permanently disabled by firing a round shot through the boiler. Another way, is to let out all the water in the boiler and then build a large fire in the fire-box ; the fire soon destroys the flues. All other kinds of rolling-stock may be temporarily disabled by removing parts, or permanently injured by burning them.

Some labor is required to bend and twist the rails, as it is not an easy matter to remove the rails from the ties. Workmen have special tools for drawing out the spikes and unscrewing the nuts, but these tools are too heavy to be carried upon a raid, where time is so important an element. But when the rails have been taken up, and there is time, it is recommended to form the ties into heaps, and set them on fire. Then to place the rails on the burning heap, loading the ends with other ties. As the rails become red hot, they will bend under the load, and cannot be used again until they are straightened. This bending may also be done by men catching the ends of the rail and bending it, while heated, against a tree or telegraph pole. Rails which are simply bent can easily be straightened by re-heating and hammering. Where only slightly bent, they can be straightened without even being re-heated. To make them useless, it is necessary to give the rail a twist. A twisted rail can only be used again by being re-rolled.

Wooden bridges may be destroyed by burning. A simple device called a torpedo was used in our late war for destroying wooden bridges, where time was of importance. A bolt of ⅞ inch iron, 8 inches long, with head and nut, was used. The head was 2 inches in diameter, and about 1 inch thick. A tin cylinder, 1¾ inches in diameter, open at both ends, enclosed the bolt, and was held in place by the head and the nut. A washer between the head and the cylinder made it tight at that end. The cylinder was filled with powder, and an arrangement made for a fuse near the nut. A fuse was inserted and the nut screwed on, and the torpedo was ready for use.

In using it, a hole was bored into the timber with an augur. The head of the bolt was inserted and was driven by a hard blow into the hole. The fuse lighted, and the explosion tore the timber in pieces. As the railroad bridges to be destroyed were ordinary truss-bridges, it was only necessary to insert a torpedo in one of the main braces, or if these braces were in pairs, in the two pieces forming a pair. The destruction of these braces at one end, or on one side, was sufficient to wreck the bridge.

The importance of guarding a railroad, and of having a good construction corps thoroughly organized to repair the damages, was illustrated in the war of 1861-5. This war illustrated the uses of the systems of railroads already in existence for military purposes, and also the great advantages of temporary railroads to perform a given service.—See *Railway Communication.*

RAILWAY COMMUNICATION.—In looking for the quickest and simplest method to make a railway for military communications in a strange country, and for the most suitable material and plant to use in its construction, it is well to have a description of the various gauges of which railways are usually made; to study the powers and capacity of different locomotives and rolling stock for these lines; and to consider the time, labor, and cost of making a railway. Before commencing a study of these three subjects a statement will be given of what has been done in making railways in war time, excluding any account of their construction for the same purpose in civilized countries, such as the case of the Prussians, who made a railway round the fortress of Metz, and at the destroyed tunnel of Nanteuil; or the railways made by the Russians from Bender to Galatz, and from Fratesi to Zimnitza. After a season of great suffering to the troops engaged in the siege of Sebastopol, caused partly by the difficulty of communicating with their base at Balaclava, a railway was constructed of the ordinary gauge of 4 ft. 8½ in. About 21 miles of track were made of single line: civil engineers with a working staff of natives were employed in its construction. The rolling stock consisted of five locomotives of 12 to 18 tons weight, and about 40 ordinary side-tip ballast trucks; one of the locomotives was worked as a stationary engine to haul trains up a short incline. This railway never had the capacity for transporting all the supplies required by an army engaged in a siege. It did a fair amount of work at the re-embarkation of the troops on the conclusion of peace, but it would have been of no use if hostilities had been continued on a different line of operations.

It must not be attributed to any failing of the Army Works Corps that better results were not obtained from this line, for it was composed of a staff thoroughly practiced in railway construction; the mistake was in having only one line of rails instead of a double line, which is indispensable to insure uninterrupted traffic; and in the plant being cumbersome and quite unsuited for military requirements. For the Abyssinian campaign materials for a railway were collected in India from the public works and other sources, and a works corps of natives for laying the line was raised in Bombay. In the month of November, Government came to the decision of sending railway plant to Abyssinia; in the following January, work was commenced at the landing place in the Red Sea, at Zoulla; and about the end of March, 12 miles of the line were opened for traffic, giving a rate of progress in constructing of one mile a week. As the railway took so long to make it was not of much use to the expedition. The chief causes of delay in making this railway may be attributed to the materials having been shipped from India without any system, any transport vessel that could afford space being employed. The plant was all for the Indian standard gauge of 5 ft. 6 in., which was heavy and difficult to handle under unfavorable conditions of landing appliances; the rails were also of different sizes and weights, giving much additional labor and loss of time in laying. For rolling stock four contractors' tank locomotives, which had been much used, were supplied; half of them were constantly under repairs. The material for making bridges consisted of rolled-iron floor-joists for barrack buildings, which were procured from Aden. One great advantage of a railway at a point of debarkation was noticed on this occasion—the saving of labor that was effected by being able to run the trucks on rails into the water, so that boats with stores from the transport vessels could be unloaded directly into the trucks. For the war in Ashantee, where the objective was to force the troops over many miles of the wildest African bush country, some steam-sappers (road traction engines), adapted for running on rails, were sent from England, and light rails were shipped for making a railway of 4 ft. 8½ in. gauge. This plant could not be well utilized for the following reasons: It was difficult to land heavy stores on a beach that had a surf constantly rolling on it; the amount of labor required to clear a track for so wide a gauge through the bush would have been excessive; and the period of fair season at the disposal of the General for the accomplishment of his enterprise was too limited for making a field railway of the full gauge of 4 ft. 8½ in. A light portable surface tramway (such as is hereafter described), with light trucks that could have been pushed by manual labor, might have answered in Ashantee for transporting stores and provisions better than the swarms of carriers that had to be employed for supplying the force that went on to Coomassie. A tramway of this class could have been laid quite as fast as the troops cut their path through the bush. These are the attempts that have been made by England to construct and utilize railways for troops in the field. They have not been very successful, owing to the plant used for them being unsuited for military requirements and being hastily got together. The 4 ft. 8½ in. gauge of the ordinary permanent railways is adapted specially to heavy and rapid traffic; its carrying capacity is greatly in excess of what is likely to be required for a force operating in an enemy's country. The plant is heavy, and it takes a long time to make a line of this gauge, which must be well and truly laid to take the rolling stock adapted for it. The rails should be 78 lbs. to the yard; a mile of line of single rails weighs 272 tons, and costs about £1,700. The ordinary plate-laying gang of three superintendents, thirty plate-layers, and forty laborers, can only lay a mile of this track in thirty hours. A field railway is only a similar line to the above, with a very much lighter rail of about 42 lbs. to the yard; it weighs 131 tons and costs on an average of £737 to the mile. The same plate-laying party can make a mile of field railway in twelve hours. In its construction nearly the same curves of large radius are required, and the gradients cannot be made steeper, while the rate of traveling on it is much slower than on a permanent line of the same gauge. In India a meter-

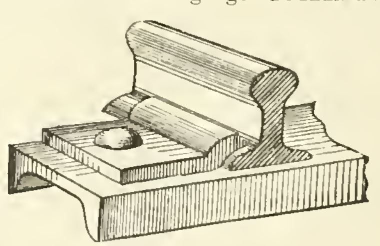


Fig. 1.

gauge has been adopted on some of the Government lines: it is 3 ft.3⅜ in. wide; rails of 36 lbs. to the yard may be used for it; the line weighs about 106 tons and costs £590 to the mile. Railways of this gauge are made for quick traffic, and require to be laid nearly as well as wider lines. The rolling-stock which is made in England and sent out to India, is of a heavy nature; the locomotives weigh 16 tons, and the carriages, which are iron-framed, weigh about 3½ tons. The United States have lately adopted the 3 ft. gauge in a great many lines, which answer their purposes just as well as the wider permanent railway. They can construct the lines with great rapidity, progressing as much as four miles in one day, including forming the earthwork. The Americans carry these light railways over the most difficult country, and up ravines and over mountain passes where it seems almost impracticable to make any sort of road. There are portable railways made in England as well as in France, which possess all the requirements of a military line. They are of various gauges, but the 2 ft. 6 in. wide has advantages over the narrower gauges—such as the power and speed of the locomotive, the capacity of rolling stock, and the great simplicity of parts. These seem to point to this gauge being more suitable for military purposes than the narrower ones. The rails are of steel, of 30 lbs. to the yard, fixed in lengths of 12 ft, to the sleepers; the sleepers are also of steel, made of various sections. The most convenient seems to be the U-shaped Fig. 1; these can be placed at any distance apart to suit the nature of soil. One section of rails of this tramway of 12 ft. weighs 310 lbs., and forms an easy load for four men to handle in laying the line, which is intended to be a surface line. It can be laid very fast by inexperienced men —about nine miles in a day. It is easily taken up, removed, and relaid in another situation. The plant for the track is complete in all its parts, such as curves, points, and crossings; it is also very compact for shipment. Some very narrow-gauge railways have been made in North Wales; the line to Festiniog is 1 ft. 11½ in. wide; passenger and mineral traffic have been running on it regularly for some time. This

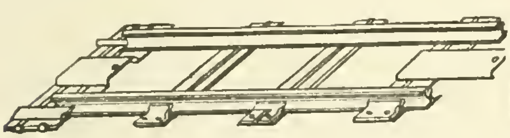


Fig. 2.

railway is 13¼ miles long and rises 700 ft. the gradients are from 1 in 70 to 1 in 180, and the curves of 2 to 30 chains radius; the locomotives, which are of Farlie's pattern, weigh about 8 tons, and can draw trains of 120 tons at an average speed of 12 miles an hour; the rails are 30 lbs. to the yard, and the sleepers are of wood. Railways are made of an even narrower gauge, 18 in.: they are much used in H. M. Dockyards and the Royal Arsenal. This gauge has been adopted in the service for a tramway to run along trenches and parallels to supply the artillery and engineer requirements of sieges. There are two types of this tramway—one with rails on wooden sleepers, and the other of a portable description. The first is that which has been taken for the service; it is designed for laying down without noise at night, this being a necessary requirement in making a tramway in siege trenches; the sleepers are of wood, 3 ft. 6 in. long, 7 in. wide, by 3 in. deep; the rails are fixed to these sleepers by T-headed coach-screws. With rails of 24 lbs. to the yard, 14 men can lay 100 yards of trench tramway *in the dark* in an hour. The other description of portable tramway of the same gauge is made of steel rails, 18 lbs. to the yard, secured in lengths of 10 ft. to steel-plate sleepers, Fig. 2, it is a handy line for laying on the surface of the ground, and is much used for agricultural and the numerous manufacturing purposes. Each section of 10 ft. of rails, with all the sleepers attached, weighs about 180 lbs., so that two men can very easily carry it; a party of 14 men can lay 400 yards of this nature of tramway in an hour. The end sleepers are made to lock, so that the joint at the rail ends is quite secure; with wooden sleepers, fishplates should be used to fasten the ends of the rails; this is very necessary on all roughly-laid lines. It would be thought that this gauge of tramway would be suitable for all military requirements besides siege work; but it is only applicable on very flat sites, and the engines for it have so little power that they would not be equal to the wants of keeping uninterrupted communication for an army. They answer perfectly in the Dockyards and the Arsenal, and are admirably adapted for laying in a trench; the engines would, however, fail in the event of a long line being required, or one over a rough country.

Systems of light tramways on structures raised from the ground have been suggested for the use of armies. One of these tramways, designed by Mr. Fell, Fig., 3, has been experimented with at Aldershot. It consists of rails on the edges of beams sup-

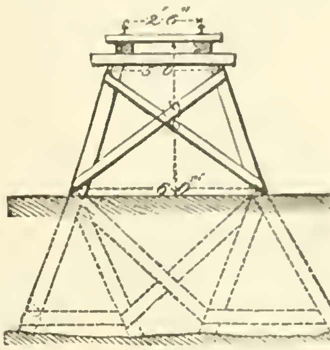


Fig. 3.

ported on trestles of various heights to overcome the inequalities of ground, the principle being to dispense with cuttings and embankments as far as possible, and to use trestles whenever the earthwork exceeds 3 or 4 feet in height. Mr. Fell has worked his scheme out still further, and suggests the adoption of iron lattice-girders on posts of a quite similar construction for raising the track over hollows, or those places wherever the rails cannot be laid on the surface of the ground. There are advantages in this method of making a railway; the raised portions of the work keep the line above the influence of rains, and make the least disturbance of natural watercourses. It requires time, however, to put together elevated iron or wooden structures, and a great deal of material is necessary; for instance, one mile of modern structure for this railway, with an average height of trestles of 3 ft. 9 in., takes 250 tons weight of material. The results of the trials of Mr. Fell's railway, which was erected at Aldershot, were as follows: An engine weighing 4½ tons, took 25 tons of load up an incline of 1 in 50; at a speed of 25 miles an hour trestles, 20 feet high, were quite steady. It was found that 500 soldiers could lay two miles of this class of tramway, after a little practice, in a day of 10 hours. Another style of raised tramway has been designed by Mr. Hadden, Fig. 4. The structure can be made of wood or iron; it consists of a single upper rail or beam, fixed on posts 7 feet high, let into the ground 3 feet; there are also lower or grip rails made of wood, which are halved and let into the posts. These have saw-cuts in them to admit of their bending to take curves in the line of 100 ft. radius. The breaking strength of the structure is estimated to be 20 tons. The materials for one mile of this tramway are stated to measure 40 cubic ft. and to weigh 80 tons. The rolling stock consists of pairs of boxes of panniers suspended on the upper rail or beam by means of central wheels or rollers with V-shaped tires; they also often have horizontal wheels acting on a lower or grip rail. These boxes are ingeniously contrived to take stores, horses, and passengers, and may be used as pontoons for taking loads across rivers. By employing long ropes, trains may be drawn by animals towing alongside of the raised tramway. The locomotives to be used on this raised tramway are reported by Mr. Hadden to be capable of drawing a load of 100 tons up an incline of 1 in 10; they are said to gain the necessary power by acting on the grip principle instead of by gravity and traction like ordinary locomotives. The driving machinery is located on a carriage by itself, and the power is very conveniently applied to one pair of the horizontal wheels on one side of the grip rail; the steam is generated in two boilers, placed in front and behind the engine truck. It is further stated by the inventor that an endless rope or chain attachment can be applied to all the wheels on one side of a train, giving continuous grip power for ascending gradients and break power for descending steep in-

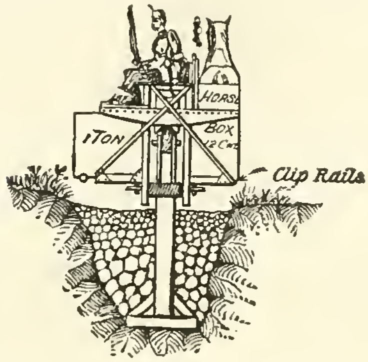


Fig. 4.

clines. The draw-bars connecting the trucks of a train are devised to work automatically on the driving action of the wheels, increasing or diminishing their grip or break power according as the strain on the draw-bar is augmented or decreased by variations in the gradients the train is traveling over. Whether the engine and the draw-bars can be perfected and made to perform these various duties remains to be proved by experiment. With regard to raised railways, it should be observed that they obstruct traffic crossing them—this is objectionable in a military point of view; they do not lend themselves to the drawing of loads by manual labor or by animal power as favorably as surface lines; sidings are not easily managed on raised structures; separate bridges are required for the passage of rivers when the carriages cannot be run on rails on the roadway of pontoon or other field bridges; they require a great deal of time to construct, and take much material; and they are not so easy to take up and relay as surface lines, and are more destructible.

In treating of lines of railway for military purposes, the use of locomotives upon them must be taken into consideration; for although the line may at first be worked by horse or by other means of draught, it must eventually be adapted to engines to make it of any use for keeping up the supplies of an army in the field. It will be advisable to look at the different natures of locomotives, and to see which appear to give the best results of work under the special conditions of service in a strange country.

Taking the ordinary passenger or goods engine of permanent lines, it will be seen to be a very heavy machine to handle, particularly in situations deficient of appliances for landing such engines. They possess great power and speed, but are too cumbersome to be used on a light line; they require the railway to be laid with care and to be nearly level, that is with gradients not exceeding 1 in 70; and they cannot work round sharp curves, 15 chains being the maximum that can be safely got round with engines of this class. The weight on each pair of driving wheels is so great, 10 to 15 tons, that the rails require to be heavy to stand the traffic. There are contractor's and tank engines which are very suitable to roughly-laid lines; they weigh about 16 or 18 tons; they seem, however, beyond the limit of weight that should be adopted for military lines. The same remarks apply to the class of engines that are used for the meter-gauge lines; they weigh about 16 tons, giving 6 tons on each pair of wheels, and, like the others, are constructed for quick speed; they are also not easy to handle under difficulties. The small engines made by Manning, Wardle & Co., and which are extensively used in H. M. Dockyards and the Royal Arsenal, are not powerful enough to take a load up a steep gradient; they are very well adapted for the 18-in. gauge of rails on level sites; they will take sharp curves and have good speed; but the lines of these locomotives must be well laid and almost level; that is the reason why such good results have been obtained from these engines in the dockyards and the arsenal, where the rails are generally cast in solid iron plates and the sites are perfectly level. The Royal Engineer Committee designed an engine for the 18-in. trench tramway, which has some advantages over the locomotives last described. It possesses the following characteristics: The working weight of the locomotive is 8 tons; the driving wheels are on a rigid base of only 3 ft., admitting of its traveling on very sharp curves; the engine is furnished with a "rail-clip" constructed on the Handyside principle, and has also a winding drum on the part, with 400 yds. of very strong steel-wire rope worked by a distinct pair of engines to the ones required for driving the locomotive; the last two appliances enable it to get up a very steep gradient; by sending the engine up by itself, and then, by clipping the rails, it can draw the train after it by means of the rope. In trials made with this locomotive, 25 tons were drawn on the level on a very roughly-laid surface line; up a slope 1 in 25, 7 tons could be drawn by the engine attached in the ordinary way; this incline had a curve in it of 25 ft. radius; the engine could just steam up a slope of 1 in 11, and draw 10 tons up the same by means of the "rail-clip" and the winding drum. There is another method of applying winding power to an engine; it is a suggestion of Mr. Russell Shaw, C. E., and consists of a chain securely fixed at the top of an incline, and the locomotive is furnished with a clip-drum that can catch up the chain. The steam-power generated in the boiler will serve to wind up a loaded train by means of this chain and drum, and, by reversing the action, the chain can be made to break the descent of the train down the same incline. It would be well to convert one of the Royal Engineer Committee locomotives to this system of haulage, so as to test the appliance.

To afford means of crossing wide rivers with a tramway, steel boats of the same description as were advocated by General Sir Lintorn Simmons, G. C. B., could be employed as pontoons for a floating bridge. The locomotives would have to be taken over the water on rafts made of these steel boats, for use with trains on the opposite side of the stream, as it is doubtful whether they could be steamed across a river on any sort of floating structure. As floating bridges for a double line of rails would have to remain some time in position, the steel pontoons advocated would be more suitable than the service pontoon bridge, and besides, the pontoon train would have their own functions to perform in the front with the troops. An idea of the sort of steel pontoon tramway wagon on bogies is given in Fig. 5. The boats are made to rest on the frame which forms the longitudinal bearers or superstructure of the bridge for the rails of the tramway; when the boats are not required to form a bridge, they would thus be available for freight wagons. Whatever kind of rolling stock is adopted for military service, it is absolutely necessary that every carriage should have its break to render perfectly safe the drawing of wagons individually by animal draught, and also to have complete control over a train descending inclines. The "Heberlein" continuous break is well suited for this purpose. It can be applied by the engine driver of the train or by the guard, and can also be put on by a person on the side of the wagons. It should be observed that, though the bogie-truck system is recommended for military rolling stock as being the safest to travel on roughly-laid lines, and as giving the power to make sharp curves on a railway, there is another plan of "flexible wheel base," invented by Mr. James Cleminson, which has all the advantages of bogies. By this method the defects of a rigid wheel base are overcome, the carriages travel smoothly and safely round sharp curves, and the rolling stock can be made much lighter in weight than ordinary railway carriages. They have been constructed to take ten passengers, or three tons to every ton weight of the carriage, giving about two tons on each pair of wheels on the rails. The rolling stock that has been approved for the trench tramway is on the same principle as is advocated for military railways; it consists of platform wagons 18 feet long Fig. 3, 6, and 7, which are well suited for transporting the requirements of troops at sieges, such as fascines, rails, and timber for gun platforms and splinter proofs. These platform wagons run on bogie trucks, they are easily drawn by men and by a horse pulling at the side of the wagon, and are made low so as not to be seen by the enemy over the earthwork of the parallels. Trucks for siege purposes have been made for the transport of artillery to the batteries; they are particularly suitable for this work, saving the very heavy labor to the artillery of arming their batteries by transporting the guns over the open country during the night. The weights of the siege guns of the present day would make this operation one of grêat difficulty if a tramway in the parallels were not available.

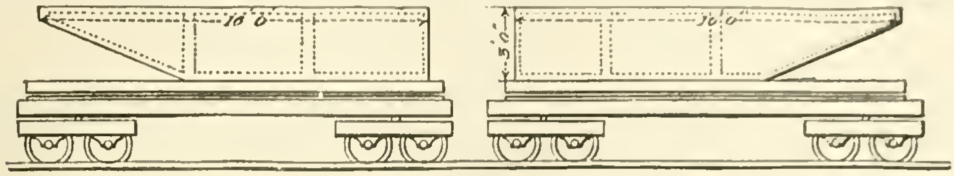


Fig. 5.

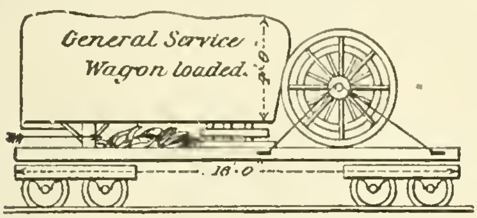


Fig. 6.

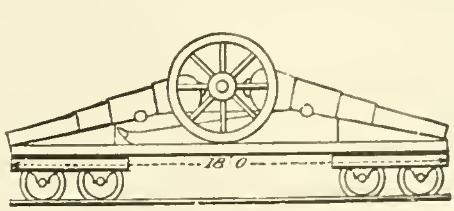


Fig. 7.

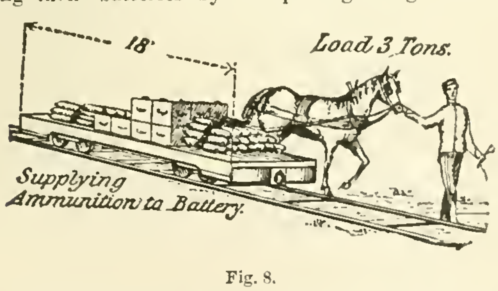


Fig. 8.

The ammunition, too, can be readily supplied to the magazines on these platform wagons; and now that the main artillery magazines have to be established at a much greater distance from a fortress than formerly was the case, a very great saving of labor is made by moving the heavy shot and shell on tram-trucks instead of the old trench cart, Fig. 8.

Wagons also for siege work have been designed that make ambulances for wounded men, and can take them from the trenches to the rear with ease and comfort, Fig. 9; the platforms that are used for general work are capable of being converted into ambulances so as to utilize the empty return trucks. These trench tramway wagons weigh only $1\frac{1}{2}$ ton, and are equal to a load of three tons. In making a comparison between transport by wheeled wagons and by means of a railway, the quantity of forage and fuel for the two systems must be taken into account. The conditions under which forage may be procured vary greatly with the different localities; but in most cases transport columns must move with a certain number of days' forage for the draught or pack animals employed, and in the same way a locomotive must take its fuel along with it. Taking, as an example, the transport of 100 tons of stores for 200 miles, the following table shows approximately the quantity of fuel, forage, and time that would be required. The calculations of this table are based upon the employment of general service wagons, taking $2\frac{1}{2}$ tons, 4 horses to draw, and 2 drivers to each wagon, with proportion of non-commissioned officers; for the pack animals the load is taken at 200 lbs. for the good horses, with one attendant to 6 horses, and non-commissioned officers in proportion. The trucks for the railway are loaded to 6 tons, and the road wagons of the "steam-sappers" to 4 tons.

Fig. 9.

The column of gross weight is estimated on the load of 100 tons with the weight of the wagons, the horses, the locomotives, the trucks, and the forage or fuel, according to the numbers and quantities in each case. To the railway means of transport has been added the weight of the plant that is necessary for making the railway; if 2 ft. 6 in. gauge is employed, the weight of 100 miles of single line will be 6,100 tons.

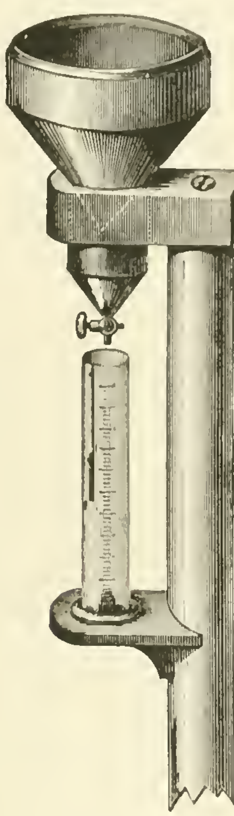
Means of Transport.	Horses or mules.	Drivers or attendants.	Wagons or trucks.	Time.			Weight of forage or fuel.	Gross weight.	Remarks.
				Day's march.	Halts.	No. of days.			
				Miles		*Total*	*Tons.*	*Tons*	
Horse draught............	180	80	40 G. S. wagons...	8	2	10	Forage, 30	252	25-mile march.
Pack animals......	1,200	220	....	10	3	13	Forage, 120.	820	20-mile march.
Steam traction on railways......	....	8	2 locomotives... 18 trucks	$\frac{2}{3}$	...	$\frac{2}{3}$	Steam coal, 5.	6,290	At 15 miles an hour.
Steam-sappers......	....	25	5 steam-sappers. 25 road wagons.	$2\frac{1}{2}$	...	$2\frac{1}{2}$	Steam coal, 20.	225	At 4 miles an hour.

See *Iron-clad Trains.*

RAILWAY STAFF VOLUNTEER CORPS.—A Corps whose object is to secure unity of action among the Railway Companies in time of war. It consists of three classes — namely, Eminent Civil Engineers, the General Managers of Railway Companies, and the leading Contractors. Their duty is to consider points relating to the transport of troops, the formation of lines of railway, etc., and to meet any exigency in time of war, all which information would prove of great value. In Germany the railways, as far as they are employed for military purposes, are under the control of the Great General Staff at Berlin, a special section of that department being entirely devoted to collect and arrange systematically all information on railways, at home and abroad, especially with regard to their capacity for carrying troops. This branch of the Staff works out the instructions given for the transport of troops and munitions of war, examines all projects of railways, and, lastly, prepares plans for the transport of German troops under different circumstances, so that in the event of war they can be concentrated with the greatest possible speed on any given point. The Railway Battalion, which was organized after the war of 1870-71, and which is now in full working order, is under the superintendence of this section. This Battalion is composed in time of peace of four companies, recruited from among the *employés* and officers of existing railways. The men are taught by very practical lessons how to construct and work a line, being employed, while learning the first duty, on the State Railways, and afterwards on a special line, called the "Military Railway," running from Berlin to the artillery practice ground at Zossen. On war breaking out, the Battalion is mobilized, and consists then of eight *constructing* and four *working* companies. The duties of the former are to make impromptu lines, and for that purpose each company is provided with a train of its own, containing all the necessary implements. The four working companies, taking up the line as it is made, will begin to put it in running order, manning it with drivers, guards, stokers, pointsmen, and telegraph clerks from their own number, and, after the service is regularly established, handing it over to the ordinary Civilian Staff, while they pass forward to make a fresh section on ahead. This Battalion includes three classes: Line, Reserve, and *Landwehr;* the two latter being at present supplemented by a list of ordinary railway servants, engaged for enrollment in time of need. In Russia, a system has been organized closely resembling that adopted by Germany. Every year picked men and officers are sent on all the Railway Lines, the former to study the theory of all that concerns the working and managing of railways, the latter to fulfill the duties of Station Masters. In 1871, after two years' practice, these men (432 and 8 officers), together with a division of infantry, and a battalion of engineers, constructed in seven days a line of 5 miles in length, with two stations and ten bridges, one of them of 54 yards span. The cost of the line was valued at £21,200, and was so well constructed that it has remained in use ever since. By an Imperial Ukase promulgated in 1870, all the Russian Railway Companies have to provide a certain number of carriages for the wounded, fitted up with litters, and well ventilated, and a number of carriges, wagons, and trucks, specially devised for military purposes. France has also introduced a Railway Battalion under her new military organization. The men of this Battalion will be in time of war associated with the Civil Railway Staff, and are classed in three categories: The first (two-thirds of annual Contingent) is incorporated in the Active Battalion, and instructed as sappers and miners, or as soldiers of the engineer train. The second (one-sixth of the Contingent) serves one year only in the Active Battalion; after which it is distributed among certain of the principal Railway Companies, in order to learn the working and managing of the lines, their construction, and restoration. The third (one-sixth of the Contingent) serves only one year in the Active Battalion, and is then transferred to the depots. This carries on operations with torpedoes, and is practiced generally in the destruction of railways, bridges, etc. A very similar organization of the Military Railway Department has been established in Italy.

RAIN GAUGE.—The use of rain-gauges is to ascertain the amount of rain which falls at any given place. They are of various constructions. The simplest is that which consists of a metallic cylinder, from the bottom of which a glass tube, divided into inches and parts of an inch, projects downwards. It is provided with a funnel, inserted within at the top, to prevent evaporation, and the rain-water is emptied out by means of a stop-cock at the bottom, or still simpler, by a hole pierced in the funnel at the top. As this form of gauge is objectionable on account of the frequent breakage of the glass-tube by frost, a float is used instead, which is raised by the water, and a scale is attached to it, to show the quantity of rain received. As this gauge does not admit of very nice readings, another sort is frequently employed, viz., a receiving-vessel and a glass measure of much smaller diameter, which thus admits of as nice graduation as may be desired. As, practically, there is often great difficulty or trouble experienced in replacing the glass measure when it chances to get broken, the late G. V. Jagga Ráo, a wealthy zemindar of Vizagapatam, proposed a gauge in the form of a funnel having a diameter of 4·697 inches, or an area of 17·33 square inches. As a fluid ounce contains 1·733 cubic inches, it follows that for every fluid ounce collected by this gauge, the tenth of an inch of rain has fallen. This measure can, of course, be graduated to any degree of nicety, and may be reproduced at pleasure. Self-registering rain-gauges have been invented by Osler, Crosley, and Beckly, but they are too expensive to come into very common use. The drawing represents the Continental Signal Service rain-gauge.

A most important point with regard to the rain-gauge is its height above the ground. Professor Phillips found the fall of rain at York, for 12 months in 1833-1834, to be 14·96 inches at a height of 213 feet from the ground; 19·85 inches at 44 feet; and 25·71 inches on the ground. This remarkable fact—viz., that different quantities are collected at different heights, the amount being always greater at the lower level, has been confirmed wherever the experiment has been made. No perfectly satisfactory account has yet been given of this singular phenomenon. The condensing of the vapor of the



atmosphere on the surface of raindrops as they fall—the rebound of the finer particles into which many of the drops break themselves as they strike with violence on the ground—and the eddies and currents which prevail most and strongest around isolated objects raised above the surface of the ground, to a large extent account for the phenomenon. Of these three, the greatest weight is to be given to the last two; and this is confirmed by the fact, that a gauge placed on the roof of a building that happens to be flat, of considerable area, and with few or no chimney-stalks to disturb the air-currents, collects an amount equal to that collected at the same time by a gauge on the ground. The proper size and shape of the rain-gauge, and its height above the ground, so as to measure with the greatest exactness possible the real quantity of rain that falls, about all of which much diversity of opinion exists, have been ably investigated by a series of extensive experiments conducted by Major Ward, Mr. Symons, Rev. Charles Griffith, and others, and the results have been published annually in Symons' *British Rainfall*.

RAIN OF FIRE.—A decoration for rockets, made with paper-cases $\frac{3}{10}$ inch in diameter, and 2 inches long, two thicknesses of paper being sufficient. The end of the case is closed, and it is charged and primed like that for a serpent, except the powder for a cracker. The composition is 16 parts of mealed powder and about 6 of charcoal. Another composition which shows in sparks, is made of 16 parts camphor, 8 of nitre, 8 of mealed powder, and 8 of tow

RAISING ARMIES.—Armies are *raised* in two ways: Either by voluntary engagements, or by lot or conscription. The Greek and Roman levies were the result of a rigid system of conscription. The Visigoths practiced a general conscription; poverty, old age and sickness were the only reasons admitted for *exemption*. Subsequently, the feudal military tenures had superseded that earlier system of public defense, which called upon every man, and especially upon every landholder, to protect his country. The relations of a vassal came in place of those of a subject and a citizen. This was the revolution of the 9th century. In the 12th and 13th another innovation rather more gradually prevailed, and marks the third period in the military history of Europe. Mercenary troops were substituted for the Feudal Militia. These military adventurers played a more remarkable part in Italy than in France, though not a little troublesome to the latter country. A necessary effect of the formation of Mercenaries was the centralization of authority. Money became the sinews of war. The invention of fire-arms caused it to be acknowledged that skill was no less essential for warlike operations than strength and valor. Towards the end of the Middle Ages, the power of Princes was calculated by the number and quality of paid troops they could support. France first set the example of keeping troops in time of peace. Charles VII., foreseeing the danger of invasion authorized the assemblage of Armed Mercenaries called *Compagnies d'Ordonnance*. Louis XI., dismissed these troops, but enrolled new troops composed of French, Swiss, and Scotch. Under Charles VIII., Germans were admitted in the French army, and the highest and most illustrious Nobles of France regarded it as an honor to serve in the *Gens d'Armes*. Moral qualifications not being exacted for admission to the ranks, the restraints of a barbarous discipline became necessary, and this discipline divided widely the soldier from the people. The French Revolution overturned this system. Now Mercenary Troops have completely disappeared from Continental Europe. England only now raises armies by the system of *Recruiters*. The last wars of Europe have been wars of the people and have been fought by nationalities. After peace armies remain national, for their elements are taken from the people, and are returned to the people by legal liberations. The institution of conscription is evidently the most important of modern times. Among other advantages, it has bridged the otherwise impassable gulf between the citizen and soldier, who, children of the same family, are now united in defense of their country. Permanent armies have ceased to be the personal guard of Kings, but their sympathies are always with the people, and their just title is that of skillful warriors maintained as a nucleus for the instruction of their countrymen in the highest school of art.

RAJA—RAJAH.—Originally a title which belonged to those princes of Hindu races who, either as independent Sovereigns or as Feudatories, governed a Territory; it then, however, became a title given by the native governments, and, in later times, by the British government to Hindus of rank, and it is now not uncommonly assumed by the Zemindars or Landholders; the title Mâharâjah, or "Great Rajah," being, in these days, generally reserved to the more or less independent native Princes. According to the ancient social system of India, the Rajah belonged to the Kshattriya or Military Caste; now, however, the title is given to, and assumed by, members also of an inferior Caste.

RAJPOOTS—RAJPUTS.—The name of various tribes in India which are of Aryan origin, and either descended from the old royal races of the Hindus, or from their Kshattriya or Warrior Caste. At all periods they seem to have played a conspicuous part in the history of India; and all over Hindustan there are many families who, rightly or wrongly, claim the title of Râjputs. At present they occupy chiefly the country known as Râjâsthan or Râjputana, including, among other States, those of Mewar, Marwar, Jeypur, Bikanir, Jessulmir, Kotah, and Bundi. Before the invasion of Mahmud the Ghiznevide, four great kingdoms were under the dominion of Râjput families—viz., Delhi, Kanoj, Mewar, and Anhulvarra; and all the Kings mentioned in the *Râjataranjinî* of Kalhana were of Râjput origin.

RAKE.—A term meaning to enfilade, or to fire in the direction of an enemy's ranks. To rake a ship is to bring guns to bear so as to fire them along her deck from end to end; this is the most disastrous thing that can happen to a vessel in action, and it is the object of all good seamanship to avoid it. When a ship is raked at short range, grape can be used with great and fatal effect.

RAM.—In fortification the act of compressing, by means of rammers, the loose earth used in building parapets and in filling gabions. Although a parapet of loose earth is less injured by shot than a rammed one, *ramming* is essential for the stability of the ramparts and parapets, as they might be seriously injured by a continuance of bad weather. *To ram* is also a term used in thrusting home the charge into a piece of ordnance. Hence "to ram home" a charge.

RAMMER.—1. The rod by which the charge of a small arm is forced home. 2. A staff having a cylindrical or conoidal head attached, used in cannon for the same purpose. The rammer-head is made of beech, maple, or other hard wood not easily split, and is bored for about two-thirds of its length to receive a tenon on the staff. For rifled guns, or for hollow projectiles, its face is countersunk. Rammers for large guns are technically termed *rammers* and *staves*. For field artillery, a sponge is attached to the other end of the staff, and the combined implement is called a *sponge and rammer*.

RAMMER HEAD.—An instrument employed in the inspection of cannon for ascertaining the interior position of the vent A head of well-seasoned wood, which fits the chamber, is attached to a wooden disc of the diameter of the main bore. The surface of the head corresponds with a longitudinal central section of the chamber; at the point where the projection of the vent would meet it a piece of hard wood is inserted. A central line drawn through its length, crossed at a right angle by another line at any known point from the smaller end, will afford convenient points to measure from. A stout wooden staff is attached to the axis of the head; at a distance equal to the length of the bore, the end is jogged into the center of a half-disc of wood, which is fitted to the bore. The whole is so constructed that the straight edge of the half-disc (or the chord) is in the same plane as a horizontal section of the head. A few holes are bored through the disc attached to the half-head, to allow the instrument to pass freely into the gun and out of it. A *wire* of untempered steel, of the size of the vent, with a sharp, well-centered point, and a small *spirit-level*, are required to use with this instrument.

The gun being leveled, and the instrument being pushed to the bottom of the bore, the upper edge of the half-disc near the outer end of the staff is then brought to a level. The surface of the half-head then corresponds with the horizontal central section of the chamber. The point of the wire being pushed gently to meet it, will show very accurately the interior position of the vent. See *Inspection of Ordnance*.

RAMMERS.—Large blocks of wood, very commonly used in military works, for the ramming of loose earth. The word *rammer* is also applied to the man employed in that duty.

RAMP.—In fortification, a gradual slope by which approach is had from the level of the town or interior area to the terreplein or general level of the fortifications behind the parapet. The width of ramps at top for the service of the artillery and other vehicles may be from 10 to 15 feet, and their inclination from $\frac{1}{6}$ to $\frac{1}{15}$, or less, depending on the difference of level to be overcome. They are usually placed in positions where they will occupy the least room of the parade. As a general rule, their side slopes are of earth; but where it is desirable to economize room on the parade the side slopes are replaced on one or both sides by a wall which sustains the earth of the ramp. When ramps serve for infantry alone their width may be reduced to 6 feet, and in some cases to 4 feet. See *Communications*.

RAMPANT.—In Heraldry, an epithet applied to a lion or other beast of prey when placed erect on the two hind-legs, with only one of the fore-legs elevated, the head being seen in profile. When the face is turned toward the spectator, the attitude is

Rampant.

called *rampant gardant*, and when the head is turned backwards, *rampant regardant*. A lion *counter-rampant* is one rampant towards the sinister, instead of towards the dexter, the usual attitude. Two lions rampant contrary-ways in saltier, are sometimes also said to be counter-rampant.

RAMPANT PLANE.—In the earlier methods of defilement, a line was taken, the position of which was determined by a series of trials, having for their object to obtain satisfactory results both as to the economy of the requisite embankments and the disposition of command of the various parts at, or in the rear of, the gorge of the work to be defiled; this position, coinciding with the natural surface, or being above or beneath it as the case required. Through this line a plane was passed tangent to the dangerous ground. This plane, termed a *Rampant Plane*, was taken as the artificial site of the work, in reference to which the relative command of all the parts was arranged upon a horizontal site. Or, in other words, the result was nearly the same as if the works had been arranged on a horizontal site, and then the whole combination turned around some fixed line of this site, until it was brought into the position of the required rampant plane. The defects of this method are evident at a glance. It preserves the relations of defense of the various works the same as in a horizontal site; but, to a great extent, it leaves out of consideration the bearing of the command on the exterior ground, and, in many cases, may lead to excessive excavations and embankments which the method now followed enable the engineer, for the most part, to avoid.

RAMPART.—A structure forming the substratum of every permanent fortification. It constitutes the enceinte, and is constructed immediately within the main ditch by throwing up the soil excavated from it. On the front of the rampart the parapet is raised, and width should be left behind it to allow of guns, wagons, and troops passing freely on the top of the rampart. The height of the rampart is dependent on the relief (height) of the buildings to be defended, and on the positions in the neighborhood which an enemy might assume. Also written *rampier*, and *rampire*. See *Permanent Fortification*.

RAMPART GRENADE.—Rampart grenades are intended to be rolled down the rampart of a work, to protect a breach against the attack of any storming column. Shells of any size will answer for this purpose, and particularly those which are unserviceable for ordinary purposes. Grenades are filled with a bursting charge, and are armed with a short fuse, which is lighted by a match in the hands of the grenadier immediately before it is thrown. They act by the force of their explosion alone. See *Grenade*, *Hand Grenade*, and *Projectiles*.

RAMPART GUN.—A large gun fitted for rampart use, and not used for field purposes.

RAMROD.—A long, slender piece of steel, employed in muzzle-loading arms, to push the charge to its proper place, and to wipe out the barrel. It is carried in a groove cut into the under side of the stock, and it is kept in its place by the pressure of the *swell* against the tip of the stock. The *head* of the rod is countersunk to fit the point of the projectile; and the *point* has a screw to receive the *wiper* and *ball-screw*—implements that are used to clean and remove obstructions from the bore. The temper of the ramrod may be tested by springing it in four directions, with the point resting on the floor. When the musket-rod is bent six inches out of line, it should spring back perfectly straight without setting. Its soundness may be tested by striking it with a piece of metal, or by bending it over the edge of a block of wood; in the first case the sound emitted should be clear, and in the second case the flaws or cracks will be opened. The screw on the point of the rod should be properly cut; it should bear properly in its groove, neither too light, nor too loose. The point should rest on the stop.

RAMROD CROSS-BOW.—A very heavy and comparatively useless weapon of the time of Louis XIV.

RAMSHORNS.—In fortification, are semicircular works of low profile in the ditch, which they sweep, being themselves commanded by the main works. They were invented by M. Belidor, a great French engineer, and, when used, take the place of tenailles.

RANCHEROS.—A name given in Mexico to a mixed breed of Spanish and Indian blood, who inhabit the country, and may almost be said to live in the saddle from their youth, are splendid riders and hunters, and form the bravest part of the Mexican army—its irregular cavalry. The importance of their services was seen in the wars with the United States. The Rancheros are lank in frame, with brown, weather-stained faces and muscular limbs, hardy, temperate, and always ready for the boldest enterprises.

RANCON.—The name of an old weapon, consisting of a long stake with a sharp iron point at one end, and two blades or wings bent backwards, and extremely keen.

RANDING.—In fortification, a kind of basket-work, formed in making gabions. One rod only is used, and an odd number of pickets, in forming the basket the rod being passed alternately inside and outside the pickets.

RANDOM.—Want of direction in firing a gun or musket; hence the expression, *to fire at random*. *A random shot* is a common expression when a fire-arm has been discharged without aiming in any particular direction.

RANGE.—In gunnery, the distance between a point on the ground vertically below the muzzle of the piece and the point on the same level at which the projectile touches in its descent. The point-blank range is when the piece is fired in a horizontal position; the range then increases with the elevation; and if the air did not oppose resistance, the greatest range would be attained with the piece elevated at an angle of 45°; but in practice this angle is found to be on an average a little over 30°. As the resistance of the atmosphere increases as the square of the velocity of the shot, being also in the direct ratio of its front section, while the momentum is as the velocity multiplied by the weight; it follows that a heavy shot should have a greater range than a light one; and that of two shots of the same weight, an elongated cylinder of small diameter will have a longer range than a spherical ball of greater diameter. On the other hand, from the rapid increase in a duplicate ratio of the resistance, as compared with the initial velocity, the range only increases to a certain point, in consequence of a more rapid flight of the projectile. The longest range yet attained has been by Sir Joseph Whitworth, with a 9-inch rifled gun, with which he sent a bolt a distance of 11,243 yards, or 6 miles and 683 yards. See *Gunnery*, and *Trajectory*.

RANGE BOARD.—This nature of board is intended for guns in fortresses, from the 7-inch caliber upwards; it is placed in a convenient position in the fortress where it can be seen and consulted. It has the distances painted on it of prominent objects within the range of the guns mounted on the works.

RANGE CURVE.—The ranges corresponding to the angles of elevation given in tables are determined by means of a *Range Curve*, which is constructed from the results of practice. Having traced the curve through several points determined by experiment, it is easy to find a series of ranges for intermediate angles and minutes.

RANGE-FINDER.—An instrument for determining ranges. There are several different principles which may be used. The distance may be measured 1st, by the visual angle subtended by objects of known height; 2d, by the velocity of sound; 3d, the instrument may furnish a base line in itself, and solve a triangle in which the base and two adjacent angles are given. The term is also applied to instruments used to solve a triangle, the base of which is obtained by outside means. The various *range-finders* are described under appropriate headings in this work. See *Watkins Range-finder*.

RANGE PLATES.—Plates of brass attached to the brackets of the English 16-pr and 9-pr. wrought-iron field carriages. They are marked with three columns of figures, showing the range in yards from 100 to 4,000 for 16-prs. and from 100 to 3,500 for 9prs., with the corresponding elevations and tenths of fuse.

RANGER.—One of a body of mounted troops, who were formerly armed with short muskets, and who ranged over the country, often fighting on foot.

RANGE-TABLES.—A properly constructed gauge-table for a particular piece contains the range and the time of flight for each elevation, charge of powder, and kind of projectile. Its object is to serve as a guide in pointing, without waste of time and ammunition, and also when the effect of the projectile cannot be seen. It aids in securing good practice. The Ordnance Instructions contain approximate range tables for the service cannon. It is with great difficulty that tables are constructed from results of the most careful experiments, owing to the different ranges and deflections obtained in firing projectiles, even from the same gun with similar charges and elevations. It must be remembered that any practice table will only serve as a general guide, and that small alterations in elevation or deflection are required, according to the force and direction of the wind the position of the piece with respect to the object, the quality of the powder, and several other circumstances.

RANK.—1. A line of soldiers drawn up side by side in one row; opposed to *file*. 2. The relative position, in the army, which officers and men hold with respect to each other, or to military things in general. In the English Army, *rank* is somewhat confusing from its varieties, and from the fact that the same officer may hold at once three different ranks. The first and only rank up to the grade of Captain is *regimental* or *substantative* rank. Above this, officers may advance in two ways: First up to rank of Lieutenant Colonel by substantative or regimental rank; second, up to Colonel by obtaining rank in the army, generally called *brevet rank*, and above that by army rank through the several grades of general officers. In his regiment, the officer holds only his regimental rank, whatever his brevet rank may be; but among officers of the army generally he takes precedence according to his brevet rank. In describing an officer who has brevet rank, his regimental rank is placed first— as, Captain and brevet Lieutenant Colonel Brown, which means that an officer named Brown, who holds rank in a regiment as Captain, has for his services been promoted in the army to be Lieutenant Colonel. Officers of the foot-guards have higher rank in the army. Another class of rank is relative rank, which attaches to certain officers. Thus Captain Brown aforesaid, in addition to regimental rank as Captain, and army rank as Lieutenant Colonel, may possibly hold a staff appointment which confers on him the relative rank of Colonel. *Local rank* is a common expedient for advancing comparatively junior officers to important duties, a higher rank than that properly held in the army being assigned to an individual within certain geographical limits, as in the East Indies, the Crimea, etc. *Temporary rank* is similarly limited by time, and is conferred usually for the period during which some appointment is held, as the officer acting as director of ordnance ranks as Major General while so employed. *Honorary rank* carries neither duty nor emolument; it is commonly given to the amount of one step to an officer who has served the time necessary for retirement; thus, a Captain, after thirty years' service, may retire (on the pay of Captain) with the honorary rank of Major. Officers who have quitted the army are also allowed to retain as honorary the last rank they held.

In the United States, officers of the Regular Army, of the Marine Corps, and of Volunteers, when commissioned or mustered into the service, being upon equal footing, take precedence in each grade by date of commission or appointment. Officers serving by commission from any State of the Union take rank next after officers of like grade by commission from the United States, except commissions issued by the President to officers of Volunteer regiments, which are considered the same as if issued by Governors of States. Militia officers, when employed in conjunction with the Regular or Volunteer forces of the United States, take rank next after all officers of like grade in those forces. In fixing relative rank between officers of the same grade and date of appointment and commission, the time which each may have actually served as a commissioned officer of the United States, whether continuously or at different periods, is taken into account. And in computing such time no distinction is to be made between service as a commissioned officer in the Regular Army and service since the 19th day of April, 1861, in the Volunteer forces, whether under appointment or commission from the President or from the governor of a State. Where periods of service are equal, precedence is determined between officers of the same regiment, corps, or department, by the order of appointment. Between officers of different regiments: 1st. Rank in actual service when appointed; 2d. Former rank in the Regular Army, in the Marine Corps, or in the Volunteer service; 3d. By lot among such as have not been in the military service of the United States. The rank of officers and non-commissioned officers in the service is as follows:—1. General. 2. Lieutenant General. 3. Major General. 4. Brigadier General. 5. Colonel. 6. Lieutenant Colonel. 7. Major. 8. Captain. 9. First Lieutenant. 10. Second Lieutenant. 11. Cadet. 12. Sergeant Major and Veterinary Surgeon. 13. Quartermaster and Saddler Sergeant (regimental). 14. Ordnance and Commissary Sergeant and Hospital Steward of the first class. 15. First Sergeant. 16. Sergeant and Company Quartermaster Sergeant. 17. Corporal. In each grade these rank by date of commission, appointment, or warrant. Chaplains have the rank of Captains of Infantry without command. On parade, or other occasions of ceremony, troops of different arms are arranged from right to left in the following order: first, Infantry; second, mounted Artillery; third, Cavalry. Artillery not mounted and Engineers serving as Infantry are posted as Infantry. Engineers serving as such are posted on the right of the Infantry. Marines and dismounted Cavalry are on the left of the Infantry. In the same arm, Regulars, Volunteers, and Militia are posted in line from right to left in the order named. On all other occasions troops of all classes are posted at the discretion of the General or senior Commander.

Questions as to the positive or relative rank of officers may often be of the greatest importance at law, in consequence of the rule, that every person who justifies his own acts on the ground of obedience to superior authority must establish, by clear evidence, the sufficiency of the authority on which he so relies. There may also be many occasions on which the propriety of an officer's assumption of command, or his exercise of particular functions, or his right to share with a particular class of officers in prize-money, bounties, grants, and other allowances, may depend on the correctness of the view taken by himself or others of his right to a specific rank or command; and an error in this respect may expose him to personal loss and damage in suits before the civil tribunals. The regulation of military rank is vested absolutely in Congress, which confers or varies it at pleasure. The will of Congress in this respect is signified by the creation of different grades of rank; by making rules of appointment and promotion; by other rules of government and regulation; or is by fair deduction to be inferred from the nature of the functions assigned to each officer; for every man who is intrusted with an employment, is presumed to be invested with all the powers necessary for the effective discharge of the duties annexed to his office. Rank and Grade are synonymous, and in their military acceptation indicate rights, powers, and duties determined by laws creating the different degrees of rank, and specifying fixed forms for passing from grade to grade; and when rank in one body shall give command in another body; and also when rank in the army at large shall not be exercised. Rank is a right of which an officer cannot be deprived, except through forms prescribed by law. When an officer is on DUTY, his rank itself indicates his relative position to other officers of the body in which it is created. It is not, however, a perpetual right to exercise command, because the President may, at any time relieve an officer from duty; or an officer may be so relieved by arrest duly made according to law; or by inability to perform duty from sickness, or by being placed by competent authority on some other duty. But whenever an officer is on duty his rank indicates his command. Struggle as commentators may, who desire to subject rank to executive caprice, rather than have its powers and duties defined by law, as the Constitution requires in giving to Congress the power to make rules for the government and *regulation* of the army, the rights of rank cannot, without usurpation, be varied at the will of the President. The law has created rank. Rank means a range of subordination in the particular body in which it is created. It is, therefore, effective in that body, without any further legislation, and its effect, when the officer is present for duty, is extended beyond that particular portion of the army in which the officer holds rank, or its exercise is restricted within a Corps only by legislation. Executive authority cannot make rank vary at will, but whatever authority the executive has over rank must be determined by law. A reference to the Articles of War will show that the President is given the authority to limit the discretion of Commanding Officers, in special cases, in respect to what is needful for the service, and also to relieve the senior officer from any command, so that the command may fall upon the next officer in the Line of the Army, Marine Corps, or Militia, "by commission there on duty or in quarters," or assign some senior to duty with troops, in order that such officer may become entitled to command. Any power of *assignment* claimed for the President beyond this is not and ought not to be sanctioned by law. The legislation on the subject of rank is thus complete. Officers, when serving only with their own regiment, serve according to their regimental rank; but when with other corps, the senior by commission in the line, whether by brevet or otherwise, is entitled to command. See *Command*.

RANK AND FILE.—The body of soldiers constituting the great mass of the Army, including Corporals, Bombardiers, and Privates. The *Rank and file* means literally the lines of men from side to side, and from front to back—a rank being a row of men standing side by side, and a file of soldiers a line of men standing one behind another. The strength of a force is reckoned by its *Rank and file*; the Non-commissioned and Commissioned Officers forming the supernumerary ranks charged with the direction of the mass.

RANKER.—A Non-commissioned Officer who rises to be a Commissioned Officer.

RANKS.—The order of common soldiers. Non-commissioned Officers are frequently reduced to the *ranks*. The term is variously applied.—*To fill the ranks* is to supply the authorized or competent number of men. *To take rank of* is to enjoy precedence over, or to have the right of taking a higher place.

RANSEUR.—A kind of *partizan*, well known in Germany during the 15th century. It came originally from Corsica, and has been called both *corseque* and *roncoul* by some authors.

RANSOM.—The price paid by a prisoner of war, or paid on his behalf, in consideration of his being granted liberty to return again to his own country. In early times, when armies received little or no regular pay, the soldier looked for his reward in the booty he might capture, and this booty included the bodies as well as the chattels of the vanquished. The conqueror had the option of slaying his prisoner; but for his profit, he would make him his slave, or sell him into slavery. The transition would be natural to accepting compensation from the prisoner himself, and setting him at liberty. In feudal warfare, the ransoms formed a large portion of a soldier's gains; those for persons of low degree belonging to the individual captors; but those for Princes or Great Nobles, to the King. Ransoms were sometimes of large amount, more than the immediate family of the captive could pay. His retainers were then required by feudal usage to contribute; as in the case of redeeming King Richard I. for £100,000, when twenty shillings was assessed on every Knight's Fee, and the Clergy subscribed liberally. David Bruce, of Scotland, was ransomed for 100,000 marks, and King John, of France, for £500,000, payable in instalments. In modern warfare, where the fighting is performed by professional soldiers, pecuniary ransoms are scarcely ever resorted to, freedom being granted to prisoners in exchange for others of corresponding rank captured on the opposite side.

RAPIDITY OF FIRE.—The rapidity with which cannon can be loaded and discharged depends on the size of the piece, the construction of the carriage, and the care required in aiming. Field-cannon can be discharged with careful aim, about twice per minute; in case of emergency, when closely pressed by the enemy, canister-shot may be discharged four times per minute. The 12-pdr. boat-howitzer of the Navy, with experienced gunners, can be discharged at the rate of sixteen times per minute. Siege-guns are generally discharged twelve times per hour; if necessary, they can be discharged as rapidly as twenty times per hour. Iron cannon can be fired more rapidly than bronze, as the latter metal is softened by heat, and the piece is liable to bend. Siege-mortars can be fired twelve times per hour, and more rapidly than this if the object be large, as a city. Siege-howitzers can be fired eight times in an hour. The fire of a sea-coast cannon depends much on the ease with which its carriage can be maneuvered. The heaviest, or 15-in. gun, mounted on the new iron carriage, can be loaded and fired in 1′ 10″ the time required in aiming depends on the angle through which the chassis is to be traversed, and piece elevated, or depressed; it can be traversed through an angle of 90° in 2′ 20″. Muzzle-loading small-arms can be discharged two or three times in a minute, and breech-loading arms about ten times; the revolver can be discharged much more rapidly for six shots. This quality of a military fire-arm should be carefully guarded, as it is found that soldiers are prone to discharge their pieces in the excitement of battle without taking proper aim, and consequently to waste their ammunition.

The calculations of the power of guns, by Colonel Maitland in his very valuable paper on "The Heavy Guns of 1884," lately read at the United Service Institution, are utterly misleading, as they leave out of account all consideration of rapidity and safety of firing; in fact, they give only the efficiency of the gun for a single round, thus placing a gun that could be fired only one round per hour on an equality with another gun firing a hundred similar rounds per hour. The Krupp gun is calculated to fire one round every ten minutes from his large guns on the practice ground at Meppen, and Captain Fitzgerald, R. N., stated in his lecture at the United Service Institution that the English 100-ton breech-loading gun could be fired only once in fifteen or twenty minutes. He institutes the following comparison to show the difference between a gun firing six shots an hour and an ideal gun ("Gun of 1886") supposed to fire 20 shots in the same time.

Data.	Elswick Gun of 1884.	Gun of 1886.
Diameter of bore	16.25	16.25
Weight of gun...	110 tons	120 tons.
" of charge..	900 lb.	900 lb.
" of pr'jectile	1,800 lb.	1,800 lb.
Muzzle velocity of projectile...	2,020 ft. per sec.	2,020 ft. per sec.
Muzzle energy of projectile.......	50,924 ft. tons.	50,924 ft. tons.
Muzzle energy of projectile per ton of gun......	513 ft. tons.	424.3 ft. tons.
No. of rounds fired per hour.	6	20
Total power of gun.............	305,544 ft. tons.	1,018,480 ft. tons.
Power per ton weight of gun.	2,777 ft. tons.	8,487.5 ft. tons.

The above shows that the more rapid firing gun, although not 10 per cent. heavier than the Elswick gun, is over 200 per cent. more powerful for destructive purposes. See *Ordnance*.

RAPIER.—This word is said to have had distinct meanings at different times, and in ancient fencing to have been a long cutting broadsword; but for the last century at least the rapier has been a light, highly-tempered, edgeless, thrusting weapon, finely pointed, and about 3 feet in length. It was for a long time the favorite weapon in dueling, and was worn by every gentleman. At present it is worn only on occasions of court ceremonial, and answers no other purpose than to incommode the wearer. In war a rapier could never have been of any service.

RAPPAREE.—A wild Irish plunderer, so called from his being generally armed with a *rapary*, or half-pike. The term was in common use in the 17th century. See *Notes and Queries*, August 17, 1861.

RAPPEL.—The beat of the drum to call soldiers to arms.

RASALDAR.—In the East Indies, the name applied to the Commander of Rasallah, which is 10,000 armed horsemen.

RASANTE.—A French term, applied to a style of fortification in which the command of the works over each other, and over the country, is kept very low, in order that the shot may more effectually sweep or graze the ground before them. Also written *Razant.*

RASP.—The rasp, like the file, is an abrading tool, but differs in that its surface is studded by protruding, isolated teeth, instead of chisel-cut teeth. The teeth of rasps are formed by a pointed tool called a *punch.* The point of this punch is generally of a triangular pyramidal form, whose triedral angles vary in size according to the effect required to be produced. The spaces between the teeth are, comparatively, wider than those for files. The apparently irregular intermingling of the teeth is such as will produce the smoothest surface for the number of teeth on the rasp.

The classification of rasps is very similar to that of files. Rasps have different degrees of coarseness, and the cuts are usually classed as—coarse, bastard, second-cut, and smooth. The coarse-cut is that used by horse-shoers; the bastard by machinists, carriage-makers, and wheelwrights; while the second cut is applied to shoe-rasps, and the smooth to cabinet-makers, etc. The rows of teeth range obliquely from left to right, or from right to left, and sometimes in circular arcs. The planes of the cutting faces of the teeth are generally placed at right angles to the axis of the file; but occasionally they are made with a slight obliquity, alternately to the right and left, for the purpose of allowing the teeth to clear themselves more freely from particles of stock. See *File.*

RATCHET.—A small piece of metal, so placed with one end on a pivot that the other can fall into the teeth of a wheel. Being perfectly free to move up and down, its own weight makes it drop into tooth after tooth as the wheel revolves.—But, from the peculiar shape of the teeth, which have the form of an inclined plane on one side, and a perpendicular face on the other, the wheel can only revolve in one direction.

RATCHET-POST.—A cast-iron post at the head of large Rodman guns to serve as a fulcrum for the bar used in elevating the gun.

RATCHET-SABOT. — A copper-cupped plate, attached to the base of a projectile, and firmly held in its place by radial grooves.

RATCHET-WHEEL.—A wheel with pointed and angular teeth, against which a ratchet abuts, used either for converting a reciprocating into a rotatory motion on the shaft to which it is fixed, or for admitting of its motion in one direction only. See *Mechanical Maneuvers.*

RATE-BOOK.—A priced vocabulary of government stores, by which officers and soldiers are debited for the loss of, or injury done to, government property under their charge, if committed through carelessness, etc.

RATION.—The established daily allowance of food for one person. For the United States Army it is now composed as follows: Twelve ounces of pork or bacon, or one pound and four ounces of fresh beef, or twenty-two ounces of salt beef; eighteen ounces of soft bread or of flour, or about sixteen ounces of hard-bread, or one pound and four ounces of corn meal. To every one hundred rations, fifteen pounds of beans or of peas, or ten pounds of rice or hominy; ten pounds of green coffee or about eight pounds of roasted (or roasted and ground) coffee, or about two pounds of tea; fifteen pounds of sugar; four quarts of vinegar; one pound and eight ounces of adamantine or star candles; four pounds of soap; four pounds of salt; four ounces of pepper; and to troops in the field, when necessary, four pounds of yeast-powder to the one hundred rations of flour.

Fresh mutton may be issued in lieu of, and at the same rate as, fresh beef, when the cost of the former does not exceed that of the latter. Fourteen ounces of dried fish, or eighteen ounces of pickled or fresh fish, may be issued in lieu of the meat components of a ration. Molasses or syrup may be issued in lieu of sugar, at the rate of two gallons to fifteen pounds of sugar. When it is impracticable for troops in the field or those traveling upon cars or transports, to draw or cook beans or rice, equivalents in money value of bread or meat may be issued; the value (in detail) of the stores not drawn, and those issued in lieu thereof, must be entered upon the abstract of issues. The following issues may be made to troops: Per 100 rations, in lieu of the usual meat portion of the ration, 75 pounds canned fresh beef; or about 75 pounds canned corn beef. Per 100 rations, in lieu of the dry-vegetable portion of the ration, 33 1-pound cans baked beans; or 20 2-pound cans baked beans; or 15 3-pound cans baked beans; or 5 1-gallon cans baked beans; or 25 pounds cheese. Six-pound cans of beef, and gallon or three-pound cans of beans should be issued in all cases when convenient; one and two pound cans of beans, and two and four pound cans of beef, to be issued only when it is inconvenient to issue the larger cans, or but small amounts are to be issued.

The army ration, in England, at home, is $\frac{3}{4}$ lb. of meat, and 1 lb. of bread ("best seconds") if in barracks, or $\frac{3}{4}$ lb. of meat with $1\frac{1}{4}$ lbs. of bread if in camp. If a grocery ration is also issued, $1\frac{1}{2}$d. for each such ration is deducted from the pay of the recipient. When men are not supplied with rations, an allowance of 6d. per diem is granted. Abroad, the Ration is 1 lb. of bread, or $\frac{3}{4}$ lb. of biscuit, and 1 lb. of fresh or salt meat, except at certain stations, where, for climatic reasons, a different Ration is specially provided. The bread ration may be increased during operations in the field, though not above $1\frac{1}{2}$ lbs. of bread or 1 lb. of biscuit. During active operations, the officer commanding may direct the issue, in addition to the above, of wine, spirits, or any other article of subsistence equivalent thereto. The stoppage for this foreign ration is 1d. The families of soldiers accompanying them abroad are allowed the following rations: the wife (married under regulation), half a ration: each legitimate child under 7, a quarter ration: from 7 to 14, a third part of a ration. When officers receive a colonial allowance in lieu of rations in kind, each is subjected to a daily stoppage of $2\frac{1}{2}$d. A Ration of forage at home consists of 10 lbs. of oats, 12 lbs. of hay, and 8 lbs. of straw for each horse. Cavalry soldiers receive this without stoppage; but their officers suffer a deduction of $8\frac{1}{2}$d. per ration. Staff officers and mounted officers of infantry provide their own forage, and are granted a pecuniary allowance of 1s. 10d. per day to enable them to do so. See *Food.*

RATION RETURNS.—The issues of subsistence are made to troops on ration returns, signed by their immediate Commander and approved by the commanding officer of the post or station. These returns call for only such limited quantity of stores as can be received and properly cared for by the troops drawing, and will, ordinarily, be made for a few days at a time. They are consolidated for the post or regiment when practicable, and embrace only the number of enlisted men, authorized laundresses, and hospital matrons actually present. At the end of the calender month, the Commissary enters on separate abstracts, for each class of troops, every return upon which he has issued provisions in that month; which abstracts the Commanding Officer compares with the original ration returns, and if correct, so certifies.

Ration-Return of —— Company —— Regiment of ——, stationed at —— for —— days, commencing the —— day of ——, 188— and ending the —— day of ——, 188—.

		Number of men.			Number of days.
		Number of women.			Number of rations.
		Total.	Total.		

Number of rations of — Remarks.

		Pork.			Peas.	
		Bacon.			Rice.	
		Salt Beef.			Hominy.	
		Fresh beef.			Cheese.	
		Mutton.			Coffee.	
		Fresh beef, canned.			Tea.	
		Corned beef, canned.			Sugar.	
		Fish, dried.			Vinegar.	
		Fish, pickled.			Adamantine candles.	
		Flour.			Soap.	
		Hard bread.			Salt.	
		Corn-meal.			Pepper.	
		Beans.			Yeast-powder.	
		Baked beans, canned.				

The A. A. C. S. will issue on the above return.

——*Regt. of*——, *Comd'g Post.* ——*Regt. of*——, *Comd'g Company.*

RATIOS.—There can be little doubt that Newton discovered by means of fluxions, of which he was in possession at a very early age, the greater part of that extraordinary series of theorems regarding motion, etc, which he first published in the *Principia.* He had, however, a great partiality for the synthetic form of demonstration employed with such success by the Greek geometers; and the consequence was that, in the *Principia*, he avoided entirely the use of analysis by fluxions, and invented for synthetical applications the closely allied method of Prime and Ultimate Ratios. The fundamental idea involved in fluxions, prime and ultimate ratios, and the differential calculus, is the same, that of a *Limit.* To give an idea of the nature, as well as to show the real origin of the name of the method, we may take a very simple case. Let a particle be projected in any direction; it will move uniformly in that direction forever, unless deflected from it by some external force. Suppose that gravity alone acts upon it, then it will describe a parabolic path, to which the original direction is the tangent at the origin; and the line which joins the disturbed and undisturbed positions of the particle at any instant is vertical. Now, the original and secondary distances of the particle from the origin are not, in general, equal, but they are more and more nearly equal as both are smaller; and, by taking each small enough, we may make the *percentage* of difference between them as small as we choose. In other words, their *prime ratio*, just at the origin, is unity. Again, the inscribed square is less than a circle; the octagon is greater than the square, but less than the circle; the regular polygon of 16 sides greater than the octagon, but less than the circle; and so on, constantly doubling the number of sides. But it can be shown that the difference of area between the polygon and the circle may be made as small a percentage of the area of the circle as we please, by making the sides of the polygon numerous enough. Hence, the *ultimate ratio* of the areas of the circle, and inscribed polygon with an indefinitely great number of equal sides, is unity. The basis of the method, which is implicitly involved in the foregoing illustrations, is Newton's *first lemma*, which is thus stated: "Quantities, and the ratios of quantities, which tend constantly to equality, and may be made to approximate to each other by less than any assignable difference, become ultimately equal." In other words, if we can make the *percentage* of difference of two quantities as small as we choose, we must produce ultimate equality. From this, in his second and third lemmas, Newton proves the fundamental principle of the integral calculus as applied to the determination of the areas of curves, by showing that if a set of parallelograms be inscribed in any curvilinear space, the percentage of difference between the sum of their areas and that of the curve may be made as small as we please by diminishing indefinitely the breadth of each parallelogram and increasing their number proportionally. Next, he shows how to compare two curvilinear spaces, by supposing them filled with such parallelograms, each of the first bearing to one of the second a constant ratio. Next, that the homologous sides of similar *curvilinear* figures are proportional. The sixth lemma is merely a definition of continuous curvature in a curve, as distinguished from abrupt change of direction. The seventh, eighth, and ninth lemmas are of very great importance. The general principle involved in their proof is this—to examine what always occurs in indefinitely small arcs, by drawing a magnified representation of them such as always to be on a finite scale, however small the arcs themselves may be. Thus, to show that the chord of a small arc is ultimately equal to the arc—of which we have in trigonometry, as a particular case, the ulti-

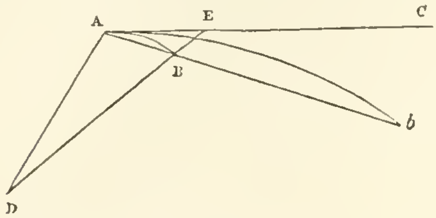


Fig. 1.

mate equality of an arc and its sine—he proceeds somewhat as follows: Let AB, (Fig. 1) be an arc of continued curvature, AC the tangent at A. Produce the chord AB till it has a *finite* length, A*b*. Describe on A*b*, as chord, an arc similar to AB. This, by a previous lemma, will touch AC at A. Now, as B moves up to A, let the same construction be perpetually made, then *b* will approximate more and more closely to AC (because the arc AB is one of continuous curvature), and the magnified arc will constantly lie between AC and A*b*. Hence, ultimately, when A*b* and AC coincide in direction, the arc A*b* (which is always between them) will coincide with A*b*. Similarly, AD being any line making a finite angle with AC, draw DBE cutting off a finite length from AD; this process enables us to prove that the triangles AED, and the rectilinear and curvilinear triangles ABD, are all ultimately equal. Finally (and this is the step of the greatest importance in the dynamical applications), if the lines AD, DE, D'E' (Fig. 2) be drawn under the above restrictions, the ultimate ratio of the curvilinear or rectili-

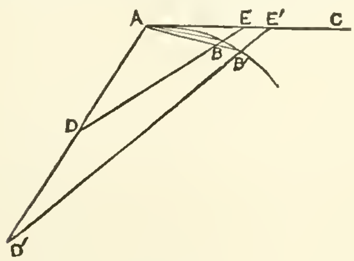


Fig. 2.

near triangles AEB, AE'B' is that of the squares of corresponding sides. From this, in the ninth and last lemma, it is easily shown that the spaces described under the action of a finite force have their prime ratios as the squares of the times: whence we pass at once to the ever-memorable investigations of the *Principia* regarding the orbits described under the action of various forces. The metho of prime and ultimate ratios is little used now (except in Cambridge, which does honor to itself in making part of the *Principia* a subject of study), as the differential and integral calculus help us to the required results with far greater ease. But to the true student of gunnery, the synthetic method of Newton is of very great value, as it shows him clearly at every step the nature of the process he is carrying out, which is too apt to be lost sight of entirely in the semi-mechanical procedures common to all forms of symbolical reasoning.

RAVELIN.—In fortification, a triangular work of less elevation than the main defenses, situated with its salient angle to the front before the curtain, which with the shoulders of the adjoining bastions it serves to protect. It is open at the rear, so as to be commanded by the curtain, if taken, and is separated from that work by the main ditch while in its own front the ditch of the ravelin intervenes between itself and the covered-way. The guns of the ravelin sweep the glacis, and perform a very important function in commanding the space immediately before the salient angles of the two next bastions, ground which the guns of the bastions themselves cannot cover. The bastions, on the other hand, flank the ravelin. In the fortifications of Alessandria, designed by Bousmard, in 1803, the ravelins are placed in front of the glacis. The original name of the ravelin was *rivellino*, which indicates a derivation from *vegliare*, to watch, the ravelin having probably been at first a watch-tower, answering to the still earlier barbacan.

RAVINE.—In field-fortification, any deep hollow, usually formed by a great flood, or a long-continued running water; frequently turned to advantage in the field. See *Divide*.

RAW HIDES.—Hides not tanned. They are used to cover the revetments of embrasures in fieldworks. The hides are doubled, the hair inwards, two to each cheek of the embrasure, and fixed by pickets driven through them.

RAW PIG.—The iron, as it comes from the smelting-furnace, is termed, "*Raw Pig*," and is a first fusion. The second-fusion iron (as understood by founders) is produced by a combination of raw pig and second-fusion, melted in an ordinary air-furnace, and then run out. These pigs are usually of a different shape than the raw pig, but to prevent confusion, and at the same time to distinguish different second-fusion irons one from another, each should be distinctly marked and piled separately. The object of using a second-fusion iron in a casting is to obtain greater density than can be produced from the raw pig alone; it moreover increases the tensile strength. In the casting of the XV-inch gun, the furnaces are charged as follows:

Bloomfield raw pig	21,143 lbs.
Bloomfield second-fusion (red-dot)	13,214 "
Bloomfield second-fusion (red-cross)	2,643 "
	37,000 "
Total in both furnaces	74,000 "

The second-fusion, marked "red-dot," consists of the following combinations, viz.:

Bloomfield raw pig	50,000 lbs.
Bloomfield second-fusion	19,575 "
Run into pigs and marked "red-dot"	69,575 "

The proportions of the other grade, marked "red-cross," are as follows, vis.:

Bloomfield raw pig	29,410 lbs.
Bloomfield second-fusion	32,590 "
Run into pigs and marked "red-cross"	62,000 "

The second-fusion iron used in these combinations is produced by melting two parts of raw pig with one of second fusion. See *Casting* and *Iron*.

RAW TROOPS.—Inexperienced soldiers or men who have been little accustomed to the use of arms.

RAZED.—A term applied to works or fortifications when they are totally demolished.

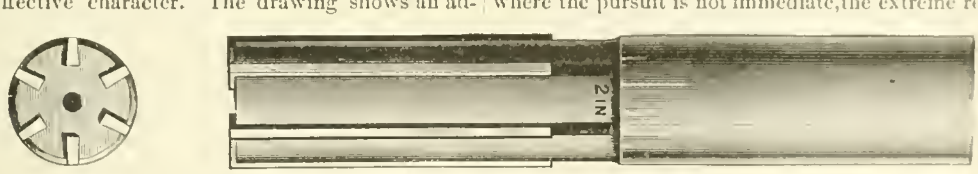
RAZZIA.—A plundering and destructive incursion.

REACTION.—A term used in reference to the political history of a Nation, to designate that tendency, often showing itself, to recoil from the effects of Reform or Revolution, and to seek a restoration of the previous state of things, or one still more antiquated and despotic. The causes that lead to reaction are various. Sometimes it springs, partly at least, from mere disappointment at the smallness of the *visible* results of those changes advocated with so much eloquence, and waited for with so much enthusiasm and hope. The inconsiderate imagination of the people expects a millenium to follow every important change; and when, after the event men find they are still in the old world of imperfections, hardships, and sorrows, they are prone to believe that they have been deluded, and are only too willing to lend an ear to the insidious misrepresentations of those who are opposed to progress. But more frequently political reaction springs from either immature or injudicious, or extravagant revolution The times are not yet ripe (as in the first Italian revolts), or the leaders are unfit (as in the German and Hungarian struggles of 1848-49), or excesses are committed (as in the great French outbreak of 1789), and so a revolution is nipped in the bud, or overthrown in the battle-field; or inflamed with sanguinary thirst for revenge, it goes mad in a "Reign of Terror," and exhausting itself in unprofitable frenzies, falls at last an easy prey to any bold and unscrupulous adventurer whom the crowd may elect out of desperation and disgust of anarchy, and whose rule is as absolute as any that preceded it. A reaction may thus, in certain cases, be useful, in so far as it teaches reformers and revolutionists the point beyond which nature forbids them to go; but its agents are almost invariably base in character, odious in their principles, and selfish in their projects. Religious reactions exhibit the same characteristics as political ones, and proceed from the same causes.

READINESS.—A state of alertness or preparation; thus, to *hold a corps in readiness*, is to have it prepared in consequence of some previous order to march at a moment's notice.

READY.—A word of command in the Manual of Arms, executed as follows: The Instructor commands—1. *Squad*, 2. Ready. Same as first motion of load, except that the muzzle is at the height of the chin, the right thumb on the head of the hammer, the fingers supported against the guard and small of the stock. (Two.) Cock the piece, and then grasp it at the small of the stock. The piece, after loading, may be brought to a *ready* by the commands: 1. *Squad*, 2. Ready. At which the piece is cocked. See *Manual of Arms, Fig.* 15.

REAMER.—A tool much used in the arsenal to enlarge a hole and bring it to a shape the counterpart of the tool, whether cylindrical or tapering. Instead of mere longitudinal fluting, the grooves in the tool may be made spiral, a right and a left hand, crossing obliquely so as to leave the surface in diamond-shaped portions. The flutings are then planed out and backed off, the result being a toothed reamer of effective character. The drawing shows an adjustable reamer, designed by the Betts Machine Company, Wilmington, Delaware. The shank of the reamer is made of steel, the blades are six in number and unevenly spaced; the blades are inserted in dove-tailed slots the bottoms of which are inclined planes; the shanks are ground to STANDARD SIZE (a thing impossible in a solid reamer, unless it reams much above standard size when new), and the blades made slightly above standard. It is plain that when the blades wear down, it is then only necessary to drive them further into the shank, and by that means again enlarge the diameter to standard size. This may be repeated until the blades are driven to the upper end of the slots, when new ones may be inserted. The solid reamer was a great advance when introduced, but the requirements of fine machine fitting call for a tool which makes solid reamers a thing of the past. The practice of *reaming out* guns, or *boring them up*, first took place in the British service in 1830; it was done with the view of increasing the weight of metal projected from such guns as were then on hand in the British service, at the time when the advantages of large-calibered ordnance were not absolutely decided on. It was therefore but a temporary expedient and for that particular purpose, reaming out has been abandoned. But in the conversion of smooth bore ordnance for the purpose of being rifled, the guns have still to be reamed out preparatory to being relined



REAR.—In the general acceptation of the word, anything situated or placed behind another. This term is variously used in military matters. *Rear of a body of troops* means the hindermost part of that body such as the *rear* of an army battalion, squadron, or company; *rear rank*, the rank which covers the front rank.

REAR ASSEMBLING BAR.—A component part of the caisson. It supports the spare-wheel axle, and has a slot for the pickaxe on the left of the middle-rail.

REAR BRACE.—The lower arm-plate of an arm-guard.

REAR CHOCK CARRIAGE.—A carriage similar in construction to the garrison standing carriage, except that it has only the two front trucks; and, instead of a rear axle tree, it has a block of wood which rests upon the platform.

REAR FRONT.—The rear rank of a body of troops when faced about and standing in that position.

REAR GUARD.—*A rear-guard* is a body of troops formed to protect the rear of an army when on the retreat; it corresponds to the advanced guard in a forward movement. A small rear-guard also follows an army on the advance, its duty being to pick up stragglers and prevent small bodies of the enemy's cavalry from making raids on the rear of the army to capture the baggage, etc. As regards its order of march, a rear-guard is described as an advanced-guard *reversed*. The principles of formation are identical in both, and the same rules generally guide both; with this difference, that the rear-guard retires before the enemy, while the advanced guard pushes against him. Consequently, although the distribution is the same as with the advanced-guard, the strength of the fractions of the rear-guard decreases instead increases from front to rear. The reserve is nearest the main body. The support is farther to the rear, in support of the rear party, which moves in several groups or in consolidated formations according to the country it passes over. In a fairly open country, where the pursuit is not immediate, the extreme rear will be formed of reconnoiterers, moving in a line thrown back at each end towards the flankers, until it assumes the semi-circular form in a manner more marked than it would in the advance. If the pursuit is active and attack imminent the rear-guard must maneuver; and here we may remark that the nature of the country affects not only the composition of the rear-guard, but the kind of action it must take with the troops at its command.

A change of base or position may have caused an army temporarily to make a retrograde movement, or the force may be retreating. In either case the mission of the rear-guard is to retard the pursuit of the enemy, and to interpose between him and the main body on the march. In carrying out this duty the rear-guard must often maintain a struggle at a disadvantage, and even, if necessary, sacrifice itself in order to enable the main force to get away in safety. No more honorable post can be assigned to an officer than that of commanding or serving with a rear-guard in such a case. The very best officers and the freshest troops should be selected for this service, especially if covering the retreat of a beaten army. In the latter case the position of a rear-guard is one of much difficulty, the enemy nearly always pursuing with activity, and also endeavoring by flank attacks to cut off the retreat. As regards the strength of the rear-guard in a retreat, it would ordinarily take the same proportion as would be allotted to the advanced-guard in a forward march. This proportion would commonly be about *one-sixth* of the whole marching strength. In exceptional cases it might even amount to *one-fourth* of the whole. It is not without reluctance on the part of a Commander that so large a rear-guard is detailed, as his first anxiety and care must naturally be to withdraw and place in safety the greatest number possible of his men. But if he neglects to cover his retreat by a sufficiently strong force the result will probably be that the rear-guard, unable to withstand the assaults of the enemy, will constantly be driven back upon the main column, and throw it into disorder. The demoralizing effect upon troops of the mere knowledge that they are in retreat is in itself very great. Should the rear-guard not be strong enough to enable the column to retire with due regularity, the feeling of depression will increase, the retreat will turn to a rout, and disaster will result. A skillful rear-guard Commander will endeavor by every means to obtain even small advantages over the enemy, in order to encourage his men and to obtain their *morale*, thus enabling them to endure with better spirit a harassing pursuit. With this view it appears desirable that the extreme rear and flanking detachments of the rear-guard should be sufficiently strong, to take all possible advantage of any imprudence on the part of the enemy's advanced troops. In the event of a retreat after an engagement something may also be done toward this end, by selecting for the rear-guard such troops as have not only suffered least during the day, but have themselves perhaps obtained some local advantage, which, insufficient to affect the general result, may yet be enough to prevent the men feeling down-hearted, and with little further stomach for action. The distance that a rear-guard should be from the main body depends upon the nature of the country, its numbers, and the manner in which the pursuit is conducted. If the pursuit is slack it can safely be a march in rear. Under all circumstances, however, constant communication should be maintained between it and the main body. It is difficult to prescribe any definite distance for the rear-guard to take up from the main body. The latter, as is natural in retreat, proceeds as fast as is convenient in the desired direction. The rear-guard has to interpose between the main body and the enemy, to check the advance of the pursuer, and to observe and reconnoiter him, in order to discover at the earliest moment any intention, on his part, of a flank or turning movement. Hence it happens that the distance of the rear-guard from the main column, in two or more cases, may vary considerably, in accordance with a great variety of circumstances; but under ordinary conditions the distances usually laid down for the advanced-guard in a forward movement would be approximately suitable for the rear-guard in retreat. A rear-guard does not require to reconnoiter in advance of its march, for the enemy cannot be there, and since the main column goes first over the ground, and investigates it thoroughly, reports and sketches of roads, bridges, and positions suitable for making a stand against the enemy, can be sent back to the rear-guard whenever it is likely to need them. In most cases the enemy, if following, is easily reconnoitered in the rear, as in the eagerness of pursuit he has little heed for concealment. On the flanks alone there is difficult and delicate work, of this particular nature, to be done. The most serious danger for a rear-guard is undoubtedly that of being turned or cut off, and not only is its own safety imperilled in such event, but its protective character as a guard to the rear of its own main column ceases to have effect. To be attacked upon its flanks is almost as dangerous as to be cut off, and against both of these contingencies the best precautionary measure is accurate and extensive reconnoissance to the flanks. The parties sent out upon this most important duty should in all possible cases be composed largely if not entirely of cavalry. As regards the composition of the rear-guard, in an open country cavalry is certainly necessary, not only for reconnoitering on the flanks, but also to meet the enemy's cavalry. But infantry is indispensable in more or less strength under all circumstances, in order to make a stand at suitable positions for defense, to form rallying points and protection for the cavalry if driven in, and to check the eager pursuit of the enemy's cavalry. If the force is of any magnitude, its rear-guard should be composed of the three arms, in proportions suited to the ground that is to be passed over. Cavalry, to meet and ward off the enemy's cavalry, which in open ground can hover round the rear and flanks, artillery, to take up favorable positions in retreat to bear on the heads of pursuing columns; and infantry, to bear the brunt of the enemy's attack and retard his advance at the chosen points of resistance. If guns are used with skill in a retreat they can often save deployment of their own infantry, by obliging the enemy, as he presses on in pursuit, to halt and deploy; the guns retreating rapidly as the enemy forms up. Artillery is thus of special value when added to a rear-guard.

As regards the action of the rear-guard generally, since the great object which it has to effect is to keep back the enemy without compromising the safety or delaying the retreat of the main body, it is evident that its duties can be best performed by very frequently occupying such natural positions as the country may possibly afford, thus absolutely forcing the enemy not only to deploy, but even to attack, and then getting safely away without serious fighting. The great art of rear-guards is that of being constantly able, without risk, and with but little trouble, to force an enemy to deploy for attack, and then to get safely away yourself without serious fighting; in other words, the rear-guard should, by frequent occupation of strong positions, be continually threatening to fight, as it is by so doing, and not by actual conflict, that it best fulfills its purpose. In a long retreat, when this course has been followed for a number of successive days, the general commanding the pursuit is apt to become reckless, and, neglecting to take all necessary precautions, may push on to attack with an insufficient force at hand, or in an irregular manner; it will then be for the rear-guard to pounce suddenly upon him, with all his available force, and having struck him a severe blow, at once resume the retreat. The officer commanding must not allow himself to be carried away by any partial success of this nature so as to forget his primary duty, for he should bear in mind that he cannot stop, except to retard the pursuit, and that every succeeding quarter of an hour brings his enemy re-enforcements. The length of time that a rear-guard can remain with safety in a position depends on its intrinsic strength, and the obstacles in the way of an enemy's turning it.

In the details of conflict the knowledge which it has of the ground is much to the advantage of the rear-guard, as it can decide what points to make a stand at, what to pass over as untenable. In this respect its position seems better than that of the advanced-guard in the forward march, but the apparent superiority is fleeting, for the conditions under which the rear-guard and advanced-guard fight are widely different. The advanced-guard can push on with the confidence fairly engendered by knowing its supports to be approaching from the rear in any required force; the rear-guard, on the other hand, cannot but feel that the longer the conflict is protracted the farther it gets from its main body. The rear-guard, therefore, has to consider a danger which does not exist for the advanced-guard, that of being cut off from its column should it remain too long in position and be successfully outflanked. If the rear-guard, however, can hold its ground long enough to cause the enemy first to reconnoiter, and then to form up for attack, its purpose and object as a delaying force will have been effected for the moment, and the commander, on his flanks being threatened, may well retire, again to occupy a farther selected position, and again to retard the progress of his pursuers. In a very close country every check thus given to the enemy obliges him to incur a considerable and serious delay; but the Commander of the rear-guard must not forget that he may be pursued by a column marching on a road to his flank, in addition to that immediately behind him. This is perhaps the greatest of all dangers against which he has to guard.

If the pursuit of a rear-guard, which has been actively carried on by the enemy up to a certain point, suddenly appears to cease, the Commander should send out strong cavalry patrols to ascertain the cause. The enemy, it will be found, has either stopped in his pursuit on the main route, or he has taken a different direction and is still advancing. In the latter case active reconnaissance by cavalry patrols should immediately be undertaken by the rear-guard, the main column being also advised of the route taken by the enemy, that it may send out flanking detachments to feel for him. An army retiring by more than one road, whose directions are generally parallel, would usually have a rear-guard upon each road under a separate commander, the rearmost groups being continued across the whole rear, and flankers only upon the outer flanks of the outer columns. The whole of these rear-guards would be included in one high command. The army would thus retire in as many columns as might be necessary, connection being kept up between the different main columns, and also between those of the rear-guards at every cross road, and wherever the country may allow of communication. No war material that could be useful to the enemy should be allowed in a retreat to fall into his hands. The rear-guard must destroy it if it cannot be removed. If hardly pressed, everything that could assist the enemy, such as standing corn and provisions, must be burnt, horses and wagons pressed and sent on to the main body. As an extreme measure, villages on the line of route must even be fired, if necessary to retard the pursuit.

REAR OPEN ORDER.—An *open order*, executed as follows: Being at a halt, the Captain commands: 1. *Rear open order*, 2. MARCH. 3. FRONT. At the first command, the right and left guides step briskly three yards to the rear, to mark the new alignment of the rear rank; the First and Second Lieutenants place themselves on the right and left of the front rank; the Third Lieutenant covers the second, in the rear rank; the Captain goes to the right flank, and sees that the guides are on a line parallel to the front rank.

At the command *march*, the Lieutenants place themselves opposite their places in line, three yards in front of the company; the front-rank men dress to the right; the rear-rank men cast their eyes to the right, step backward, halt a little in rear of the alignment, and then dress to the right on the line established by the guides. The file-closers step to the rear and place themselves three yards from the rear rank.

The Captain superintends the alignment of the officers, and the front rank, and the right guide that of the rear rank; the Captain verifies the alignment of the rear rank, and of the file-closers; the officers and file-closers cast their eyes to the front, as soon as their alignment is verified.

At the command *front*, the guides resume their places in the front rank, and the men cast their eyes to the front; the Captain places himself three yards in front of the right file.

REAR SIGHT. The *rear sight* is composed of a base, which is firmly secured to the barrel at a short distance from the breech, and a movable part capable of being adjusted for different elevations of the barrel. The sight originally affixed to the rifle musket had a single leaf, to which was attached a slide containing the sight notch, which could be adjusted

for all distances between 100 and 900 yards. By an order of the War Department, this was replaced by a sight which had three movable leaves, turning on a common axis, and bearing notches adjusted to 100, 300, and 500 yards, respectively. Aiming a fire-arm consists in bringing the top of the front sight, and the bottom of the notch of the rear sight, into the line, joining the eye and the object. A sight for a military arm should satisfy the following conditions, viz.: 1st. It should be easily adjusted for all distances within effective range; 2d. The form of the notch should permit the eye to catch the object quickly; 3d. It should not be easily deranged by the accidents of the service. The *globe* and *telescopic* sights are used for very accurate sporting-arms, but they are too delicate in their structure, and too slow in their operation, for general purposes. In the *absence* of a proper rear sight, the soldier of the line may be taught to point his piece by aiming over the center of the knuckle of his left thumb: the position of the thumb along the barrel determines the elevation of the piece. This method is practiced by certain French troops of the line, for distances less than 400 yards.

REBELLION.—The term rebellion is applied to an insurrection of large extent, and is usually a war between the legitimate government of a country and portions or provinces of the same who seek to throw off their allegiance to it, and set up a government of their own. When humanity induces the adoption of the rules of regular war toward rebels, whether the adoption is partial or entire, it does in no way whatever imply either a partial or complete acknowledgment of their government, if they have set up one, or of them, as either an independent or sovereign power. Neutrals have no right to make the adoption of the rules of war by the assailed government towards rebels the ground of their own acknowledgment of the revolted people as an independent power.

Treating captured rebels as prisoners of war, exchanging them, concluding of cartels, capitulations, or other warlike agreements with them; addressing officers of a rebel army by the rank they may have in the same; accepting flags of truce; or, on the other hand, proclaiming Martial Law in their territory, or levying war taxes or forced loans, or doing any other act sanctioned or demanded by the law and usages of public war between sovereign belligerents, neither proves nor establishes an acknowledgment of the rebellious people, or of the government which they may have erected, as a public or sovereign power. Nor does the adoption of the rules of war towards rebels imply an engagement with them extending beyond the limits of these rules. It is victory in the field that ends the strife and settles the future relations between the contending parties. Treating, in the field, the rebellious enemy according to the law and usages of war has never prevented the legitimate government from trying the leaders of the rebellion or chief rebels for high treason, and from treating them accordingly, unless they are included in a general amnesty.

All enemies in regular war are divided into two general classes; that is to say, into combatants and non-combatants, or unarmed citizens of the hostile government. The military commander of the legitimate government, in any war of rebellion, distinguishes between the loyal citizen in the revolted portion of the country and the disloyal citizen. The disloyal citizens may further be classified into those citizens known to sympathize with the rebellion, without positively aiding it, and those who, without taking up arms, give positive aid and comfort to the rebellious enemy, without being bodily forced thereto. Common justice and plain expediency require that the military commander protect the manifestly loyal citizens, in revolted territories, against the hardships of the war as much as the common misfortune of all war admits. The commander will throw the burden of the war, as much as lies within his power, on the disloyal citizens of the revolted portion or province, subjecting them to a stricter police than the non-combatant enemies have to suffer in regular war; and if he deems it appropriate, or if his government demands of him that every citizen shall, by an oath of allegiance, or by some other manifest act, declare his fidelity to the legitimate government, he may either expel, transfer, imprison, or fine the revolted citizens who refuse to pledge themselves anew as citizens obedient to the law and loyal to the government. Whether it is expedient to do so, and whether reliance can be placed upon such oaths, the commander or his government have the right to decide.

Armed or unarmed resistance by citizens of the United States against the lawful movements of their troops is levying war against the United States, and is therefore treason. See *Civil War*, *Insurrection*, and *Posse Comitatus*.

REBOUNDING LOCK.—A gun-lock in which the hammer rebounds to half-cock, after discharge, as a means of safety. The drawings show the action of the Parker *rebounding-lock*. The operation of the lock is very simple and renders all fire-arms using it safe from liability of a premature or accidental discharge. Fig. 1 shows the hammer down on the plunger, and Fig. 2 shows the lock at half-cock. When the gun is discharged, the main spring carries the hammer in the usual manner until the spring comes in contact with the stud in the plate and stops. The hammer by its own momentum now explodes the cap, and at this point is shown in Fig. 1, with the nose of the sear resting on the incline of the tumbler ready to force it back to half-cock as soon as the pressure is relieved from the trigger.

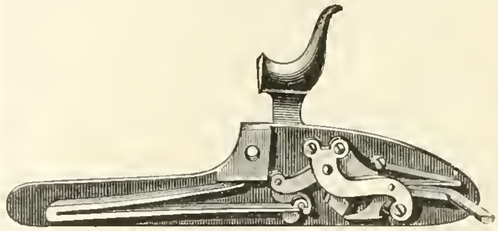


Fig. 1.

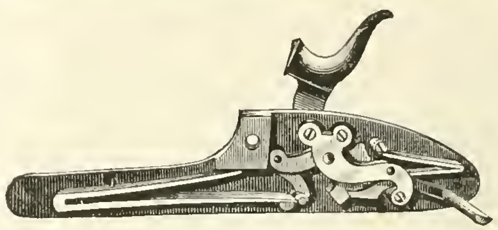


Fig. 2.

REBUFFO.—A bastard cannon, or a three-fourth Carthoun (Karthaune), a 36-pounder of 15 calibers long; according to Ufano, a 45-pounder.

RECALL.—A call on the trumpet, bugle, or drum, by which soldiers are recalled from duty, labor, etc.

RECEIPT.—A voucher or acknowledgment, which should always be given when official papers are received. When flags of truce are the bearers of a parcel or a letter, the officer commanding an outpost should give a receipt for it, and require the party to depart forthwith. The above is the form of a receipt used by Quartermasters.

Received at..,..this............day of............, 188 , from..
in good order and condition, the under-mentioned packages of.. ....
for transportation and delivery to.................. ....
at...

No. of packages.	Articles and quantities.	Cost. Dolls.	Cost. Cts.	Gross weight.

(Signed in duplicate.) *Quartermaster.*

RECHAUD.—A chafing-dish, or pan, used for various purposes, particularly during a siege. Rechauds are filled with burning materials, and hung in different parts of the walls, so as to throw light into the ditches, and to prevent surprises.

RECHUTE.—A term used in fortification to signify a greater elevation of the rampart in those parts where it is likely to be commanded.

RECIPROCAL DEFENSE.—A good flanking defense, to be found in permanent fortifications. In constructing works of this nature, the following are the objects aimed at: 1. To afford cover or protection to the guns, masonry, and bodies of the defenders from the effects of an enemy's fire of every description. 2. To arrange the covering works in such a manner that the defenders may use their weapons with facility, and that the enemy may be kept under fire from his first appearance within range of the heaviest guns to the moment even of his arrival at the crest of the defender's works, a condition which necessarily leads to the introduction of reciprocal or flanking defense, as it would, in many cases, be impossible that it could be fulfilled by means of direct fire alone, each work of defense, becoming a cover to the assailants against the fire of its defenders when they have advanced to its base, it being also evident that flanking fire is much more efficient than direct fire. The term "reciprocal" here used expresses more fully the character and object of such defense than the term "flanking," as it generalises the idea intended to be conveyed, by including reverse fire and every arrangement by which the ground not acted upon by direct fire of one part of a work is brought within the action of the fire of another part.

RECOIL.—When the charge of gunpowder contained in a gun is fired, the sudden expansion of the powder into many times its former bulk acts with equal force in every direction. The resistance offered by the ball, which moves more or less easily in the bore, being far less than that of the bulky and heavier gun and carriage, the ball is forced to a great distance; but the gun, with its carriage, must nevertheless feel the reaction, and is driven backward a certain space, ordinarily a few feet. This retrograde motion is called the recoil, and dangerous accidents sometimes take place from it. After the recoil, the gunners have to work the piece back to its former position for the next discharge. In the Armstrong naval gun, and some other modern cannon, the trunnions of the gun are mounted on an inclined plane, up which the recoil drives them, to run down again by their own weight. The gun and shot remaining the same, the recoil is proportionate to the charge. The recoil of small-arms is known as their "kick," and is felt on the shoulder of the marksman. The increase in the size of cannon and in the charges employed, has necessitated the introduction of some additional means for controlling the recoil. The following are used, viz: 1st. Pneumatic Buffers. 2d. Hydraulic Buffers. 3d. Friction Checks.

Pneumatic Buffers.—These are attached principally to carriages for 15-inch guns. They consist of two closed iron cylinders, placed between the rails at the front part of the chassis, secured thereto by iron straps; and of two piston-rods with heads, working air-tight through the iron heads that close the rear ends of the cylinders. The rear ends of the piston-rods are attached to a heavy iron plate projecting below the rear part of the gun carriage. A small hole in each end of the cylinders relieves the pressure of the air in front of each piston-head and prevents the formation of a vacuum in rear of it. When the recoil takes place, the piston-rods are drawn to the rear, compressing the air in the cylinders and checking, gradually, the motion of the system. Should vacuums be formed in front of the heads, the expansion of the air in rear would force the piece forward beyond the position for loading.

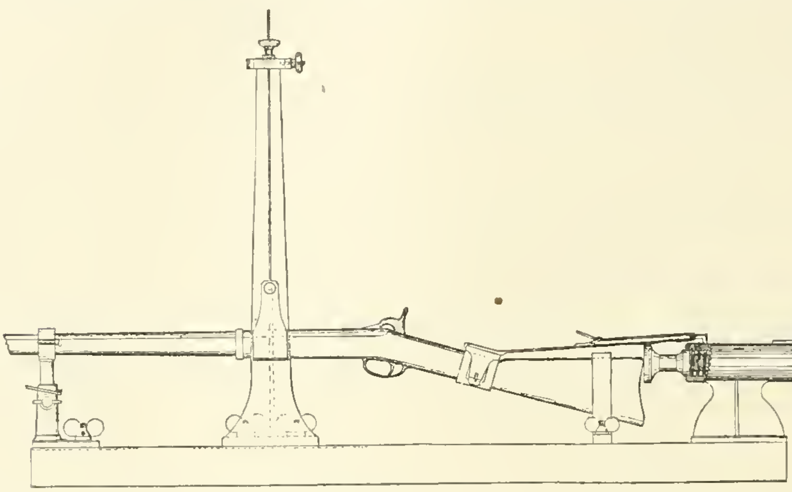
Hydraulic Buffers.—The hydraulic buffer is attached to carriages for 15-inch guns and for heavy rifles. Each consists of a cast-iron cylinder with head, and a piston-rod and heads the latter having perforations in it instead of being solid as in the previous system. A non-freezing liquid is placed in the cylinder. The motion given to the piston-rod by the recoil is arrested by the liquid which is forced to pass through the holes in the head. The amount of liquid, and the number and size of the holes, which are determined by experiment, regulate the amount of recoil. One cylinder may thus be sufficient for any sized gun, though with the largest cannon two are generally employed. The cylinder may be attached to the front or to the rear end of the chassis. In the first case, the piston-rod, connected with the rear of the top-carriage, is drawn out of the cylinder; in the second case, the rod secured to the front of the carriage is forced into the cylinder. Each has its advantages, the first is, however, the most rigid.

Friction Checks. These are found upon many of the carriages for heavy rifles. The simplest is the "Parrott" system. Two iron clamps actuated by screws are placed on the rails in rear of the top-carriage; their pressure on the rails is regulated by the screws. Part of the force of recoil is expended in moving the clamps on the rails; they may, before firing, be so placed as to allow free recoil over a certain distance, the motion being afterwards checked. The "Sinclair" *check* is now preferred. It consists of a box-clamp bearing against the front axle of the top-carriage; and of a broad wrought-iron rail slightly wedge-shaped, extending nearly the length of the chassis along its center line. Attached to the front of the chassis are two transom-plates between which the rail works, free to move to the front, but prevented by them from moving to the rear. The rail is secured to the rear of the chassis by a steel, or rubber spring. The clamp has two friction plates between which the rail passes, and on which they are tightened by means of a screw and handle. The friction of the clamp upon the rail checks the recoil, and when it ceases the reaction of the strain upon the rail, due to its elasticity would cause the rail to bend were it not free to move forward in the direction of its length, being retained only by the spring.

RECOIL DYNAMOMETER.—Three conditions, theoretically essential to obtaining a true record of recoils, can only be approximated to in practice: I. The recoiling mass should consist of *nothing but the gun.* II. The *entire recoil* should be expended on the *dynamometer.* III. The registration should be effected *without sensible motion* of the gun. The first condition would require that the gun should be suspended by an imponderable pendulum rod. This is approximated to by reducing the suspending apparatus to the minimum consistent with strength and convenience. The second condition would require that the gun should be stripped of all guides and restraints involving friction. This is effected by having guides near enough to the gun to prevent inconvenient derangements, but nowhere in actual contact. The third condition would require that the dynamometer should be set, in advance, at an initial tension exactly equal to the expected recoil. This condition can only be satisfied so far as to set the dynamometer at an initial tension not greater than the minimum recoil which the instrument can reasonably be expected to be called upon to measure. In the particular instrument, which forms the subject of this report, the spring stands at an initial tension of fifty pounds avoirdupois, which is, consequently, the minimum limit of its capacity for measuring recoils.

The accompanying drawing will give a general idea of the instrument, and enable it to be assembled. Being assembled the following sequence of adjustments has been found most convenient: 1. Open and depress the front guide; 2. Balance the piece, loaded, in the sling, at the elevation desired, having first attached the "bridle," described beyond. 3. Bring the butt-plate heel nearly into contact with the recoil-block, by shifting the pendulum column, and clamp it; 4. Complete the contact accurately by means of the horizontal screw at the head of the pendulum column; 5. Raise or lower the gun by means of the vertical screw, at the head of the pendulum column, until the point of contact is in the center of the circular face of the recoil-block. An assistant should now steady the butt in this position while the front adjustments are made; 6. Slide the front guide to a convenient point under the barrel and clamp it; 7. Raise the front guide until, when closed, the barrel hangs midway in it without touching: then, before clamping: 8. Rotate the front guide in a horizontal plane until the gun has the least perceptable lateral "inshake," at which position its vertical "inshake" also will be limited. Clamp the front guide in this position: 9. Bring the faces of the butt-guides nearly into contact with the butt. See that the butt-plate contact has not been deranged. Mark the position of the sling on the gun to facilitate readjustment. See that the index has been pushed back to 50: 10. Adjust the bridle.

The "bridle is not an essential element of the instrument, but only a convenient accessory. The return of the dynamometer spring inflicts a sharp blow on the gun, which would throw it forward and necessitate tedious readjustments after each shot. The bridle restrains this forward throw without materially interfering with the prime object of the instrument. Two forms of bridle accompany the instrument, one of which embraces the gun at the small of the stock by a leather collar, which is buckled back to a hook on the dynamometer by a leather strap; the other embraces the gun in front of the front sight by a metallic collar, similarly buckled back to the column of the front guide. The first form is the lighter and less objectionable, and can be used with all guns and carbines, except such as open by a lever, like the Sharp's arms. In a series of trials with the service rifle and ammunition the instrument gave a very uniform record of 98 pounds recoil. The pull of the trigger, in experiments for recoil, is canceled by the simple expedient of placing the thumb behind the guard-bow and *pinching together* the bow and the trigger while standing on the right of the gun.



RECOMMENDATIONS.—All members of any Court who concur in recommendations to mercy sign. The recommendation is introduced after the finding and sentence are closed and authenticated. The recommendation should distinctly set forth the reasons which prompt it.

RECONNOISSANCE.—There are no more important duties, which an officer may be called upon to perform, than those of collecting and arranging the information upon which either the general or daily operations of a campaign must be based. For the proper performance of the former, acquirements of a very high order, in the departments of geography and statistics, are indispensable requisites; to which must be added a minute acquaintance with topography, and a good *coup d'œil militaire* for that of the latter. However detailed and perfect may be a map, it can never convey all the information that will enable an officer to plan, even an ordinary march, with safety; still less, operations that necessarily depend, for their success, upon a far greater number of contingencies. To supply these deficiencies of maps, an examination of the ground must be made by the eye; and verbal information be gained on all the points connected with the operation over this ground. This examination and collection of facts is termed a *reconnoissance.*

From the services demanded of a reconnoitering officer, it is, in the first place, evident that he should possess acquirements of no ordinary character; but, in addition to these, he should be gifted by nature with certain traits, without which his acquisitions would be of little account in the discharge of the responsible duty in question. With clear and specific information before him, one-half of a General's difficulties, in planning his measures, are dissipated. In a letter from General Washington to Major Tallmadge, he remarks, in relation to reports made to him, on a certain occasion: "But these things, not being delivered with a certainty, rather perplex than form the judgment." It is in truth this feeling of certainty that constitutes all the difference; having it, the General makes his dispositions with confidence; without it, he acts hesitatingly; and thus communicates to others that want of confidence felt in his own mind. An officer, then, selected for the duty in question should be known to be cool-headed and *truthful;* one who sees things as they are, and tells clearly and precisely what he has seen. In making his report, whether verbally or in writing, the officer should study conciseness and precision of language. He must carefully separate what he knows, from his own observation, from that which he has learned from others; and add all the circumstances of place and time with accuracy.

The first thing to be done by an officer selected for any reconnoissance, is to ascertain *precisely* the duty required of him; and what further should be done in case of certain contingencies that may, from the nature of the duty, be naturally looked for. In the performance of the duty assigned him, and in making his report, the officer should keep always in mind the specific character of his mission, as his guide in both points. As the deed of a reconnoissance supposes a great deficiency in information upon the natural features of the country, the officer, detailed to make one, should provide himself with maps, a good telescope, such simple aids for judging of distances, and ascertaining the relative positions of objects, as he can himself readily make; writing materials; one or more good guides; and gain all the knowledge he can, from the inhabitants at hand, bearing upon his mission. The talent of judging of distances, and of the connection between the various features of a country within the field of vision, is partly a natural and partly an acquired one. Some individuals can never be brought to have any confidence in their own judgment on these points; others have a natural aptitude for them, which requires but little practice for their perfect development. The powers of the eye vary so greatly among civilized persons, that no general rules can be laid down as a guide for the matter in question. Among uncivilized hordes,used to a roaming life, there are found standards which are well understood by all, — the Arab, for instance, calling the distance a mile, at which a man is no longer distinguishable from a woman growing out of their habits. The first thing then to be done by an officer, in acquiring the *coup d'œil militaire*, is to learn, both from books and on the field, what space is taken up by a battalion and its intervals, by a squadron, and by a battery when in order of battle; how much when in column of march; and the average time required for certain movements, under given circumstances of the ground. This acquirement he may make by adopting some standard of his own: his ordinary pace, and that of a horse, serving for computing time and distance reciprocally. The next step is to acquire the habit of estimating, by the appearances of these different objects, from various points of view, how far off they are. This must be done practically. A very simple aid to it is the following: — Upon the stem of a lead-pencil, cut square, and held out at a uniform arm's length from the eye, by means of a thread attached to it and fastened to the top button-hole, let the officer mark off, on one of the edges, the length seen on it by holding the pencil upright between the eye, and a man placed successively at different distances from it, as 100, 150—1,000 yards. This will give one rough standard for practice.

Trustworthy guides are invaluable, but most rare, in an enemy's country. The best, from the information they acquire by their habits of life, are to be found among those classes whose avocations keep them much abroad, going from place to place within a certain sphere constantly; such as common carriers, hunters, smugglers, etc. Among the first things to be attended to by an officer,in taking post at any point, is to find out persons of this class, and to ascertain their whereabouts when wanted. Kind treatment, *douceurs*, and promises, should not be spared to enlist either their good will or their interests; and, if policy requires it, they may openly be treated with apparent harshness, to screen them from odium among their neighbors. If none of this class can be found, then resort must be had to a higher; local authorities being in preference selected, and if necessary forced to act. Here very careful treatment is requisite: when the necessity of the case is admitted by them, much may be gleaned by kindness, courtesy, and a certain deference, from such persons, that cannot be looked for from their inferiors.

Before starting on his mission, the officer should question his guide thoroughly; and if he has several, question each apart; like precautions should be taken with respect to other inhabitants. Care must be had to find out the usual beats of one taken as a guide, so as not to take him out of his own neighborhood. Should there be but one guide, he must necessarily be placed with the most advanced portion of the detachment accompanying the officer. It may be well to remark that guides are useful even in a country of easy communications; as, in case of a rencontre, they may point out by-ways convenient for retreat if necessary.

To designate all the objects to be embraced in a reconnoissance, would lead further than the limits of this article will allow; some general heads, which will serve as guides in all cases, will therefore be alone noticed. A general view of the ground to be examined must first be taken in, so as to obtain some notion of the forms of the parts, their connection, and relations to each other, before going into a detailed examination. To one possessed of some topographical knowledge, this study of what is before him will not demand much time. A level country, for example, he knows is usually well cultivated, and therefore has plenty of hedges, ditches, etc., which lend themselves well to affairs of light troops — may be not a little inconvenient to maneuvers of artillery — and frequently bring up cavalry very unexpectedly in full career. In a mountainous one, dangerous passes, narrow roads, torrents with rough beds, ugly sudden turns, etc., will necessarily be met with. Each and all of these demand a particular examination, and in his report their advantages and disadvantages should be clearly pointed out by the officer.

If the reconnoissance is for an onward movement; the distances from halt to halt, as well as all others, should be estimated in *hours of march*, the nature of the roads,and the obstacles along them be carefully detailed; the means that may be gathered along the line to facilitate the movement,as vehicles, men, and materials for removing obstacles, etc. The points where cross-roads are found, must be specified; the direction of these roads; their uses, etc. All local objects along the line, as villages, farm-houses, etc., should be carefully designated, both as to their position on the line, or on either side of it; and also as to their form, and color, etc., as "square white house on the right;" "round gray stone tower on hill to left." The names of localities, in the way in which the inhabitants pronounce them, should be carefully written, and called over several times, so as to be sure to get them as nearly as practicable right in sound; then the names, as written by an intelligent inhabitant, should be added. All halting points must be well looked to; their military capabilities, in case of attack; as well as their resources for accommodating the troops, be thoroughly gone into. If the halt is to take position for some time, to await or watch the enemy, then more care must be taken, the whole site be well studied as to its fulfilling the proposed end; the points of support on the flanks be designated, as well as others in front and rear, that may require to be occupied; the suitable localities to be chosen for parks, hospital, etc.; the communications to be opened or repaired, pointed out; and all the facilities either for an advance or a retrograde movement, be laid down. See *Armed Reconnoissance*, *Patrols*, and *Topographical Reconnoissance*.

RECORDER.— One who keeps a record; specifically, the officer who registers the proceedings of a Board or Minor Court.

RECORD OF FIRING.— A book is furnished to each post for the "*record of artillery*" and "*record of firing*." In the front of this book are printed instructions fully explaining how it is to be kept. Under appropriate headings, in the part set aside for record of artillery, each gun is described by its number and marks; when received and where from; whether mounted or dismounted; if mounted, in what part of the work, stating its platform number. The result of each inspection, made as hereinafter described, will be entered for each piece in this part of the book.

In the portion of the book devoted to record of firing, each piece has a separate page, which, when filled, is carried on to another. Each shot fired is duly recorded as to date of fire, kind and weight of projectile, kind and quantity of powder, elevation, time of flight, range, etc. When a piece is transferred from one post to another a complete record is sent with it, and the previous number of fires is entered in the book at the last post, so that the firing may not go beyond the limit prescribed as the endurance of the piece; this has been fixed at one thousand service rounds for cast-iron cannon.

RECORDS.—Official accounts or registers. All Military Records, such as files of public letters, letter-books, order-books, and other record-books, muster-rolls, etc., are the property of the Government, and are preserved for future reference in the settlement of claims against the Government and for other official purposes. Whenever posts, Districts, Geographical Departments, Divisions, and other commands, are discontinued, all such Records as are not required for use at the Department Headquarters in which the commands were included are immediately sent by express to the Adjutant General of the Army. Every person who wilfully destroys, or attempts to destroy, or with intent to steal or destroy, takes and carries away any Record, paper, or proceeding of a court of justice filed or deposited with any clerk or officer of such court, or any paper, or document, or Record filed or deposited in any public office; or with any judicial or public officer, without reference to the value of the Record, paper, document, or proceeding so taken, pays a fine of not more than two thousand dollars, or suffers imprisonment at hard labor, not more than three years, or both. Every officer having the custody of any Record, document, paper, or proceeding specified above who fraudulently takes away, or withdraws or destroys any such Record, document, paper, or proceeding filed in his office, or deposited with him, or in his custody, pays a fine of not more than two thousand dollars, or suffers imprisonment at hard labor not more than three years, or both; and moreover, forfeits his office, and is forever afterward disqualified from holding any office under the Government. The established printed forms and blanks of all muster-rolls and returns required from the Commanders of Divisions, Brigades Regiments, Corps, Companies, and Posts are furnished from the Adjutant General's Office on requistions made directly upon him. The receipt of these forms and blanks is immediately acknowledged. Officers keep these blanks under their own personal care, to guard against their being misapplied. The use of violet or other colored inks (except as carmine or red ink is used in annotation, indorsement, and ruling) is prohibited in the Records and correspondence of the army. Rules for keeping the principal Record-books at the different headquarters; forms for making rolls, returns, etc., lists of papers required from each command in the army, and of blank forms and books issued by the several Departments, are furnished the proper officers on application to the Adjutant General of the army. All officers and clerks on duty in the Bureaus of the War Department are prohibited from exhibiting any table, statement, or paper belonging to the official Records, or giving any information, copy, or extract from the same, or giving any information respecting the business of the Department to any person whatever not on duty in one of the offices of the Department, without, in each case, the authority, in writing, of the Chief of the Bureau concerned. A rigid compliance with this order is enforced, to prevent improper use of information irregularly obtained.

RECOVER.—In tactics, a word of command in firing, whereby the piece is brought from the position of *aim* to that of *ready*.

RECRUITING.—Formerly, in England, the task of raising recruits for the army was intrusted to the Colonels of Regiments, who employed civilian agents and others to persuade young men to join their standards; these agents often resorting to very illegal methods to entrap recruits. Subsequently, the duty was assigned to several Recruiting Corps, each known by the name of its Commanding Officer, but under this system, so many irregularities, and such difference of practice arose, that in 1802, for purposes of uniformity, economy, and proper control, it was decided to place the whole recruiting under the immediate direction of the Adjutant General. For this purpose, the country was divided into recruiting districts. At the head of each district was placed an Inspecting Field-officer, with the duty of superintending all recruiting parties in his district, and of approving the recruits brought. At the District Headquarters there was a Paymaster, responsible for all the financial concerns, and a Medical Officer, who examined the recruits in point of health and physical fitness. Recruiting parties used to consist of old Sergeants, who sought by every means to induce young men to enter the army; they frequented fairs, wakes, and country gatherings, endeavoring by beat of drum, smart uniforms, well-fed personal appearance, and persuasion—not always too truthful—to convince the rustics of the advantages of the Queen's Service; advantages which really existed, though not always to the extent depicted. The adoption in 1872-73 of the system of Regimental Localization changed all this. The United Kingdom is divided into 66 sub-districts, at the head of each of which is a Colonel, who commands the Brigade Depot, and the auxiliary and reserve forces of his subdistrict. He also controls the recruiting within his command, primarily, for the regiments composing the brigade; and secondly, for the rest of the Army. To preserve uniformity of action, the Colonels report on recruiting matters to the Inspector General of Recruiting, an official on the Staff at the War Office. On a would-be recruit presenting himself, the recruiter must ask him if he already belongs to the militia; if not, and he appear physically eligible, he is given a shilling, after which, should he abscond, he becomes a deserter. The Sergeant must then give the recruit 24 hours for consideration; afterward, but within 96 hours from his first enlistment, he must take him before a magistrate, when, if the recruit declare that he voluntarily enlists, the justice reads to him the Articles of War relative to desertion, and puts the questions detailed in the attestation. This done, the oath of allegiance is administered, and the man becomes definitely a soldier, receiving his free kit and bounty. The recruit may avow his dissent before the magistrate, when he must be forthwith discharged on returning the shilling, and paying twenty shillings as "smart" for the trouble he has given. False declarations as to age, previous service, health, etc., involve the recruit in various penalties. About 18,000 recruits are raised annually in time of peace for the British Army; but a larger number will be necessary, as enlistment for short service with the colors becomes more the rule.

In the United States, the recruiting service is conducted by the Adjutant General, under the direction of the Secretary of War and the Commander of the Army. Details for recruiting service are ordinarily for the period of two years. The Adjutant General details the field officers for Superintendents, and announces in Orders the number and grade of the company officers to be selected by the Commander of each regiment for the charge of recruiting parties. These officers are chosen irrespective of the roster, and with regard to their fitness for the duty. They are ordered by their Regimental Commanders to report in person to the Superintendents designated for their respective arms of service. Officers on the general recruiting service are not ordered on any other duty, except from the Adjutant General's Office. A recruiting party consists generally of one Lieutenant, one Non-commissioned officer, and not more than four privates. The parties are sent from the principal depots, and none but suitable men selected. The Adjutant General of the Army causes frequent inspections to be made of the recruiting depots and rendezvous, for the purpose of enforcing the regulations and orders governing enlistments, and especially to prevent the reception of men of bad character, and the illegal enlistment of minors into the service. Officers in charge of rendezvous will in no case absent themselves from their stations without authority from the Superintendent. Success in obtaining recruits depends much on the activity and *personal attention* of recruiting officers. They must not intrust to enlisted men the duties for which they alone are responsible, but must use every care to prevent the imposition of minors and bad men upon the service. Recruiting officers will not allow any man to be deceived or inveigled into the service by false representations, but will in person explain the nature of the service, the length of the term, the pay, clothing, rations, and other allowances to which a soldier is entitled by law, to every man before he signs the enlistment. See *Recruiting Depot*, *Recruits*, and *Superintendent of Recruiting Service*.

RECRUITING DEPOT.—A depot for the collection and instruction of recruits. These depots are established by orders from the Adjutant General's Office. To each *depot* there is assigned a suitable number of officers to command and instruct the recruits The recruits are *dressed in uniform* according to their respective arms, and are regularly mustered and inspected. They are well drilled in the Infantry Tactics, through the school of the soldier to that of the battalion, and in the exercise of field and garrison pieces. Duty is done according to the strict rules of service. Recruits are not put to any labor or work which would interfere with their instruction, nor are they employed otherwise than as soldiers, in the regular duties of garrison and camp. To give encouragement to the recruits, and hold out inducements to good conduct, the Commanding Officer of the Depot may promote such of them as exhibit the requisite qualifications to be *Lance Corporals* and *Lance Sergeants*, not exceeding the proper proportion to the number of recruits at the Depot. These appointments are announced in orders in the usual way, and are continued in force until they join their regiments, unless sooner revoked. No allowance of pay or emoluments is assigned to these appointments: they are only to be considered as recommendation to the Captains of companies and Colonels of regiments for the places in which the recruits may have acted; but such Non-commissioned officers are to be treated with all the respect and to have all the authority which belong to the stations of Sergeant and Corporal.

The General Superintendent causes such of the recruits as are found to possess a natural talent for music to be instructed (besides the drill of the soldier) on the fife, bugle, and drum, and other military instruments; and boys of sixteen years of age, and upward, may, under his direction, be enlisted for this purpose. Care is taken to enlist those only who have a natural talent for music, and, if practicable, they are taken on trial for some time before being enlisted. The posts used as Recruiting Depots are not to be made places of confinement for military prisoners. Whenever deserters from the Army are apprehended by, or come in custody of recruiting parties, they are sent to the depots, and thence, at the earliest opportunity, forwarded for trial to their regiments, where the witnesses in their cases should be. When trial by General Court-Martial of prisoners belonging to or under charge of the recruiting service becomes necessary, the charges are forwarded, through the Superintendent, to the Adjutant General of the Army, with a list of the officers available for duty on the Court. *Recruiting parties* and recruits are mustered, inspected, and paid in the same manner as are other soldiers. The number of recruits at depots to be assigned to each arm and regiment is directed from the Adjutant General's Office. As soon as a recruit joins any recruiting depot, regiment, or station, he is examined by the Medical Officer, and vaccinated when it is required.

The Boards of Inspection at recruiting depots reject any man found to have borne an unsatisfactory character on any previous enlistment, or who has shown such character since enlistment. In all cases of *rejection*, the reasons therefor are stated at large in a special *report*, made by the Board, which also shows when, where, and by whom the recruit was enlisted. This report, together with the Surgeon's certificate of disability for service, is forwarded by the Superintendent or Commandant, of the post direct to the Adjutant General. In all such cases the Commanding Officer causes the articles of clothing which may have been issued to the recruit, with the price of each article, to be indorsed on the certificates of disability. If the recommendation of the Board for the discharge of the recruit be approved, the authority therefor is indorsed on the certificate, which is sent back to be filled up and signed by the Commanding Officer, who returns the same to the Adjutant General's office. The Board states in the report whether the disability, or other cause of rejection, existed before his enlistment; and whether, with *proper care and examination*, it might not have been discovered. In all other cases the Superintendent or Commanding Officer causes an extract from the proceedings of the Board of Inspection to be furnished the officer making the enlistment. Upon receipt of this extract the officer promptly renders a special report in explanation to the Adjutant General.

An officer intrusted with the command of recruits ordered to regiments, on arriving at the place of destination, forwards the following papers: 1. To the *Adjutant General* and *Superintendent*, each, a discriptive roll and an account of clothing of such men as may have deserted, died, or been left on the route from any cause whatever, with date and place also, a special report of the date of his arrival at the post, the strength and condition of the party when turned over to the Commanding Officer, and all circumstances worthy of remark which may have occurred on the march. To the *Commanding Officer* of the regiment or post, the muster and descriptive roll furnished him at the time of setting out, properly signed and completed by recording the names of the recruits *present*, and by noting in the column for remarks, opposite the appropriate spaces, the time and place of death, desertion, apprehension, or other casualty that may have occurred on the route. See *Recruiting*, *Recruits*, and *Superintendent of Recruiting Service*.

RECRUITS.—Men raised for service in the army, to fill vacancies in regiments or to augment the strength of the Army. In the United States, any male person above the age of sixteen and under the age of thirty-five years, effective, able-bodied, sober, free from disease, of good character and habits, and with a competent knowledge of the English language, may be enlisted, due attention being given to the restrictions concerning minors. This regulation, so far as respects age, does not extend to soldiers who may re-enlist, or who have served honestly and faithfully a previous enlistment in the army. Men having the appearance of being hard drinkers are rejected, though they may not at the time be intoxicated. No man having a wife or minor child can be enlisted or re-enlisted without special authority from the Adjutant General's office. If minors present themselves, they are to be treated with great candor; the names and residences of their parents or guardians, if they have any, are ascertained, and these are informed of the minor's wish to enlist, that they may make objections or give their consent. No person under the age of twenty-one years can be enlisted or re-enlisted without the written consent of his parents or guardians, provided that such minor has parents or guardians entitled to his custody and control. Recruiting Officers are very particular in ascertaining the true age of the recruit. If *any doubt* exist as to the age of the applicant, his oath is not taken as the *sole* evidence of *legal* age; and if he cannot, in addition, furnish undoubted proof of the fact, he will not be accepted. The law forbids the enlistment of boys under sixteen years of age; of all insane or intoxicated persons; of deserters from the military or naval service of the United States; and of all persons who have been convicted of felony. Minors under eighteen years are not enlisted except for musicians, or to learn music, and then only under authority from the Superintendent. In every case of a recruit rejected, or discharged as a minor, when it appears that the enlistment was carelessly made in violation of Regulations, recommendation is made that the expenses incurred by the Government in consequence thereof shall be stopped against the pay of the Recruiting Officer.

After the nature of the service and terms of enlistment have been fairly explained to the recruit, the officer, before the enlistments are filled up, will read to him, and offer for his signature the annexed declaration, to be appended to each copy of his enlistment:

I, ——— ———, desiring to enlist in the Army of the United States for the period of five years, do declare that I am —— years and —— months of age; that I have neither wife nor child; that I have never been discharged from the United States service on account of disability, or by sentence of a Court-Martial, or by order before the expiration of a term of enlistment; and I know of no impediment to my serving honestly and faithfully as a soldier for five years. ——— ———.

Witness:

——— ———

If the recruit be a minor, his parents or guardian must sign a consent to his enlisting, which is added to the preceding declaration, in the following form:

I, ——— ———, do certify that I am the (*father, only surviving parent, or guardian, as the case may be*) of ——— ———: that the said ——— ——— is ——— years of age; and I do hereby freely give my consent to his enlisting as a soldier in the Army of the United States for the period of five years.

——— ———.

Witness:

——— ———

The forms of declaration, and of consent in case of a minor, having been signed and witnessed, the recruit is then duly examined by the Recruiting Officer and Surgeon, if one be present, and, if accepted, the 47th and 103d Articles of war are read to him: after which he is allowed time to consider the subject until his mind appears to be fully made up before the oath is administered to him.

As soon as practicable, and at least within six days after his enlistment, the following oath is administered to the recruit:

STATE OF———,
Town of———, *ss:*

I,——— ———born in———,in the State of———, and by occupation a———,do hereby acknowledge to have voluntarily enlisted [or re-enlisted] this—— day of———, 18—, as a soldier in the Army of the United States of America for the period of ——— years, unless sooner discharged by proper authority, and do also agree to accept from the United States such bounty, pay, rations, and clothing as are or may be established by law; and I do solemnly swear that I am ——— years and ——— months of age, and know of no impediment to my serving honestly and faithfully as a soldier for ——— years, under this enlistment contract with the United States. And I, ——— ———, do solemnly swear (or affirm) that I will bear true faith and allegiance to the United States of America; that I will serve them honestly and faithfully against all their enemies whomsoever; and that I will obey the orders of the President of the United States, and the orders of the officers appointed over me, according to the Rules and Articles of War.

——— ———. [SEAL.]

Subscribed and sworn to before me this —— day of ———, 18—.

———,
———,
Recruiting Officer.

This oath may be administered by any Commissioned Officer of the army.

The Medical Officer (when one is provided) next examines the recruit. When there is no Medical Officer, the Recruiting Officer personally makes this examination. The recruit is examined stripped, to see that he has free use of all his limbs; that his chest is ample; that his hearing, vision, and speech are perfect; that he has no tumors or ulcerated or extensively cicatrized legs; no rupture or chronic cutaneous affection; that he has not received any contusion, or wound of the head, that may impair his faculties; that he is not a drunkard; is not subject to convulsions; and has no infectious disorder, nor any other that may unfit him for military service.

In accepting recruits at rendezvous, the following instructions govern in examining the eye:

1. No recruit shall be enlisted who cannot see well, at six hundred yards' distance, a black centre three feet in diameter on a white ground. The test will be made by means of cards, prepared under the direction of the Surgeon General of the army; the black spots on the cards will be circular, four-tenths of an inch in diameter, and the recruit must be able to count them with facility at twenty feet distance.

2. *Anomalies in the refraction of the eye.*—The principal anomalies in the refraction of the eye are myopia, hypermetropia, and astigmatism. These anomalies, if unaccompanied by disease of the eye, are not to be regarded as a cause for the rejection of a recruit, unless they impair the vision to such a degree as to prevent him from counting the test-spots described in the last paragraph at the distance named. *Myopia* (near-sightedness) is a refractive defect of the eye in which parallel rays falling upon the cornea are brought to a focus before they reach the retina. *Hypermetropia* (over-sightedness)is a refractive defect of the eye in which parallel rays falling upon the cornea are not yet brought to a focus when they reach the retina. *Astigmatism* is a refractive defect in which when parallel rays fall upon the cornea they are not brought to a focus in the same plane for all the meridians of the eye. The character and approximately the degree of these defects can be ascertained by the spectacles and test-types which will be issued for this purpose by the Surgeon General of the army, on requisition from the Medical Officers.

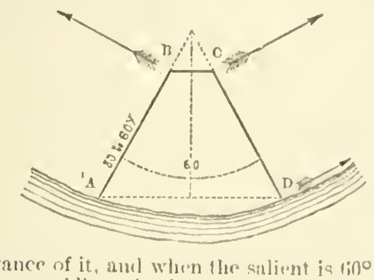
3. *Presbyopia* is not a refractive anomaly, but a condition due to a diminution in the accommodation of the eye, resulting from advancing age Vision for distant objects remains normal, while that for near objects is impaired. This defect is not of itself a cause for the rejection of a recruit, but those in whom it exists are usually over age. The existence of the defect can be ascertained by the test-types referred to in the preceding paragraph.

4. *Color-blindness.*—At the principal recruiting depots all the accepted recruits are examined for color-blindness by the Medical Officers on duty. Any defect observed is noted on the descriptive list of the soldier, but does not of itself constitute a cause of rejection, except in the case of enlistments for the Signal Corps. The examination for this defect is made by the method of Holmgren. Test-wools for the purpose, accompanied by printed directions for their use, are issued to the principal recruiting depots by the Surgeon General. See *Recruiting, Recruiting Depot*, and *Superintendent of Recruiting Service.*

RECURSANT.—In Heraldry, moving or coursing backward; said—of an eagle displayed with the back towards the spectator's face.

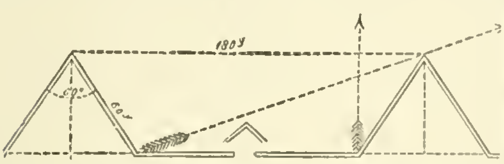
REDAN.—The simplest work in Field Fortification. It consists of two parapets whose faces join in forming a salient angle toward the enemy, like a letter V, in which the apex is to the front. Regarded by itself, the redan is a work of very little strength, since there is no flanking fire to protect its faces, and nothing to prevent an enemy from forcing an entrance at the gorge; but redans are useful in many positions, and the rapidity with which they may be constructed, render them favorites with engineers and generals. A row of redans along an exposed front of an army adds much to its strength,the troops behind protecting the gorge, and the redans flanking each other. It forms an excellent defense for a bridge-head, the gorge being covered by the river. Redans figured largely in Wellington's works for defending Lisbon in 1810. The redan of Sebastopol in 1855 was the principal point of the English attack, and the scene of two bloody repulses by the Russians in June and September.

The faces of the redan should receive direction such as to sweep the approaches to the flanks of the position. From the angular point but a single line of direct fire can be brought to bear on the sector



in advance of it, and when the salient is 60° or less, only a very oblique fire from the faces can be brought upon this sector, which becomes thus a sector without fire for the assailed. To remedy this, a portion of the salient is filled in so as to form a short defensive line perpendicular to the capital. This line is termed a *pan-coupée*, and gives a direct fire in the direction of the capital prolonged outwards. See *Field-works*.

REDAN LINE.—The simplest arrangement for a continued line consists in a series of redans connected by straight curtains. The faces of the redans are sixty yards in length; their salient angles 60°; and the distance between their capitals 180 yards. This combination will place the salients at 160 yards from the



collateral reenterings. An inspection of this system shows that the ditches are not flanked; that the salients are not well protected, owing to the cross-fire leaving a considerable sector without fire in front of them; that the curtains, which, from their position, are the strongest points, are the best defended, and in turn they afford no protection to the faces. All these defects become more sensible as the redans are placed further apart. See *Lines*.

RED COAT.—An English soldier, or a soldier who wears a red coat.

RED FLAG.—A flag used by Revolutionists as an emblem of defiance. It is used in the United States service as a danger-signal at target practice, and on a man-of-war as a signal that the ship is receiving or discharging her powder. See *Flags*.

RED HAND.—In Heraldry, a sinister hand erect, open, and couped or, the wrist gules, being the arms of the province of Ulster, was granted to the baronets of England and of Ireland as their distinguishing badge on the institution of that order in 1611, and is borne by the baronets of Great Britain and of the United Kingdom. It is assumed into the armorial coat, and may be borne upon a canton, or on an escutcheon, which may be placed either in the middle chief or in the fess point, so as least to interfere with the charges composing the family arms.

RED-HOT SHOT. Cannon-balls heated to redness, and fired from cannon at shipping, magazines, wooden buildings, etc., to combine destruction by fire with battering by concussion. In the great bombardment of Gibraltar, on Sept. 13 and 14, 1782, red-hot shot was used with great effect by the defenders under the Governor General Elliott, the attacking squadron being completely silenced and a large number of ships set on fire.

REDOUBT.—A small fort of varying shape constructed for a temporary purpose, and usually without flanking defenses. The term is vague in its acceptation, being applied equally to detached posts and to a strong position within another fortress. Redoubts are made square, pentagonal, and even circular. Each redoubt has parapet, ditch, scarps, banquette, etc., as in regular fortifications; but it is commonly rather roughly constructed, haste and unprofessional labor precluding mathematical accuracy. The entrance may be by a cutting through the parapet, the cutting being covered within by a traverse, or preferably, by an excavated gallery leading into the ditch, and thence by a ramp through the counterscarp. For the sake of flanking the ditch, and preventing an assaulting party from forming in it, caponnieres of timber, loopholed, are sometimes formed; or, if the soil be stiff or chalky, a gallery may be cut behind the counterscarp and loopholed toward the ditch. In some modern redoubts the line of each side is broken to afford flanking defense. Redoubts have the weak feature of not defending their own ditches, and of being approached at their salient angles with comparative impunity. They are therefore not adapted to a protracted defense, but as temporary field works, or in a war of posts, they are often of incalculable importance. Troops whose stability in the open field is doubtful are especially strengthened by redoubts in their line. Redoubts are particularly useful in fortifying the tops of hills, or commanding passes, or where the object is to occupy a hostile territory, or to feel the way gradually through a wooded country. The size to be given to a redoubt, or generally to any inclosed work, will depend upon the number of men available for its defense, taking it as an established rule that it is better to have a force concentrated than too much distributed, and therefore injudicious to make works of a greater extent than can be well manned and vigorously defended. The number of men will depend upon the particular circumstances of the case; as, for instance, its situation with regard to distance from the enemy; whether it is likely to be attacked by a powerful force or only by raiding parties; whether it is of such vital importance as to require it to be held at all hazards, and its distance from supporting force.

In permanent fortification, the term redoubt, or *reduit*, is applied to the outworks placed within other outworks; their object being to strengthen the defense of the principal work. A work of this class is usually placed within the demi-lune, and is termed the *demi-lune redoubt*. Small works of this kind are also placed in the salient and re-entering places-of-arms of the covered-way, and are termed the *redoubt of the salient, or re-entering place-of-arms*. These redoubts are in some cases simple earthen works; in others they are revetted; and in others casemated both for the service of artillery and small-arms. See *Inclosed Works*, and *Outworks*.

REDOUBT OF THE RE-ENTERING PLACE OF ARMS. The object of this redoubt is to strengthen the covered-way and sweep with its fire the enemy's establishments on the glacis of the demi-lune. The redoubt being directly in front of the bastion-face, its relief should be reduced that the fire of this face may not be too much masked. To effect this, we commence by establishing the bottom of its ditch, so that the point of it nearest the bastion may just be seen by the musketry fire of the face; we then adopt nearly a minimum relief of scarp wall; finally, we arrange the interior crest of one face, so as to allow no exterior slope at one extremity and make the other at the salient 2 feet higher. This slope of 2 feet, and the direction given to the scale of declivity of the interior crest, determine a plane of defilement for the redoubt, the prolongation of which will pass at about 3 feet above the salients of the two demi-lunes, which are symmetrically situated with respect to the bastion capital. This is done in accordance with a principle generally adopted, that when one work is less advanced than another, and commanded by it, the plane of its interior crest prolonged should pass 3 feet above the points which the enemy can occupy on the advanced work—which, from the nature of the attack, must first fall into his possession—so that he may not have a plunging fire into the retired work, from his establishments, which are generally about 3 feet above the parapet of the work occupied.

On account of the ditch between the tenaille and the enceinte flank, a breach might be opened in the curtain, by means of a battery, established on the glacis of the re-entering place-of-arms, if there was no mask beeween the ditch referred to and this glacis. By placing the angle of the redoubt on the line drawn through the extremity of the curtain and the extreme of the dem-lune, it is readily seen that these two works so combined cover the opening left by the ditch. The means here resorted to is of frequent use in fortification; and the problem may be thus stated: a line being given, which is partially covered by an existing mass, from fires in a given direction, to interpose another mass, which combined with the first, shall entirely mask the given line. See *Noizet System of Fortification.*

REDRESSING WRONGS.—If any officer shall think himself wronged by his Colonel, or the Commanding Officer of the Regiment, and shall, upon due application being made to him, be refused redress, he may complain to the General, commanding in the State or Territory where such Regiment shall be stationed, in order to obtain justice; who is required to examine into the said complaint, and take proper measures for redressing the wrong complained of, and transmit, as soon as possible, to the Department of War, a true state of such complaint, with the proceedings had thereon. If any inferior officer or soldier shall think himself wronged by his Captain or other officer, he is to complain thereof to the Commanding Officer of the Regiment, who is required to summon a Regimental Court-Martial for the doing of justice to the complainant: from which Regimental Court-Martial, either party may, if he thinks himself still aggrieved, appeal to a general Court-Martial. But if, upon a second hearing, the appeal shall appear vexatious and groundless, the person so appealing, shall be punished at the discretion of the said Court-Martial.

RED SHORT IRON.—Iron which is difficult to weld and is brittle when heated is said to be *red-short* or *hot-short.* This defect is due to the presence of sulphur.

RED TAPE.—The tape used in Public Offices for tying up documents, etc.: hence, official formality.

REDUCE. This term is used in various military senses. *To reduce a place*, is to oblige the commander to surrender it to the besiegers, by capitulation. *To reduce the square*, is to restore or bring back a battalion or battalions, which have been formed in a hollow or oblong square, to their natural situation in line or column. *To reduce to the ranks*, is to degrade, for misconduct, to the station of a private soldier. *Reduced*, in its ordinary sense, is to be taken off the establishment, and to cease to receive pay as soldiers. When a regiment is reduced, the officers are generally put upon half-pay. Sometimes the corps are reduced, and the officers remain upon full pay. This happens at the close of a war, when the standing army of the country is confined to a certain number of battalions. Hence is derived the expression *in* and *out* of the *break.*

REDUIT. In fortification, a central or retired work within any other work, intended to afford the garrison a last retreat, whence they may capitulate. It is commonly of masonry, loopholed, and often circular. Many engineers doubt the use of reduits altogether, as blocking up the working space, being themselves inconvenient for the men, and incapable of protracted defense, while they frequently mask the fire of other works more to the rear.

REDUCTION OF METALS.—A metal is said to be reduced to its metallic state when it is separated from the condition of a chemical compound in which it exists as an ore. This is generally effected either by the direct action of heat, or by heating the compound along with a *reducing agent.* Thus, when oxide of mercury is simply heated, the oxygen is given off as gas, and mercury or quicksilver appears as metal. Again, when sulphuret of lead is heated with iron, sulphuret of iron is formed, and the lead is reduced to its metallic state. In this case the iron is the reducing agent. The principal reducing agent employed in metallurgy is carbon, or rather the gas carbonic oxide, which is formed under certain conditions when carbon is burned. See *Iron*, and *Metallurgy.*

RE-ENLISTMENT.—A renewed enlistment. In the United States Army, any Non-commissioned Officer, musician or private, who re-enlists within one month after the date of discharge from first enlistment, receives $2 per month in addition to the monthly pay he was receiving prior to discharge; and also $1 per month additional after each subsequent re-enlistment so long as he shall remain continnonsly in the army.

RE-ENTERING ANGLE.—In fortification, an angle in the line of works of which the apex points away from the front. As an example, the flanks of a bastion make re-entering angles with the adjoining curtains. Advantage is commonly taken of the comparatively sheltered position of these angles to form *Places d'Armes* for the assembly of troops. See *Angle.*

RE-ENTERING ORDER OF BATTLE.—An order of battle, the front of the army forming a re-entering or inclosing angle, and the reverse of the salient formation. This order presents many advantages, as it can inclose the enemy, and shake morally and physically the troops which form the angle of the salient, by their rear being threatened and their retreat cut off.

RE-ENTERING PLACE OF ARMS.—Enlargements in the covered-way, at the re-entering angles of the counterscarp; this space is formed by setting off demi-gorges of 30 yards (more or less), and making the spaces form angles of 100° with the adjoining branches of the covered way.

REEVE.—A word used in speaking of ropes, signifies the passing of a rope through any hole, dead-eye, block, or pulley, in conjunction with which it is to be used. See *Cordage.*

REFINING OF METALS.—The last operation connected with the smelting of copper, tin, lead, and some other metals, is usually called the refining process. With copper, for example, the impure or blister copper, containing from 95 to 98 per cent. of the metal, alloyed usually with small quantities of iron, tin, antimony, etc., is melted in a refining furnace, and exposed to the oxidizing influence of the air. By this means, the foreign metals present become oxidized, and rise to the surface as slag, which is skimmed off; the oxide of copper, formed during the process, being afterwards reduced by throwing coal on the surface of the melted metal, and stirring with a pole of green wood. The disengagement of gases from the wood during the "poling" causes the metal to splash about, and so expose every portion of it to the reducing action of the coal; thus the oxide of copper is deprived of its oxygen, and the copper rendered nearly pure. Tin is also refined by throwing billets of green wood into it while in a melted state, which has the effect of bringing impurities to the surface as froth, in a somewhat similar way to the oxidizing of foreign metals in copper. Lead is purified from antimony and tin by an analogous mode of oxidation, and silver is separated from it by a special process. The refining of iron is a name applied to the process for partially separating the carbon from cast-iron, and is described under IRON. Of the less important metals used in the arts, zinc, antimony, and mercury do not usually undergo any special refining process; aluminium, it is said, will not afterwards purify when once reduced to the metallic state; and nickel, of which German silver is largely composed, is refined by a process or processes kept strictly secret by manufacturers. We may state here that no metal is ever quite pure in its commercial state, even though it has gone through the usual operation of refining, but all are to a certain extent alloyed with certain others. For the great majority of purposes, it is not necessary that metals should be chemically pure, and when it is, they can only be made so by refined chemical processes. It will be readily understood, however, that it is always necessary to carry the refining of gold and silver further than the less valuable metals. To render gold sufficiently pure for manufacture into coin, an ingenious process has, within the last few years, been proposed, by which fused gold is mixed with about 10 per cent. of black oxide of copper, and then stirred so as to oxidize any foreign metals which happen to be present. The oxide of copper does not fuse, but is disseminated through the melted metal, and oxidizes any tin, antimony, or arsenic, and causes them to rise to the surface, so that they may be skimmed off. Perfectly pure gold is prepared by dissolving the metal in aqua-regia—a mixture of nitric and hydrochloric acids—and precipitating silver (with which it is almost always alloyed) as well as any other foreign metals by chemicals which have no action on the solution of gold. The metallic gold is afterwards precipitated as a finely-divided powder, by a salt of iron, and is then fused and cast into bars. Silver is rendered pure by dissolving it in nitric acid, filtering the solution, and then precipitating the metal with common salt as a chloride of silver. This is afterwards mixed with sulphuric acid, and then, by introducing bars of zinc, a chloride of zinc is formed, whilst the silver is readily reduced to the metallic state.

REFLECTING SIGHTS.—Guns are laid with *reflecting sights* when the size of the port in a casemate is not large enough to use the ordinary sights, or when it is desirable to protect the men employed in aligning the sights from the enemy's fire. Several methods of using them are employed.

In the first plan, the sights are very similar to those usually employed, but they are both placed on the thinner part of the gun in front of the trunnions. And as there is not room for a man's head to be placed behind the tangent scale, on account of the coils of the gun, a small mirror on a moveable socket is placed just behind the tangent scale notch, and the man who lays the gun stands at some convenient position at the side of the muzzle, and aligns the sights in the mirror exactly as he would do in laying direct. He is well protected from the enemy's fire.

In the second plan, which is adopted in Moncrieff's protected barbette system, in addition to a set of direct sights, a mirror at the breech, set at an angle, with a cross cut on it is used in conjunction with a notch, which slides in a graduated vertical groove at the trunnions. The trunnion notch is first adjusted to the required elevation, and a man below then looks up at the mirror, and the gun is moved until by reflection the distant and the trunnion-sight notch coincide with the intersection of the lines cut on the glass.

Another plan is to have one mirror set at an angle attached to a trunnion, so that the distant object is reflected on to another mirror, which slides under cover in a graduated slot in the side of the elevator. The gun is laid by sliding the lower mirror to a certain graduation (required by the range) on the slot, and then moving the gun till the distant object is seen reflected in the lower mirror covering the intersection of cross-lines, which are cut on both the mirrors.

Reflecting sights have the disadvantage of a limited field of view, which may cause delay in finding the object in the mirror, even when the gun is approximately brought into the correct line before using these sights; and reflection, especially when double causes indistinctness, particularly at long ranges.

REFORMADO.—An officer, formerly so called, who for some disgrace was deprived of his command, but retained his rank, and perhaps his pay.

REFORMED.—In a military sense, after some maneuver or evolution, to bring a line to its natural order, by aligning it on some given point. Also, to restore order among broken troops.

REFORMED OFFICER.—In the British Army, one whose troops or company being broken up, is continued on full or half-pay. He preserves the right of seniority, and continues in the way of preferment by brevet.

REFUSE.—A military term, signifying to throw back, or to keep back out of the regular alignment which is formed when troops are upon the point of engaging the enemy. Thus it is said in the oblique order of battle, that if the right flank attacks, the left must be *refused*.

REGALIA.—The ensigns of royalty, including more particularly the apparatus of a coronation. The regalia of England were, prior to the Reformation, in the keeping of the Monks of Westminster Abbey, and they are still presented to the Sovereign at the coronation by the Dean and Prebendaries of that Church. During the Civil War the Crown and most of the regalia fell victims to Puritan zeal; and on the restoration of the Royal Family, new ensigns had to be made for the coronation of Charles II., which, with occasional alterations and repairs, have continued in use down to the present day. The regalia, strictly so called, consist of the crown, the scepter with the cross, the verge or rod with the dove, the so-called staff of Edward the Confessor (made in reality for Charles II.,) the blunt sword of mercy called Curtana, the two sharp swords of justice, spiritual and temporal, the ampulla or receptacle for the coronation oil, the anointing spoon (probably the only existing relic of the old regalia), the armillae or bracelets, the spurs of chivalry, and various royal vestments. All these, with the exception of the vestments, are now exhibited in the jewel-room in the Tower of London, in which are also a smaller crown, scepter, and orb for the coronation of a Queen Consort, two other Queen Consorts scepters—one of ivory, made for Marie d'Este; and the state crown of silver and diamonds, which was used at the coronation of Queen Victoria, containing a large ruby and sapphire, the former said to have been worn by Edward the Black Prince. The Prince of Wales' crown of gold, which is without stones, is modern.

The proper regalia of Scotland consist of the crown, the scepter, and the sword of state. The crown probably belongs to the time of Robert Bruce, and is adorned with crosses and fleurs de lis alternately. It was originally an open crown, but two concentric arches were added in the reign of James V., surmounted at the point of intersection by a mound of gold and a large cross patée. The scepter is of the time of James V.; the sword was a present from Pope Julius II. to James IV. in 1507. During the Civil War the regalia were removed by the Earl Marischal for safe custody from the crown-room of Edinburgh Castle, their usual place of deposit, to his Castle of Dunnottar; and while Dunnottar was besieged by the parliamentary army, the regalia were preserved by being conveyed by stratagem to the Manse of Kinneff, by the wife of Ogilvy of Barras, the Lieutenant Governor, and the wife of the Minister of Kinneff. From the restoration to the union the regalia continued to be kept in the crown-room as formerly; at the beginning of each session they were delivered to the Earl Marischal or his Deputy, in whose custody they remained while Parliament was sitting, and were afterward restored to the charge of the Treasurer. William, ninth Earl Marischal, who opposed the Treaty of Union in all its stages, declined to witness its consummation, but appeared by his Deputy, who took a written protest that the regalia should not be removed from the Castle of Edinburgh without warning given to him or his successor in office. From that time till 1818, the regalia remained locked in a chest in the crown-room, away from public gaze. On Feb. 4, 1818, an order being obtained by warrant under the sign-manual of George IV., then the Prince Regent, the chest was broken open, and the crown, sword, and scepter were found as they had been deposited at the union, along with a silver rod of office, supposed to be that of the Lord High Treasurer. They are now in the charge of the Officers of State for Scotland, as commissioners for the custody of regalia, and are exhibited in the crown-room, along with a ruby ring set with diamonds, worn by Charles I. at his coronation at Holyrood in 1633; the golden collar of the garter, sent by Elizabeth to James VI.; the St. George and dragon, or badge of the order of the garter; and the badge of the order of the thistle, with figures of St. Andrew and Anne of Denmark, set in diamonds. These latter insignia were bequeathed by Cardinal York, the last of the Stuarts, to George IV., and sent to Edinburgh Castle in 1830 by the special order of William IV

REGAN CARTRIDGE-BELT.—This belt is intended to carry from thirty-five to forty cartridges, arranged so as to have five in each division. The thimbles are sewed to the belt. Between each division of five cartridges is a space of about half an inch, designed to allow the covers to project a little beyond the extreme cartridges in each division. In one of these spaces is a little oblong pocket, like a spectacle-case, for screw-driver. In the second space, on either side of the front of the belt, is a buckle, which is riveted to the belt, and designed to fasten the cross-belts. On each side of the center division of thimbles on the back part of the belt are two other buckles, to fasten the cross-belts on behind. To each division of five cartridges is arranged a little cover for the cartridges, to prevent them from being lost by dropping out, fastened by a small brass knob, adjusted to the center thimble of each division of cartridges. A strap and buckle, to support the bayonet scabbard, is sewed on inside of the belt on the left side. Cross-belts are attached to the waist-belt, to remove the weight from the waist, and these are so arranged as to carry a blanket and a change of underclothing.

REGARDANT.—A term used in Heraldry with reference to an animal whose head is turned backward. See *Passant* and *Rampant*.

REGIMENT. In all modern armies, a regiment is a Colonel's command, and the largest *permanent* association of soldiers. Regiments may be combined into brigades, brigades into divisions, and divisions into armies; but these combinations are but temporary, while in the regiment the same officers serve continually, and in command of the same body of men. The strength of a regiment may vary greatly even in the same army, as each may comprise any number of battalions. French and Austrian regiments have ordinarily 4 to 6 battalions. Among British infantry, the smallest regiments are those numbered from the 26th upward (except the 60th), which have 600 men each, composing one battalion. The 60th and rifle brigade comprise each 4 battalions. The whole artillery force is comprised in one regiment. The strength of a regiment is changed from time to time; usually by the addition or withdrawal of private soldiers. The present plan would be, in case of war, to raise the skeleton regiment to war strength by calling in men from the army reserve.

The regimental system could only exist where standing armies are maintained. Accordingly, the Macedonian syntagmata and the Roman cohorts were evidently regiments in a strict sense. During the Middle Ages, feudal organization precluded the system, and its first reappearance was in France. Francis I. formed legions of 6,000 men each, which were divided into independent companies, the latter being, in fact, battalions, and each legion a regiment. The word regiment began to be applied to bodies of British troops in Elizabeth's reign; regiments are spoken of at the time of the Armada, 1588, and as composing the force in Ireland in 1598. From that time forward, the army and militia of Britain have been organized into regiments. Charles I. and the parliament each raised regiments, all of which were disbanded at the restoration, with the exception of the Lord General's Regiment of Foot, and his Life-Guard of Horse. These two were re-engaged (1661), and form the present Coldstream Guards and Royal Horse-Guards. In the same year, a Scotch corps of 1700 men, which had taken service in France in the time of James I., returned to England, and was included in the British Army as the 1st foot. Other regiments of infantry were gradually raised as required. In 1693 was raised the first troop of horse Grenadier Guards, and the 2d troop in 1702. These were disbanded in 1782, and reformed as the 1st and 2d Life-Guards, which still exist. Besides Cavalry and Infantry, the British Army comprises the Regiment of Artillery, and the Corps of Royal Engineers, and military train.

The total Regiments of the British Army for the year 1876-77 (and substantially the same at present) were:

		Regiments.	Officers and Men.
Life Guards		2	868
Horse-Guards (Blues)		1	434
Cavalry of the Line—			
Dragoon Guards	7		
Dragoons	3	28	15,973
Hussars	13		
Lancers	5		
Horse Artillery		1	5,633 in 6 brigades.
Foot Artillery			29,291 in 26 brigades.
Royal Engineers		1	5,710
Foot Guards		3	5,950 in 7 battalions.
Infantry of the Line		110	119,483 in 141 battalions.
Army Hospital Corps		1	1,574
Army Service Corps		1	3,014
West India Regiments (black troops)		2	1,832 in 2 battalions.
Colonial Corps		1	649 in 1 battalion.
Total		151	190,411

Each regiment is nominally commanded by a Colonel, who is an old General Officer, and whose office is merely a sinecure. The real command, however rests with the Lieutenant Colonel, in each battalion, who is assisted by a Major and has for a Staff an Adjutant, one Quartermaster, one Paymaster, and one Surgeon. The regiment or battallion is divided into companies in the Infantry, Engineers, and Army Service Corps; and into troops in the Cavalry. The Artillery is divided into 30 brigades, each of which is as large as an ordinary regiment. The brigade is subdivided into batteries, which are the working units. The working officers are Captain and two Lieutenants to each infantry company or cavalry troop; Major, Captain, three Lieutenants per battery of artillery.

The following is the present organization of regiments and companies in the United States Army:

		Colonel.	Lieutenant Colonel.	Majors.	Adjutant (Extra Lieutenant).	Regimental Quartermaster (Extra Lieutenant).	Battalion Adjutant.	Battalion Quartermaster.	Captains.	First Lieutenants.	Second Lieutenants.	Chaplain.	Sergeant Major.	Quartermaster Sergeant.	Total enlisted.	Aggregate.
1	Ten Regiments of Cavalry—each	1	1	3	1	1	...	...	12	12	12	1	1	1	797	841
2	Troop of Cavalry	...	...	...	...	...	...	...	1	1	1	...	...	...	66	69
3	Five regiments of Artillery—each	1	1	3	1	1	...	...	12	24	13	...	1	1	525	581
4	Light battery of Artillery	...	...	...	...	...	...	...	1	2	2	...	...	...	80	85
5	Battery of Artillery	...	...	...	...	...	...	...	1	2	1	...	...	...	40	44
6	Twenty-five Regiments of Infantry—each	1	1	1	1	1	...	...	10	10	10	1	1	1	505	541
7	Company of Infantry	...	...	...	...	...	...	...	1	1	1	...	...	...	50	53
8	Engineer Battalion	...	1	...	...	...	1	1	5	5	5	...	...	...	200	216
9	Two Companies—each	...	...	...	...	...	...	...	1	1	1	...	...	...	50	53
10	Two Companies—each	...	...	...	...	...	...	...	1	1	1	...	...	...	49	52

On the organization of a regiment, the batteries of artillery, companies of infantry, and troops of cavalry are permanently designated by letters in alphabetical order. Officers in the first instance are assigned to these subdivisions, and afterward succeed thereto as promoted to fill vacancies. Battalion and parade formations are regulated by the Tactics. The field officers are assigned by their Department Commanders wherever their services are most required, provided the assignment is with troops of their own regiments. Regiments are furnished with field music on the requisitions of the commanders, made, from time to time, direct on the Adjutant General; and, when requested by regimental commanders, the Adjutant General endeavors to have suitable men selected from the recruits, or enlisted, for the regimental bands.

Each regiment is supplied with a Regimental Order Book, a Regimental Letter Book, a book of the Letters Received, and a Descriptive Book, to contain a list of the officers of the regiment, with their rank, and dates of appointment, and promotions, transfers, leaves of absence, and places and dates of birth.

REGIMENTAL COURT-MARTIAL.—A legal tribunal, composed of three Members and a Judge-Advocate, convened for the punishment of offenders in the army. See *Courts-Martial*, *Judge-Advocate*, and *Trial*.

REGIMENTAL FUND.—Councils of Administration at posts occupied by companies of the same regiment at regular meetings, set aside and cause to be paid over to the regimental treasurer fifty per cent. of the amount accruing to the post fund during the preceding two months after deducting the expenses of the bakery. This amount constitutes the *Regimental Fund*. If private contributions toward the support of the band are made, the sums so received are not taken up in the account current of the Regimental Fund.

The Adjutant is Treasurer of the Fund for his regiment, which he disburses on warrants drawn by the Colonel or Commanding Officer, under specific resolves of the Regimental Council of Administration. He renders, through the Colonel, periodical returns of the state of the Fund and of the property purchased therefrom, in the same manner as prescribed for the Post Treasurer, and his accounts are always open to the inspection of the Colonel and Regimental Council.

The musical instruments and everything pertaining to the band are kept by the Adjutant. The Colonel or Commanding Officer, who approves the appropriations of the Council, is held accountable for all expenditures of the fund not made in accordance with the Regulations.

The following are the objects to which the Regimental Fund is appropriated exclusively:

1. The maintenance of a band.
2. When not needed for the band, it may be transferred to the companies of the regiment as company fund. See *Company Fund*, and *Post Fund*.

REGIMENTAL HOSPITAL.—In Great Britain, each regiment has a Hospital for the reception of the sick belonging to it. This Hospital is under the immediate care of the Regimental Surgeon, who is subordinate to the general Medical Board. See *Hospitals*.

REGIMENTAL ORDERS.—Such orders as are issued by the officer commanding a regiment for the information of the officers and regiment generally.

Regimental orders follow up all orders issued by the officer commanding the brigade, garrison, station, etc., having reference to the regiment.

REGIMENTAL RECRUITING SERVICE.—The Commander of a regiment is the Superintendent of the Recruiting Service for his regiment. When men are enlisted by Regimental Recruiting Officers, the principles governing the general service in regard to qualifications of recruits are observed. As a rule, recruiting funds are not furnished for the regimental service. When special authority is given to open a temporary rendezvous, or detach a party to recruit companies which have become reduced, requisition for funds may be made by the Regimental Commander upon the Adjutant General.

To prevent deserters at large and men who have been discharged with bad character from imposing themselves again upon the service, no enlistments are made by company officers, or at posts, without special authority in each case, except when the man has been honorably discharged from the same company or post within one month previous to his application, so that his character is known. In all other cases, application is made to the Adjutant General for authority to enlist the man—naming him—and, if a discharged soldier, giving his last company and regiment, and such evidence of good character as can be obtained. Enlistments, when made under such conditions, may bear the date of the application.

REGIMENTALS.—The uniform clothing of officers and men in the military service, as prescribed for each regiment and department.

REGIMENTAL SCHOOLS.—In the British Army, the Schools for Adults, and Boys above eight years of age, under the School-master, and the Infant and Industrial Schools under the School-mistress, for girls and little boys. In the first, plain subjects are taught to soldiers who voluntarily attend, or to soldiers' children. The education is wholly secular, the only theological teaching being exposition of a portion of Scripture during the first half-hour of morning school; but even at this, attendance is at the option of the parents. The Infant School is conducted on similar principles. The Industrial School is to fit girls for the occupations of life, and to render them capable of entering domestic service; a grant of money is made by Government for the provision of materials. There is a school of each sort in every battalion of infantry or regiment of cavalry, the total cost of which amounts, for 1873-74, to £36,253. Adult soldiers are admitted gratuitously; for children, there is a nominal charge of 1d. each a month. The orphans of soldiers and the children of soldiers serving abroad are received at any neighboring school without payment; those of pensioners, contractors, etc., at 3d. a month; and the children of officers at 5s. a month. It is forbidden that any difference should be made in the schools in the treatment of these different classes of pupils.

REGULAR APPROACHES.—The term *Regular Approaches* is applied to the means employed by a besieging force to reduce a fortified position which is too strong to be carried by the usual mode of an open assault. These means consist in approaching the position under the cover of the ordinary trench

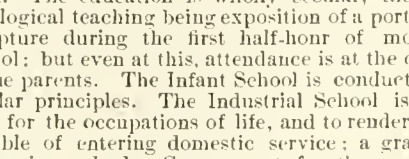


Fig. 1. Profile of Approach by the Simple Trench.

bordered by a parapet, which is gradually pushed forward in the most favorable directions to shelter the troops placed in it from both enfilading and plunging fires. In the construction of the trenches various articles are required to give speedy and safe cover, besides the usual trenching tools. These are termed *Trench Materials*, and consist of—1. *Tracing Tape or Cord;* 2. *Tracing Pickets;* 3. *Ordinary Pickets;* 4. *Fascines;* 5. *Sap Fagots;* 4. *Gabions;* 5. *Sap-rollers;* 6. *Sand-bags;* 7. *Blindage Frames;* 8. *Gallery Frames* and *Sheeting*. The tracing tape is a strong white tape or cord usually 150 feet long, and divided off into spaces of 6 feet, a piece of tape 6 inches long being sewed to each point of division. At each end of the tracing tape a short piece of cord is attached to tie the tape to two tracing pickets. The tracing tape, for convenience, is rolled up into a ball. The tracing pickets are 18 inches long and one inch in diameter. For ordinary use they are tied up in bundles with their bark on; but for setting out night work the bark should be stripped off to make them more readily seen. Those used for securing fascines are from 2′ to 4′ long, and from 1¼″ to 1¾″ thick; those for setting out or tracing the works are 18″ long and 1″ diameter. The fascines are usually made 18′ long, and 9″ in diameter, and are afterwards cut into suitable lengths for the purposes to which they are to be applied. Sap-fagots are made, like fascines, of straight brush-wood at least 1″ in diameter. They are 2′ 9″ long, and 5″ in diameter. The center stake should be from 1½″ to 2″ in diameter, and project 9″ inches beyond one end of the sap-fagot; this projecting portion is sharpened, to enable the sap-fagot to be planted firmly in the ground in an upright position. The exterior diameter of the gabions is 2′, and the height of wattling 2′ 9″. They are made with seven, or nine stakes, which project 6″ above the wattling at top, and are pointed. The ordinary trench gabion and the gabion for revetting batteries receive the same dimensions; the latter is more strongly made and of the heaviest brush wood. At the siege of Sebastopol the want of brush wood for the wattling of gabions led to the introduction of the common hoop-iron for this purpose, which had served to secure the bales of hay. The number of pickets employed for each gabion was usually thirteen. It was found that these gabions could be constructed more readily than the ordinary kind; that they were not much heavier, were more durable, and in all other respects as serviceable. The sap-roller is a large gabion 7 feet 6 inches in length, and 4 feet 4 inches exterior diameter. It requires for its construction fifteen stakes, each from 1¼ inches to 2 inches in diameter. After it is completed, it is stuffed compactly with fascines 7 feet 6 inches long. The sap-roller is sometimes made of two concentric gabions, the diameter of the smaller 2 feet 6 inches. The space between the two is well stuffed with fascines. The sand-bag, for the revetment of batteries, when empty and laid flat, is 2 feet 8 inches long, and 1 foot 4 inches wide; those used in the construction of the trenches are 2 feet long and 12 inches wide.

The trenches are divided into two principal classes; *approaches* or *boyaux*, and *parallels*. The approaches serve simply as covered communications which lead to and connect the parallels, and are usually directed towards the points of the defenses upon which the attack of the besiegers is made. The approaches are run in a zigzag, or in a straight line, towards one or several of these points. The trenches of the approaches are 8 feet wide at bottom; 3 feet 6 inches deep in front, and 4 feet at the rear. The reverse receives a slope of 45°. The front is usually made with a slope of 2 feet base. The earth from the trench is thrown to the front to form a parapet. The general height of this parapet is nearly 5 feet; its width at the base about 18 feet. The parallels are designed as stations for troops to guard the besiegers' works and the workmen employed in their execution from the sorties of the garrison. The general direction of the parallels is parallel to, or concentric with, a line connecting the most salient points of that portion of the defenses attacked. The trenches of the parallels receive a width at bottom of 10 feet; their depth in front is 3 feet, and in rear, 3 feet 6 inches. Two steps, each 18 inches high and 18 wide, lead from near the bottom of the trench, on the front side, up to the natural ground. The reverse of the trench receives a slope of 45°; or else, is also cut into two steps. The steps in front are alone revetted with fascines.

When the parapet is formed of earth alone as is represented in Fig. 1, the trench is termed a *Simple*

Trench. In this case the earth of the parapet is allowed to take its natural slope towards the trench. The step, or berm of 18 inches between the parapet and the trench in the parallel, serves as a banquette. Portions of the parallels, from 20 to 30 yards in length, are arranged with steps, revetted with fascines, leading from the trench over the parapet, to enable the troops in the parallel to move from it to repel a sortie of the besieged, Fig 2. The direction of the simple trench is laid out by the tracing-tape and pickets. The trench is executed by soldiers of the line; each man being furnished with a pick and shovel, with which he places himself speedily under

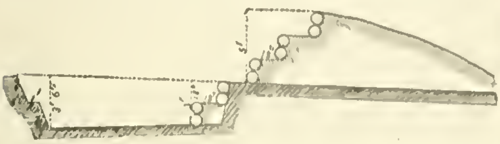


Fig. 2. Profile of a Parallel of a Simple Trench with Steps for Sorties.

cover, by digging a hole and throwing the earth in front of him; continuing his labor until he has excavated 6 feet in length of the trench, and as much of it to the rear as may be assigned to the relief, or working party, to which he belongs. After the trench has received its general width and depth, the slopes and steps are finished off under the direction of the engineer troops. See *Siege*

REGULARS.—Those troops whose conditions of enrollment are not limited to time or place, in contradistinction to militia or volunteer corps; troops permanently in service. France first set the example of keeping troops in peace. Charles VII, forseeing the danger of invasion,authorized the assemblage of armed mercenaries, or Compagnies D'ordonnance. Louis XI. dismissed these troops but enrolled new ones,composed of French,Swiss and Scotch. Under Charles VIII.,Germans were admitted in the French army, and the highest and most illustrious nobles of France regarded it as an honor to serve in the Gens D'armes. Moral qualifications not being exacted for admission to the army the restraints of a barbarous discipline became necessary,and this discipline divided widely the soldier from the people. The French Revolution overturned this system; now no mercenary troops are to be found in continental Europe. England only now raises armies by the system of *Recruiters.* The last wars of Europe have been wars of the people and have been fought by nationalities. After peace,armies remain national,for their elements are taken from the people by legal liberations.

REGULATION PRICE. This phrase as applied to an Officer's Commission, was the regulated price paid by Officers for each step of rank (according to a fixed scale), other than death vacancies, vacancies caused by augmenting a regiment, or vacancies resulting from the promotions of Colonels to be Major Generals. When an Officer of any rank, from a Lieutenant Colonel downwards, was desirous of retiring from the service, he was entitled to sell his commission for the price stipulated by the regulations. Sometimes, he received more than the regulation sum. Purchase being no longer permitted in the army, the sale of commissions mentioned has only reference to Officers who entered the army before November 1,1871.

REGULATIONS.—Under the Constitution of the United States,rules for the government and *regulation* of the army must be made by Congress. Regulation implies *regularity.* It signifies fixed forms: a certain order; method: precise determination of functions, rights and duties. Rules of Regulation also embrace, besides rules for the administrative service, systems of tactics, and the regulation of service in campaign, garrison, and quarters. In the case of the Staff Departments, legislative authority has been delegated *jointly* to the President and Secretary of War. But in relation to the powers, rights, and duties of officers and soldiers in campaign, garrison, and quarters, Congress has not delegated its authority to the President, nor have such matters been *precisely* determined by military laws. Even rights of rank, command, and pay, concerning which Congress has legislated, are subjects of dispute, and variable expositions of laws regulating those essentials of good government have been given by different executives, with an increasing tendency to invalidate rank created by Congress. There can be no remedy for these encroachments, unless Congress should pass a law to enable cases to be brought before the Federal Civil Courts, in order that the true exposition of military statutes and authorities in dispute may be determined. With such a remedy, laws, however defective they may be, would at least be known, and rights, powers, and duties established by law would be well determined.

But it may be said in relation to such rules of regulation, how can a body like Congress determine upon systems of tactics, etc.? Their constitutional duty might easily be performed as follows: 1. By clearly declaring, in a manner not to be misunderstood, that the General-in-Chief is charged with the discipline and military control of the army under the rules made by Congress and the orders of the President. 2. The Secretary of War is charged with the administrative service of the army under the rules made by Congress and the orders of the President. 3. By directing the General-in-Chief, with the advice of properly constituted Military Boards, to report to the President rules for the government and regulation of the army in campaign, garrison, or quarters, including systems of tactics for the different arms of the service. 4. By directing the Secretary of War, with the advice of properly constituted Boards, to report to the President rules for raising and supporting armies: including regulations for the administrative service. 5. By directing the President to submit the rules made in accordance with provisions 3 and 4, to another board organized by the President, with directions to harmonize the details of the several reports; which last report shall be submitted to Congress for confirmation or orders in the case. 6. By directing that each year, previous to the meeting of Congress, the following Boards be assembled under the orders of the General-in-chief, viz.: a Board of General Staff Officers; a Board of Artillery Officers; a Board of Cavalry Officers; and a Board of Infantry Officers. The Secretary of war to assemble all the following Boards, viz.: a Board of Engineer Officers; a Board of Ordnance Officers; a Board of Medical Officers; and a Board of Quartermasters, Commissaries and Paymasters. Each of the Boards so assembled to report to the General-in-Chief or Secretary of War, such suggestions of improvements in their respective services as it may be desirable to adopt. 7. The repeal of all laws delegating legislative authority to the President and Secretary of War.

REGULATORS.—1. The popular name of a party in North Carolina, which arose in 1768 and had for its object the forcible redress of public grievances. 2. Contrivances designed to render the power and resistance proportionate to each other. Regulators generally act upon that point of the machine which commands the supply of the power by means of some mechanical contrivances, which check the quantity of the moving principle conveyed to the machine whenever the motion becomes accelerated, and increase the supply whenever it becomes retarded. For example, this is accomplished in a steam-engine by acting on a valve called the throttle valve, placed in the main pipe.

REGULUS.—A term in metallurgy, which is now used in a generic sense for metals in different stages of purity, but which still retain, to a greater or less extent, the impurities they contained in the state of ore. When, for example, the ore known as the sulphuret of copper is smelted, the product of the different furnaces through which it passes is called regulus until it is nearly pure copper. The name, which signifies "Little King," was first given by the alchemists to the metal antimony, on account of its power to render gold brittle.

REIGN OF TERROR.—The name given to that period in the history of France when the Revolutionary Government, under the guidance of Maximilien Robespierre, supported itself by the pure operation of terror, exterminating with the guillotine all the enemies, or supposed enemies, of the Democratic Dictatorship. In the year 1793 the Convention vested the Government in a "Committee of Public Safety", a body belonging to the Party of the Mountain, and of which Robespierre, Couthon, and St. Just became the Triumvirate. This Committee, to which every other authority in the country was subjected, deliberated in secret, and the convention sanctioned all its decrees. Louis XVI. had already been brought to the scaffold; and on Oct. 16 his Queen, Marie Antoinette, after being subjected to every possible indignity, was beheaded; the Princess Elizabeth sharing the same fate on May 10, 1794. The execution of the Girondists followed, and that of the Duke of Orleans. The guillotine became the only instrument of Government: a look or a gesture might excite suspicion, and suspicion was death. The Calendar was remodeled, and all religious rites suppressed. When the power of the Committee had attained its climax, a decree was passed abrogating every delay or usage calculated to protect an accused person; but from that moment a reaction began. A section of the Mountain Party were satiated with blood, and, had become impatient of the control of Robespierre. On July 28, 1794, he was denounced in the Convention for his barbarities, and his death brought to a close this sanguinary era in French history.

REIN.—A term applied to a crack or vein in a musket barrel.

REINFORCE.—The cylinder of a cannon is usually divided into two portions, called the *first* and *second reinforce*. The first reinforce extends from the base-ring to the seat of the ball, and is the thickest part of the piece, for the reason that the pressure of the powder is found, both by experiment and calculation, to be greatest before the projectile is moved far from its place. The shape of this reinforce was formerly made slightly conical, under the impression that the pressure was greater at the vent than at the seat of the projectile; but it is now made cylindrical throughout. For bronze cannon, the thickness of this part is approximately given by the empirical formula

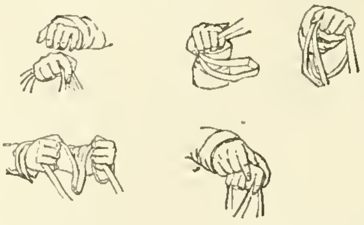
$E = D\sqrt{\frac{C}{\frac{1}{2}P}}$, in which D represents the diameter of a solid cast-iron shot suited to the bore: C the proof charge; and P the real weight of the projectile. For cast-iron cannon, E should be multiplied by the coefficient 1.17. In general terms, the thickness of a bronze gun, at the seat of the charge, is a little less, and of a cast-iron gun a little greater, than the diameter of the bore. These dimensions exceed those determined by calculation, but are necessary to enable the piece to resist the shocks of the projectile, etc. The second reinforce connects the first reinforce with the chase. It is made considerably thicker than necessary to resist the pressure of the powder, in order to serve as a proper point of support for the trunnions, and to compensate for certain defects of metal liable to occur in the vicinity of the trunnions of all cast cannon, arising from the crystalline arrangement, and unequal cooling of the different parts. See *Cannon*.

REINFORCE-BAND.—In ordnance a band at the junction of the first and second reinforce.

REINFORCEMENTS.—Additional forces; especially those troops intended to augment the strength of an army. History proves that battles have been decided by reinforcements, and that victory is commonly the prize of the General who is the last to bring his reinforcements into action. It was to the proper employment of reserves that Napoleon owed so much of his success; and the barren victory of Borodino and his complete defeat at Waterloo are by many attributed, in the one case to his holding back the guard altogether, and in the other to his delay in using it. Jomini and other writers lay down that reinforcements being the last argument on the battle-field should always be composed of troops of a superior kind, but the experience of recent wars shows that, on account of the new tactics which have been adopted since the introduction of arms of precision, all troops, so far as they have not come into action, are reserves to the leader. Reinforcements should be placed near enough to support the troops in action, but they must be kept out of sight, and their position concealed from the enemy. Their distance from the second line depends entirely upon the nature of the ground, as well as upon the extent of the ground covered by the line from right to left; and their strength should consist of about one-fourth or one-fifth of the whole force in cavalry and infantry, and of about one-third of the guns. The reserve batteries may either be kept with the main reserve, or concentrated on any point where their united fire may help to shake the enemy previous to the final attack. In the attack of the fortress, no assault should be attempted without a sufficient reserve, which should be well placed for following the supports of the escalading parties: its strength should never be less than three-fourths of the garrison of the work assaulted.

REINFORCE-RING.—In ordnance, a flat molding at the breech end of the reinforce.

REINS.—The straps of a bridle, fastened to the curb or snaffle on each side, by which the rider or driver restrains and governs the horse. They serve to prepare the horse for the movements, to guide and halt him; their action should be gradual and in harmony with that of the legs. In using them the arms should be moved with ease, and from the wrist to the shoulder. The rein-hold will vary with the design of the rider and the propensities of the horse. The drawing shows the usual manner of holding and shifting the reins. In holding them separately, one passes into each hand, between the third and the fourth fingers, and out over the fore-



finger, where it is held down by the thumb. Usually the reins are held in the left hand, as when first taken up. Here the left rein passes under the little finger, and the right under the third, both passing through the hand, and the superfluous rein hanging over the first joint of the fore-finger, the thumb securing it. Sometimes, the right rein enters the hand over the fore-finger from above and crosses the left rein in the palm, where the fingers close upon them. The loop, formed of the residue, hangs down between the hand and body.

The reins should be shifted quickly and expertly without breaking the time or altering the pace.

To shift the reins from the left hand: Turn the thumbs well towards each other and carry the right hand over the left; place the fore-finger of the right hand downward, in the place of the little finger of the left hand, between the reins; and pass the reins through the right hand, placing the thumb upon the left rein, near the second joint of the fore-finger.

To return them to the left hand: Carry the left hand over the right and place the little finger of the left hand downward between the reins; then carry them smoothly upward through the hand, and let the ends hang over the fore-finger.

REIS EFFENDI.—A title formerly given to an Officer of State in the Ottoman Empire. He was the Chancellor of the Empire, and Minister of Foreign Affairs. His duty in the first-mentioned capacity was to confer with the Grand Vizier regarding the orders and instructions to be sent to the different Provinces, and regarding the proper decision on any subject affecting the Empire, whether internal or external; and in the latter capacity he had the sole and exclusive charge of the relations of the Porte with Foreign Courts.

REITRES.—A body of armed horsemen, who came out of Germany and entered the French service during the reign of Henry III. They were incorporated with the carabineers.

REJOINDER.—In military law, the defendant's answer to the plaintiff's replication. The weight of authority is against permitting a rejoinder on the part of the prisoner, unless evidence has been adduced in the reply of the prosecutor. But such evidence should not be permitted in reply, and there should be no rejoinder.

RELAIS.—A term used in fortification to signify a space, containing some feet in breadth, which is between the foot of the rampart and the scarp of the fosse. It serves as a convenient receptacle for the earth that occasionally crumbles off.

RELATIVE RANK.—The precedence which certain Non-combatant Officers and others are entitled to take among their combatant brethren; for instance a Commissary General in the English Army has the rank of Major General. Relative rank carries with it all precedence and advantages attaching to the military rank with which it corresponds, except command, and regulates rates of lodging, money, number of servants, rations of fuel and light (or allowance in their stead), detention and prize money. Relative rank does not entitle the holder to salutes from ships or fortresses, nor to the turning out of guard. It has lately been determined that the Assistant Military Secretary at the Horse Guards is to have the relative rank of Colonel.

The following is the relative rank of the English Navy and Army:

Navy	*Army*
Admiral of the Fleet	Field Marshal.
Admirals	Generals.
Vice Admirals	Lieutenant Generals
Rear Admirals	Major Generals.
Captains of the Fleet; Commodores, 1st and 2d class	Brigadier Generals.
Captains over three years' service	Colonels.
Captains under three years' service	Lieutenant Colonels.
Commanders	Lieutenant Colonels.
Lieutenants of 8 years' standing	Majors.
Lieutenants under 8 years' standing	Captains.
Sub-Lieutenants	Lieutenants.
Midshipmen	Sub-Lieutenants.

In the United States Army and Navy the relative rank of officers is as follows:

Army	*Navy*
Second Lieutenant	Ensign.
First Lieutenant	Master.
Captain	Lieutenant.
Major	Lieut't Commander.
Lieutenant Colonel	Commander.
Colonel	Captain
Brigadier General	Commodore.
Major General	Rear Admiral
Lieutenant General	Vice Admiral.
General	Admiral.

The officers in the Marine Corps rank with those bearing the same titles in the army. See *Rank*.

RELEASE OF PRISONERS.—The Articles of War provide that any officer who presumes, without proper authority, to release any prisoner committed to his charge, or suffers any prisoner so committed to escape, shall be punished as a Court Martial may direct.

RELEVANCY.—In law, the condition of a plea which is well founded in point of law, provided it be true in fact. An objection to the relevancy corresponds in many respects to a demurrer in English.

RELIEF.—In fortification, the general height to which the works are raised; if the works be generally high and commanding, they are said to have a *bold relief;* if the reverse, a *low relief*. The term *relief* is also given to a party of soldiers detached from a guard, who relieve sentries off their post on the expiration of their term on duty.

RELIEVER.—An iron ring fixed to a handle, by means of a socket, so as to be at right angles to it. It serves to disengage the searcher of a gun, when one of its points is retained in a hole, and cannot be extracted otherwise.

RELIEVING THE ENEMY.—Whosoever relieves the enemy with money, victuals, or ammunition, or knowingly harbors or protects an enemy, suffers death, or such other punishment as a Court-Martial may direct.

RELOADING CARTRIDGES.—In 1866, when the manufacture of the service-cartridge was commenced at Frankford Arsenal, Philadelphia, Pa., little or nothing was known as to how a good reliable military cartridge could be made. To explain the difficulties which had to be overcome at every step, the machines to be invented to do the work uniformly, accurately, and economically, would fill a large volume. It can be said, however, that through the combined efforts of the officers in command of Frankford Arsenal, Philadelphia, and the National Armory, Springfield, Mass., a cartridge was produced which would reflect credit upon any nation. Up to the present time this cartridge, perfected and slightly modified, has been the service-cartridge for breech-loading small-arms and machine guns. With the invention and adoption of breech-loading small-arms and metallic cartridge shells, heavier and more uniform charges of powder were introduced, giving greater range and accuracy. This was followed by a desire and necessity for soldiers becoming trained marksmen. To meet economically the demand for an increased expenditure of ammunition thus produced, reloading shells were used. Until this demand came such shells had not been made to any extent at Frankford Arsenal, although a plan for making them had been worked up at that post, which has since been quite generally adopted by all manufacturers, of reloading shells in this country, and also abroad by several nations, viz., making a pocket in the head of the shell formed in the continuous metal from which it is drawn, and into which a primer could be inserted from the exterior. Reloading shells have generally been made of brass, and are now so made to a great extent. This metal possesses sufficient elasticity, but is wanting in durability, as experience has proved. The service non-reloading shell is made of copper with a small percentage of spelter, and has shown durability equal in years to those longest made.

The reloading cartridges now furnished to the army are the following:—Frankford Arsenal, solid head; Lowell, solid head; Winchester, solid head; Berdan, folded head. The Frankford Arsenal, Lowell, and

Winchester cartridges have a central vent in the primer pocket, which admits of the exploded primer being driven out of the pocket from the empty shell by a punch. The Berdan, having no central vent, requires a special tool, applied on the outside, to remove the exploded primer.

The materials required for reloading comprise lubricated bullets, musket powder, and cartridge primers adapted to the shells to be reloaded. The following comprises a set of Frankfort Arsenal hand tools for reloading cartridges:

Name.	Cost price.
1 brush wiper	$0 10
1 charger	05
1 die, crimping	1 00
1 die, reloading	75
1 die, resizing	1 75
1 drift	05
1 extractor, primer	1 00
1 funnel	10
1 mallet	15
1 oil cup	25
1 priming tool	1 00
1 punch, primer	25
1 punch, reloading die	25
1 punch, resizing die	25
1 safety socket	25
1 scraper, shell	10
1 setter, primer	1 25
1 wiping rod	10
1 box containing set	35
Total cost of set	$ 9 00

The first operation of reloading is the removal of the exploded primer. For central-vent cartridges this is done by inserting the extractor in the shell and resting the head of the latter in the recess for it on the safety-socket, then driving out the primer with

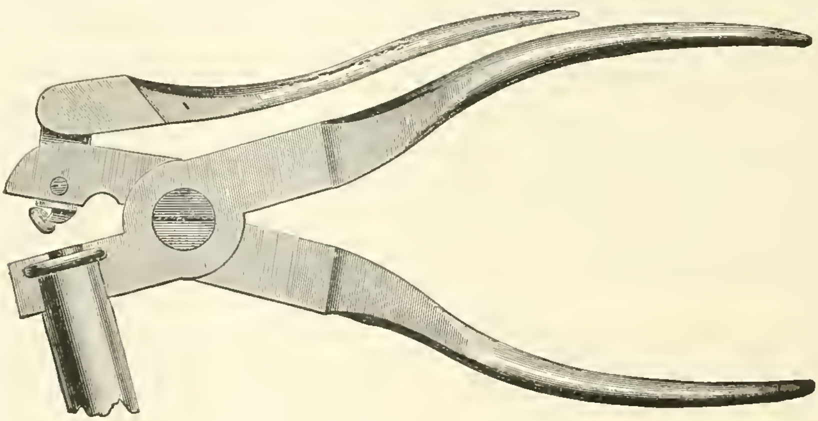


Fig. 1.

the mallet. The Bridgeport tool for exterior extraction, shown in Fig. 1, and specially adapted to the "Berdan" shells, may be used for all cartridges; but the primer punch for central-vent shells is the more simple and positive in its action. If the wire of the extractor should break, extra ones are supplied with each set of tools, and are put in by unscrewing the plug in the head of the extractor, driving out the broken pin with the new one in the direction of the head, the hole being tapered, dropping in the new pin at the head, and replacing the screw plug.

The shells, whether old or recently fired, should always, if possible, be cleaned of the powder residue, etc., by immersion and agitation in hot water. Cold water will clean them, but hot water is a better solvent, and the shells dry more quickly when taken out of it. When circumstances render it impossible or inconvenient to use water, the brush wiper may be used for brushing out the residuum left in the shell by the combustion of powder and fulminate. After cleaning, examine the shell to ascertain if it shows signs of rupture. These may generally be seen at the head, the mouth, or as transverse or longitudi-

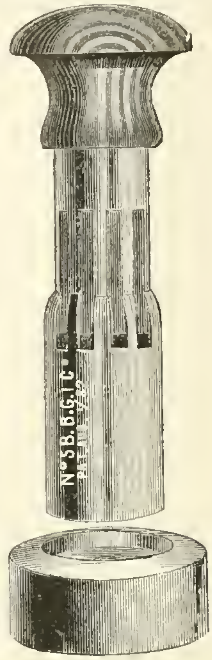


Fig. 2.

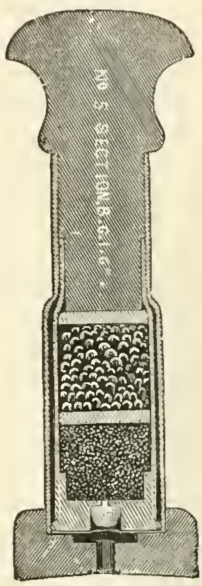


Fig. 3.

nal marks on the body. The shell is next forced into the die for resizing, using the mallet if necessary, striking fairly and squarely on the head of the shell, so as to avoid bending or distorting its flange. The outside of the shell or inside of the die should be oiled to facilitate the entrance of the shell and prevent abrasion. It is driven out by means of the punch inserted in the die and shell. This last operation is likely to cause a bur on the mouth of the shell, which would deface the bullet if not removed. For this purpose the scraper is supplied. Insert it about 0".5 into the shell, held in left hand, scraper in right; give the shell and scraper a half-turn in opposite directions, bearing with the scraper *only hard enough* to take off the bur. The handle of scraper and axis of shell should be kept nearly parallel to each other to avoid thinning the mouth of the shell. Although the shell may be fired several times without resizing, this operation is considered *necessary after each round*, otherwise the shell will be unduly expanded by successive rounds, and eventually fail to enter the gun-chamber; after which the extra force required to resize it might prove injurious to the metal.

The shell is next inserted in the loading die, the primer entered into the pocket, and the safety socket placed over it, large end down; the primer may then be driven home with the primer-punch and mallet. Considerable loss of primers by premature explosion in this operation has occurred, and a tool is supplied for setting primers by pressure, which is used as follows: The shell is placed in the tool for inserting primers—the primer having been previously just entered in the pocket—and the primer pressed home by means of the lever and screw. The end of the screw is so formed as to insure the primer being below the surface of the head at least 0″.005. It should be slightly lubricated to avoid wear of the projection on the end and abrasion of the primer. The Bridgeport tool, shown in Fig. 2, may also be used to set the primers of all shells but the "Lowell," which has, intentionally, a primer to fit the pocket tightly, and requires considerable force for its proper insertion. The screw tool will set the "Frankford Arsenal," "Berdan," "Lowell," and "Winchester" primers equally well. The shell is now ready for reloading. It is inserted in the loaded die, the latter into the safety-socket, and the powder-funnel into the mouth of the die. A level measureful of powder is then poured into the shell through the funnel, after which the bullet, or shot, is inserted and driven home with the punch and mallet until the shoulder of the punch touches the end of the die, as shown in Fig. 3. This insures proper and uniform length of cartridge.

The reloading die may be used as a gauge for determining whether cartridges are of the proper dimensions for entering the chambers of guns. As a rule, any cartridge that will enter the reloading die will enter the chamber of the gun freely. It is, in fact, a combined reloading die and gauge for cartridges. To use it as a gauge insert the punch in the small end and the cartridge in the opposite end. If the cartridge enters fully without moving the punch, it is of proper length and diameter.

When shells are reloaded for immediate use they may be fired after the foregoing operation. But if loaded for storage for any length of time, the crimping die should be used to secure the bullet in position. To perform this operation, insert the loaded cartridge into the die, then set the head in the recess of the safety-socket, the latter resting on a bench or table, and drive the cartridge in with the blows of the mallet on top of the die. The safety-socket has a central hole concentric with the counter-bore. In extracting the primers it supports the head of the case and forms a receptacle for exploded primers. It also supports the head of the shell on opposite ends in the operations of loading and crimping, and the central hole protects the primer from severe shocks in driving home the bullet, and it also guides the punch in setting the primers. Fig. 4 shows the Bridgeport crimping apparatus. The wiping rod serves to clean out the bore of the dies, etc., by means of cotton waste or a rag drawn through the slot in its end. Particular care should be taken to free the exterior of the shell from grit or dirt before resizing, to protect the die and shell from scratches; also, that neither water nor oil gets into the case or primer, as either will injure or destroy the powder or fulminate. No *excess* of oil should be left in the chamber of the gun or on the cartridge, as it would tend to rupture the case in firing and also temporarily disable the gun. A slight amount of lubricant on the cartridge or chamber throughout their length seems to prolong the life of reloaded shells. The tendency of the shells to tear apart appears to be due to their unequal expansion in the chamber; the front end being thin is more quickly expanded, and in the absence of the lubricant is held by pressure and friction against the walls of the chamber, while the thick rear end of the shell is forced backward by the pressure of the gases. As a rule, sufficient lubricant from the bullet finds its way into the chamber to answer all purposes. These tools are made as simple and strong as possible. Some of them, particularly the dies and punches, require to be used with great care, so as not to injure their surfaces or alter their dimensions, where such would affect the cartridge. They are cheap, durable, and quite rapid in operation if the work be divided among several operators or be done by one person performing each operation separately on a number of shells. Special tools employed in the operations of loading, other than those required for the service cartridges, are noticed under specific headings. See *Cartridge*, *Cartridge-loading Implements*, and *Center-fire Metallic-case Cartridge*.

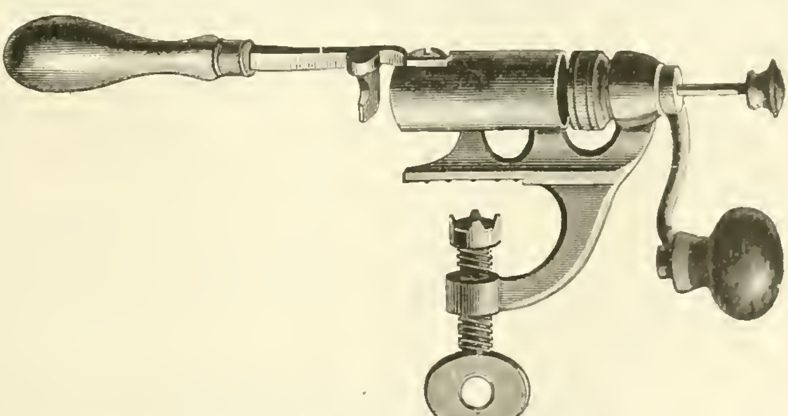


Fig. 4.

REMARKS.—Army Returns, Regimental Returns, Guard Reports, etc., have a column allotted for observations relative to extraordinary occurrences, headed "Remarks." The voucher to Abstract B, page 660, used by Quartermasters, may be noticed as an example.

REMBLAI.—The quantity of earth in the mass of rampart, parapet and banquette. In well constructed works, the equality between the *deblai* and *remblai* is indispensable for every part, nay, for every face. For works not defiladed, and having therefore their crests horizontal, the following method of calculation may be employed, whenever expedition is required. Supposing the parapet and the ditch to have the same length and equal profiles, their volumes will be equal and the problem becomes thus simplified: knowing the area of the profile of the covering mass, to calculate the dimensions of the ditch so as to make the surface of its section equal to that of the remblai. Let S represent the area of

Quartermaster ———————————————,

U. S. Army, at ———————————————,

for the period herein expressed, having signed duplicates hereof.

Amount of pay.		Amount of stoppages.		Amount received.		Signers' names.	Witnesses.	Remarks.
Dollars.	Cents.	Dollars.	Cents.	Dollars.	Cents.			

on my Form

for the month of ———————————, 188 .

——— Quartermaster———

the section of the remblai. When earth is excavated, it increases in bulk, and whatever care be taken in ramming it in, the volume it occupies in the remblai will be greater than the space it filled in the deblai this increase of bulk, called *foisonnement*, is $\frac{1}{8}$ in strong soil, $\frac{1}{12}$ in ordinary soil, and $\frac{1}{20}$ in sand. Represent it by $1 \div F$ and let the area of the profile of the ditch $= S'$; then, we have

$$S = S' + \frac{S'}{F}, \text{ whence } S' = \frac{S.\ F}{1+F}.$$

When the work is defiladed by an increase of command at the salients, it becomes necessary to obtain the mean profile; this is done by calculating the areas of the profiles at the salient and at the extremity of the face, and taking their mean

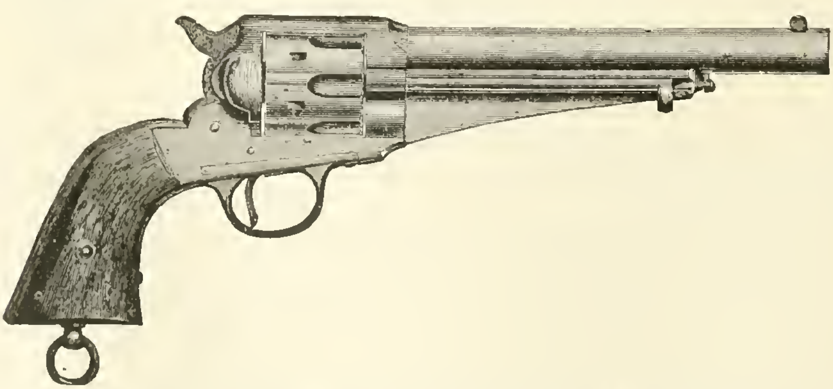
REMINGTON-LEE MAGAZINE-GUN.—This arm is the same in principle as the one previously described in this work, under the head of *Lee Magazine-gun.* Since E. Remington & Sons have secured the exclusive right to manufacture and sell the Lee Magazine-gun they have introduced several valuable improvements, among which may be mentioned the change of the handle of the bolt from the middle position to the rear end. This greatly facilitates the rapidity with which the arm can be fired, as the hand can keep its hold on the bolt-handle at the same time that the trigger is pulled. By referring to the *Frontispiece* we can see that when the bolt is closed the position of the handle is directly above the trigger. The bolt has also a removable front end or "head." This allows the firing-pin and main-spring to be put into it from the front end, so that the rear end where the handle is now attached is very much stronger than the old bolt, as no cutting has to be made for the key-sleeve, F, shown and described on page 192 of this volume, that piece being now discarded.

A different method is also employed in fastening the firing-pin, C, to the thumb-piece or cocking-piece, E, by a locking-nut, T.

The magazine is made of one piece of metal, in the sides of which are depressions having certain curvatures and angles, which form projections on the inside for the guidance of the follower upon which the cartridges rest, so that they shall each be presented in their turn to the center of the bore of the barrel. The lugs on the rear end of the top of the magazine are extended forward a sufficient distance to prevent the cartridge from rising above the bore, and also prevents their escape from the magazine when it is detached from the piece. The quadruple-leafed spring, N, shown on page 192, is substituted for a coiled one, which is much simpler and more effective.

By the use of this improved magazine, that part of the receiver which projects above and in the rear of the chamber known as the "overhang," is removed, making a larger opening for the introduction of a cartridge, when the arm is used as a single breech-loader. See *Lee Magazine-gun.*

REMINGTON REVOLVER.—This revolver is a modification of the Colt revolver. As the hammer is cocked a hand, which is pivoted to its lower portion, rises and engages the ratchet on the base of the cylinder and causes it to revolve. A stop-bolt engages the stop notches in the surface of the cylinder to prevent the momentum of the cylinder from carrying it past the firing point. It disengages from them under the action of a hammer cam, which, rising during the cocking of the hammer, presses up the rear end of the bolt and liberates its front end from the notch. When the revolution is about complete, the beveled lower surface of the hammer cam comes opposite the point of contact on the bolt. At this moment the tail of the bolt (being slit so as to have a lateral spring, and the head being pressed upward by a flat spring, slides down over the inclined surface of the cam, and the head engages the stop-notch in the cylinder. The spring is slit and bent so as to act upon both the bolt and the trigger. The drawing shows the general appearance of the Remington revolver, as at present made. The very numerous advantages or improvements claimed for the Remington revolver, as compared with the Colt arm are the use of a light base pin, which can be withdrawn by loosening its catch, and thus allowing the removal of the cylinder; the introduction of the ejector frame, fastening to the barrel by a small

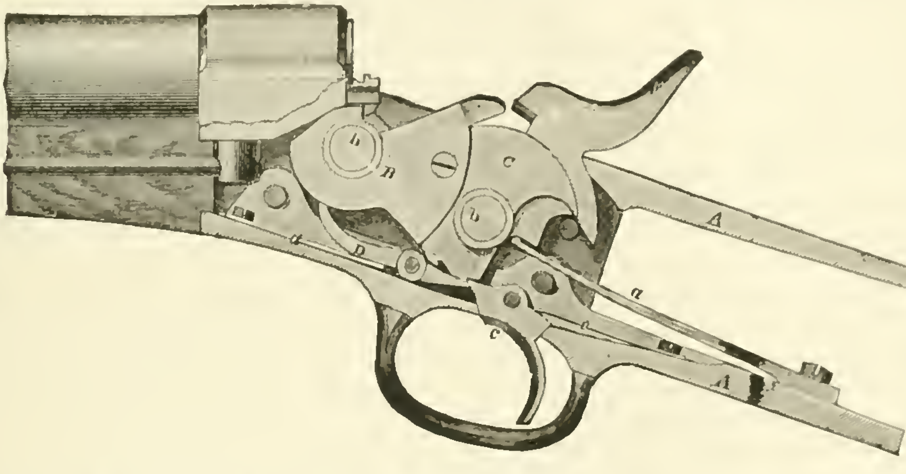


screw and to the frame by a dowel-pin, lessening the liability of accidentally tearing the ejecting system from the barrel; the coiling of the ejector spring around the base-pin instead of around the ejector; the fact that the butt of the Remington is forged solid with the pistol frame. It is also claimed that the pistol has a neater appearance than the Colt. See *Colt Revolver.*

REMINGTON RIFLE. The mechanical construction of the breech-system of the Remington arm is plainly shown in the accompanying drawing, exhibiting the system with breech-block and hammer open and in position for loading. The simplicity of the system, the largeness of its parts, and their peculiarly natural operation, it is thought, avoid the necessity of more elaborate and distinct illustration. The receiver, composed of frame and guard-strap (AA), is a substantial housing of wrought-iron, case-hardened, the sides of which are .28 inch in thickness. This frame, containing the lock and action, is closed at the bottom by the guard-strap, which is firmly secured in its place by two screws. The butt-stock is mortised for the reception of the end of the guard-strap (lower A), and tang of frame (upper A), tenoned into the receiver, and fastened by a tang-screw passing through the stock vertically from tang to guard-strap. The front part of the receiver is the chamber, $1\frac{1}{2}$ inches in length, into which the barrel is screwed. The fore-stock is secured to the barrel by a recoil-stud upon the under side of the latter. The constituent parts of the action are the breech-block (B) and pin (b); hammer (C) and pin (b); main-spring (a) and screw; trigger (C), trigger-spring (c) and screw; locking-lever (D), locking-lever spring (d), and screw; firing pin and screw. The extractor engages in a slot in the shoulder of the breech-block. The end of the ramrod screws into a ramrod-stud. The breech-block and hammer are solid pieces of fine steel, 69-100 of an inch thick, pivoted upon pins of the same material 46-100 in diameter. These pins pass entirely through the sides of the frame, and are held in place by the button screwed on to its left exterior side. The main-spring, trigger-spring, locking-lever, and the locking-lever spring are all of the very finest quality of refined steel, the springs having the simplest possible curves, and the action of the main-spring upon the hammer being direct. The function of the locking-lever is two-fold, one of its offices being to lock the trigger, so that it cannot escape from its notch in the tumbler, when the breech-block is opened, and a second to secure the breech-block when closed by the force, directly transmitted, of the lever-spring (d). It should be remarked that the whole of the lock work of this system, with the exception of the hammer, is attached to the guard-strap, which is thus, by a very ingenious construction, made to subserve the double purpose of guard-strap and lock-plate.

The extractor works in a recess cut in the left interior of the chamber, and is operated by means of a projection on its lower face, which engages with the shoulder of the breech-block, so that the act of swinging back the block very readily withdraws the empty cartridge-case by an entirely positive motion, independent of spring or indirect agent, a mode of extraction distinguished for its simplicity, smoothness, and certainty of operation. The firing-pin works through the breech-block. It is forced against the primer by the sudden shock of the hammer, which is imparted through the direct action of the strong and very slightly-curved main-spring, so that a misfire is impossible with cartridges properly made and fitted to the chamber.

The operation of this arm is especially simple. To load the piece, the hammer is first brought to full cock, and the breech-piece swung back by pressing the thumb-piece with the thumb of the right hand. The backward motion of the breech-block withdraws the discharged shell from the chamber, and if this motion is executed quickly,



with the muzzle of the arm slightly elevated, the case will fall out without necessitating the use of the fingers. The fresh cartridge is then inserted, and the breech closed in one continuous motion. The arm is then ready to fire. See *Hepburn-Remington Rifle* and *Keene-Remington Magazine-gun.*

REMINGTON THREE BARRELLED RIFLE. A gun, recently designed by Mr. G. R. Remington and tested with very satisfactory results. It has a fixed chamber closed by a movable breech-block, which rotates about a horizontal axis at 90° to the axis of the barrel, lying below the axis of the barrel and in front. The locks complete are contained in the breech-block, which being lowered out of the way by the tang on its lower end, permits the insertion of the cartridges into the chambers through a perforated extractor plate. This plate being moved by the arm on the pivot of the breech-block, withdraws the empty shells when the block is fully opened. A weak spring-catch in the stock holds up the tang of the breech-block when the piece is closed, and affords the only means of locking it.

REMISSION. Abatement; forgiveness. Remission of punishment, as regards a soldier tried by a Court-Martial, is in the power of the confirming authority, and he can at any time remit any portion of the sentence at discretion. The periodical visitors of military prisons have the power of recommending remission of punishment. When a prisoner confined in a military prison is recommended for a remission of punishment by his commanding officer, the recommendation should be submitted for the approval of the periodical visitors.

Though a soldier's punishment may have been wholly remitted, there is to be no remission of any penalty consequent on his conviction, such as forfeiture of service, good-conduct pay, etc.

REMONSTRATE.—To urge strong reasons against the instructions given by superior authority. If an officer or soldier considers himself aggrieved on any point, he is permitted to represent his case, but it must be done in a respectful manner through his commanding officer to higher authority; at the same time, where the duty of the service may require it, that duty must be first carried out with cheerfulness and alacrity.

REMOUNT.—To furnish the cavalry with horses in the room of those which have been killed, disabled, or cast.

REMOUNTS.—The name given to horses that are passed into the government service by purchase for artillery or cavalry purposes, or which are reared in a stud, as in India. The general age of remounts varies from 3 to 5 years old.

RENDEZVOUS.—A place appointed for a meeting; especially for the assembling of troops. The term commonly denotes a place for enlistment.

RENEGADE.—A term applied to one who deserts from a military or naval post.

RENNEN.—A kind of tilt. A description of tournament practiced at the close of the 12th century.

REPAIR OF ARMS.—The keeping in constant good order the different fire-arms belonging to a troop or company, such as rifles, etc. In the British Army a half-yearly allowance is made to Captains of troops and companies for this purpose. In the United States service the cost of repairs of damage done to arms, equipments, etc., through negligence of an officer or soldier, is deducted from the pay of said officer or soldier.

REPEATER.—Any fire-arm that may be discharged many times in quick succession; especially a form of fire-arm so constructed that the charges may be successively introduced, by an action of the lock, from a chamber containing them, into the breech, and fired, or are discharged from a revolving chamber at the breech. See *Magazine-gun*, and *Revolver*.

REPLEADER.—In English law, a right to plead again, or deliver a fresh pleading in consequence of the issue which had been joined not meeting or exhausting the real point in dispute. This right is much abridged, in consequence of the liberality now used in amending the record.

REPLEVIN.—In English law, a form of action by which goods which have been seized under an illegal distress are taken back (security being given to the amount for which the goods were distrained), and the action of replevin commenced, to try the legality of the seizure.

REPLICATION.—In common law, the pleading of the plaintiff in answer to the defendant's plea. The plaintiff's first pleading is the declaration, which is answered by the defendant's plea, and which in turn is answered by the plaintiff's replication.

REPLY.—It is the duty of a Court to prevent new matter from being introduced into the prosecution or defense, but a prisoner may urge in his defense mitigating circumstances, or examine witnesses as to character or services, and produce testimonials of such facts, without its being considered new matter. If any point of law be raised, or any matter requiring explanation, the Judge Advocate may explain. No other reply is to be admitted.

REPORT.—1. A loud noise, such as that made by the discharge of a cannon or musket. The distance at which cannon can be heard depends on the wind and the state of the atmosphere, also whether conveyed over water, which considerably increases the distance to which sound can reach. During the Sutlej campaign in 1845–46, the report of the guns at the battle of Sobraon was very distinctly heard at Loodianah, a distance of 80 miles. But the report of cannon, it is stated, has been heard at far greater distances.

2. A statement of facts when any officer or soldier is accused of a breach of military discipline. A report is usually made by stating on paper, in official form, by the officer making the report, the nature of the case, for the information of the Commanding Officer. In a regiment this is done through the Adjutant.

REPORTS.—Specific statements of any particular occurrences. Officers or men making written reports are required to sign them, specifying the regiment to which they belong, and their rank. All field officers not serving at the headquarters of their regiments make monthly reports to their regimental Commanders. These reports embrace everything essential to a correct record of their services. The number, date, and source of authority of every order affecting their duties is stated, with the date of its receipt, their execution of its requirements, and the time they were so employed. The date of departure of a field officer from his post or station, whether on leave or on duty, as well as the date of his return to his post, is in all cases specified.

Officers on detached duty report, monthly, to the Commanders of their Posts, of their Regiments, or Corps, and to the Adjutant General, their stations, the nature of their duties, and the authority placing them thereon—likewise each *change* of *address*. All officers doing duty in the Quartermaster's Department are required to make out and forward to the Quartermaster General, on the first day of each month, a personal report, giving their post-office address, and a statement of the duty on which they have been employed, since their last report. On the first day of each month the officers of the Subsistence Department report by letter to the Commissary General their stations and duties during the preceding month. This letter is required from Commissaries of Subsistence only, and not from officers acting as such. Every Medical Officer reports to the Surgeon General and to the Medical Director the date when he arrives at a station, or when he leaves it, and the orders under which he acts. At the end of each month he sends a personal report to the Surgeon General, giving his post-office address for the next month, and a statement of the duty upon which he has been employed, or if on leave of absence, since his last report.

Company, Post, and also Regimental Commanders make a report annually, on the first day of July, through the usual military channel, of any officers under their command who, by special aptitude or study, are notably well fitted for any branch of service, science, or art, either civil or military. Such reports give full particulars of qualifications and preparation. This information is useful to the General of the Army in making details and selections for duty. The date of appointment, of detail, and of removal of all Staff officers, or of officers selected for duty in Staff Departments, which may entitle them to receive additional pay, is immediately reported by the officer making such appointment, detail, or removal, to the Adjutant General, and to the Paymaster of the Department, or command to which such officers belong. Whenever a change takes place in the position or location of troops, the fact is immediately reported by the Commanding Officer to General, Division, or Department Headquarters, specifying the date of departure of the whole or any part of the troops, or of the arrival of any detachment, as well as all other circumstances connected with such changes in the command. These special reports are always accompanied by an exact *return* of the troops according to the established printed forms. A similar report is noted on the next monthly return of the Post or Station.

REPOSITORY.—A museum, or place of deposit of musters or the samples of the different arms, tools, stores, etc., used in the service. The repository at Woolwich forms a school of instruction for both officers and men on first joining the artillery, and is interesting and instructive to all ranks in the regiment.

REPRIEVE.—The suspension of punishment for a crime, and is used chiefly in connection with capital crimes. The power of suspending all sentences at any time is vested in the Crown at discretion. There are also several grounds on which the Judge or a Court reprieves the sentence. The President of the United States has power to grant reprieves and pardons for offenses against the United States, except in cases of impeachment.

REPRIMAND.—rebuke, which is included in the army under the head of punishments. Courts-Martial only inflict it on officers, in which case it may be either a simple reprimand or a severe reprimand, and may, at the discretion of the Confirming Officer, be administered privately or publicly.

REPRISAL.—The retaking, from an enemy, goods which he has seized, or the capture from him of other goods, as an equivalent for the damage he has wrought. A *reprise* is a ship captured from an enemy or pirate. If recaptured within 24 hours of the hostile seizure, she must be wholly restored to her owners; if later, she becomes the lawful prize of her recaptors. Reprisals form the worst features of warfare, and are seldom resorted to in conflicts between civilized nations, or, at least, should not be.

REPROACHFUL, OR PROVOKING SPEECHES.—The Articles of War declare that no officer or soldier shall use any reproachful or provoking speeches or gestures to another. Any officer who so offends shall be put in arrest. Any soldier who so offends shall be confined, and required to ask pardon of the party offended, in the presence of his Commanding Officer.

REPUBLIC.—A political community in which the sovereign power is lodged, not in a hereditary chief, but either in certain privileged members of the community, or in the whole community. According to the constitution of a governing body, a Republic may therefore vary from the most exclusive Oligarchy to a pure Democracy. The several Republics of Greece, and that of Rome were, at the outset at least, aristocratic communities. The Mediæval Republics of Venice, Genoa, and the other Italian towns, were also more or less aristocratic. The sovereign power was held to be vested in the franchised citizens, and every function—legislative, executive, or judicial—not exercised directly by that body could only be exercised by parties deriving their authority from it. But the extent of the franchise, and the mode of exercising it, varied much in these civic communities; and the most prosperous and long-lived was Venice which was moreover the most aristocratic of them all. In the 16th century the seven Provinces of the Netherlands, on their revolt from Spain, adopted a Republican form of Government, as did Switzerland on becoming independent of the German Empire. Great Britain was nominally a Republic for eleven years (from 1649 to 1660). France was a Republic from 1793 to 1805, and from 1848 to 1853; and the Republic was again proclaimed Sept. 4, 1870. Such government as Spain had between Feb. 1873, and Dec. 31, 1874, was of a true Republican form. Switzerland is also a Republic; since 1848 more democratic than formerly. The other Republics of Europe are the diminutive States of San Marino and Andorra, and, in certain respects, the free cities of Hamburg, Bremen, and Lübeck. The most important of modern Republics is that of the United States of America—dating from its separation from Great Britain—where pure Democracy has been tried on a scale unknown elsewhere. Except during the short-lived Empire from 1863-67, Mexico has been a Republic since 1824. Nine Republics at present exist in South America—Peru, Chili, Paraguay, Bolivia, Colombia or new Granada, Venezuela, Ecuador, Uraguay, and the Argentine Confederation. In the Republics of the ancient world, the franchised classes exercised their power directly without any system of delegation or representation. The same was at first the case in the Swiss Cantons where, however, representative government has been gradually introduced. Modern Republics have been founded on the representative, not the direct, system, which can hardly exist except in a community that is very small and concentrated as to space. Switzerland and the United States of America are Federal Republics, consisting of a number of separate States bound together by a treaty, so as to present to the external world the appearance of one State with a central Government, which has the power of enacting laws and issuing orders which are directly binding on the individual citizens.

REQUA BATTERY.—A kind of mitrailleur, having twenty-five barrels arranged horizontally. It was used at the siege of Charleston in 1863. Its weight complete is 1,382 pounds.

REQUEST COURT.—A local Court assembled periodically in India for the recovery of small debts not exceeding 400 rupees. In each military cantonment, a Court of Request is assembled monthly, and all persons are amenable to it except soldiers in the ranks. Not less than three officers, all military men should form the Court.

REQUISITION. 1. This term, in international law, besides meaning the demand made by the Authorities of one Nation or State upon those of another for the

Requisition for Stationery for ______ stationed at ______ for the ______ commencing on the ______ day of ______, 188__, and ending on the ______ day of ______, 188__.

Quires of foolscap paper.	Quires of letter paper.	Quires of folio-post paper.	Quires of envelope paper.	Sheets of blotting paper.	Official envelopes.	Letter envelopes.	Two-quire blank books.	Three-quire blank books.	Bottles of black ink.	Bottles of red ink.	Ounces of wafers.	Ounces of sealing-wax.	Steel pens.	Quills.	Lead pencils.	Office tape.	Bottles of mucilage.	Pieces of rubber.		

I certify that the above requisition is correct, and that I have not drawn stationery for any part of the time specified.

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rendering up (or extradition) of an alleged criminal, is used also in the rules of war as nearly synonymous with the word "Contribution." The distinction made is that a Requisition is a demand upon the people of an invaded country to furnish such things as provisions, forage, transportation, or even labor; while a Contribution is a payment in money to provide for the needs of the military or civil government established. The former term, however, is generally used to cover all demands upon the people of the conquered country. It is now well settled that the rights of private citizens should be respected and their property secured from pillage. It is the rule of most civilized nations that supplies or labor demanded should be paid for after the war, and receipts given at the time. This is the principle laid down in the *Instructions for the Armies of the United States in the Field*. It was formerly the usual practice to inflict severe requisitions in the way of fines on an offending district or town as a penalty. It is now generally agreed that such measures are rarely justifiable, and are of little practical benefit to those who employ them. 2. Forms prescribed for the demand of certain allowances. On page 663 will be seen the form of Requisition for Stationery.

REREWARD.—The part of an army that marches in the rear, usually the guard; the rear-guard.

RESERVE.—The reserve of a Nation is that force upon which the national defense is thrown, when its regular armies have failed in securing its safety. This reserve may be the *levée en masse* of the whole adult male population, or it may consist of a smaller section of the people duly trained to arms. The latter is, of course, the preferable system, when the arms of scientific modern warfare are to be brought into action. In different countries the reserves are organized on very different principles. In Great Britain they comprise the Army Reserve, the Enrolled Pensioners—both of which consist of soldiers who have served in the army—the Militia, Yeomanry, Volunteers, and trained Constabulary. The numbers of the reserve forces provided for in the Army Estimates of 1876–77 were as follows:

Militia	139,619
Yeomanry Cavalry	15,078
Volunteers	168,750
Army Reserve force (including Enrolled Pensioners) first-class	10,000
second-class	21,000
	354,447

Of the volunteers, 31,823 were Artillery Volunteers, 366 Light Horse, 6,295 Engineers, 139 Mounted Rifles, 1,458 Permanent Staff, and 128,669 Rifle Volunteers.

The scheme of army reorganization, which has been carried out during the past few years, has had a very important bearing on the reserve forces. In 1870 it was attempted, by modifying somewhat the conditions of enlistment into the regular army, to make the provisions for securing and maintaining a numerically strong Army Reserve more efficient than they had hitherto been. Enlistment continued as before to be for twelve years; but service in regiments going abroad was to be for six years, while the remaining six years' service was to be in the Reserve, the men being liable to be called out like the Naval Reserve, and receiving a pay of 4d. a day. In 1876 men commenced to pass from the Colors into the Reserve, which is expected ultimately to reach about 80,000 men. By an Order in Council of March 31, 1871, the power of the Lord Lieutenant ceases, and the management of the Reserve Forces in counties is vested in the Ministers of the Crown.

One of the objects chiefly kept in view in the comprehensive scheme of 1872 for the reorganization of the army was the bringing of the Auxiliary Forces into closer and more mutually helpful relations with the regular army. The main feature of that scheme is the localization of the combined military forces in certain territorial districts, so that there shall belong to each such district two Line Battalions, two Militia Battalions, and Volunteers, formed into an Administrative Brigade, the whole to rest on the Brigade Depot as center. Arrangements were made to secure that a larger number of officers of the line regiments should pass into the Militia and the Yeomanry, and that the efficiency of the Reserve should increase. The aim of the measure was "To unite the spontaneity and all the other advantages of the Auxiliary Forces with the highest amount of training that the Regular Army could furnish to any other body of men."

RESERVE AMMUNITION.—This term is applied to the supply of war ammunition carried in rear of an army for replenishing men and guns with fresh ammunition in case the first supply fails.

The *reserve ammunition* of a regiment is carried in carts, one for the cavalry and three for the infantry. These carts can carry 9,600 rounds each of Martini-Henry or 8,960 rounds of Snider. In the artillery, there are three reserves of ammunition. The first (108 rounds per 9-pr. and 72 per 16-pr. gun) is that contained in the second line of wagons of each battery; the second(44 per 9-pr. and 108 per 16-pr. gun) is conveyed in the artillery general service wagons, and should be always up with the army, but kept from under fire The third reserve is carried by the transport, and contains 200 rounds per 9-pr. gun and 200 per 16-pr. gun, and remains at one or two days march in rear of the army. The above number of rounds, with those with the battery, makes up 500 rounds per 9-pr. gun, and 480 rounds per 16-pr. gun.

RESERVE MILITIA.—A portion of the Militia. A certain number not exceeding the fourth part of the quota of the privates of the Militia for England, Scotland, and Ireland, respectively, may volunteer to join this force. They may volunteer to be trained for 56 days in each year with the regular army, and in case of national danger or great emergency are liable to general service in the regular army.

RESIGN.—To resign an appointment or commission, an officer must send in his resignation through the prescribed channels. Non-commissioned officers can resign their appointments, when they find themselves unequal to the performance of the duties of their rank, with the consent of their Commanding Officer. Enlisted men are not permitted to resign, and can only quit the service after having been properly discharged.

In the United States service, no officer is considered out of service on the tender of his resignation, until it shall have been duly accepted by the proper authority. Any officer who, having tendered his resignation, prior to due notice of the acceptance of the same by the proper authority, and without leave, quits his post or proper duties with the intent to remain permanently absent therefrom is registered as a deserter, and punished as such. The resignations of officers appointed by the President can be accepted by him alone.

Before approving tenders of resignation of disbursing officers, Commanding Generals cause all public moneys or property in their hands to be turned over to the officer designated to receive the same. This action is indorsed on the resignation, and promptly reported to the War Department. Resignations tendered under charges, when forwarded by any commander, are always accompanied by a copy of the charges; or, in the absence of written charges, by a report of the case, for the information of the Secretary of War. Before final payments are made to an officer whose resignation has been accepted, he is required to exhibit a certificate of non-indebtedness to the United States from the proper accounting officers of the Treasury.

In time of war, or with an army in the field, resignations take effect within thirty days from the date of the order of acceptance. Leaves of absence are not granted by commanding officers to officers on tendering their resignation, unless the resignation be unconditional and immediate. Any officer of the army who accepts or holds any appointment in the diplomatic or consular service of the Government is considered as having resigned his place in the army. This applies to officers on the Active List, and to all retired officers, excepting those exempted by law.

RESISTANCE OF THE AIR. A body moving in the air experiences a resistance which diminishes the velocity with which it is animated. That the retarding effect of the air, on projectiles moving with high velocities, is very great, is seen by comparing the actual ranges of projectiles with those computed under the supposition that they move in vacuo. Thus it has been shown that certain cannon-balls do not range one-eighth as far in the air as they would if they did not meet with this resistance to their motion, and small-arm projectiles, which have but little mass, are still more affected by it.

Incompressible fluid.—The resistance experienced by a plane surface moving parallel to itself through an incompressible fluid, is equal to the pressure of a column of the fluid, the base of which is the moving surface, and its height that due to the velocity with which the surface is moved through the fluid, or, from the law of falling bodies, $h=\frac{v^2}{2g}$; in which h is the height, v the velocity, and g the force of gravity. The resistance on a given area is therefore proportional to the square of the velocity, and the density of the fluid medium.

Let d, S, and v represent the density or weight of a unit of volume of fluid, the area pressed upon, and the velocity of the moving surface, respectively, and Q the resistance in terms of the unit of weight, and we have,

$$Q=kdS\frac{v^2}{2g};$$

in which k is a coefficient to be determined by experiment.

Compressible fluid.—If the medium be formed of compressible gases, as the atmosphere, the density in front of the moving body will be greater than that behind it; and it will be readily seen that the body will meet with a resistance which increases more rapidly than the square of the velocity, in such a manner that the coefficient, k, or the density of the medium, d, should be increased by a quantity which is a function of the velocity itself, or, what is the same thing, by adding another term to the resistance which shall be proportional to the cube of the velocity. In examining the table of resistances, obtained by Hutton by firing a one-pound ball into a ballistic pendulum, at different distances, with velocities varying from 300 to 1,900 feet, Piobert found, that if v^2 in the foregoing expression be replaced by the binomial term, $\left(v^2+\frac{v^3}{r}\right)$, in which $\frac{1}{r}=\frac{1}{1427\text{ ft.}}$, the expression would nearly satisfy the results of experiments. Calling $A=\frac{kd}{2g}$, and πR^2 the area of the cross section of a projectile, the general expression for the resistance in air becomes,

$$Q=A\pi R^2\left(1+\frac{v}{r}\right)v^2.$$

In this expression, A is the resistance, in pounds, on a square foot of the cross-section of a projectile moving with a velocity of one foot; r is a linear quantity depending on the velocity of the projectile. For all service spherical projectiles, $A=.000514$; and for all service velocities $r=1,427$ feet. The value of A for the rifle-musket bullet has been determined at the Washington Arsenal, and found equal to 0.000358. This shows that the resistance of the air is about one-third less on the *ogeval* than on the spherical form of projectile. This value has been found to answer well for calculating the ranges of rifle-cannon projectiles. The coefficient A, being a function of the density of the air, its value depends on the temperature, pressure, and hygrometric condition; in the above value the weight of a cubic foot of air = .075 lb., at a temperature of 60° Fahr., and for a barometrical pressure of 29.5 inches. If the surface of the projectile be rough or irregular, the value of this coefficient will be slightly too small.

The motion of a body falling through the air, will be accelerated by its weight, and retarded by the buoyant effort of the air, and the resistance which the air offers to motion. As the resistance of the air increases more rapidly than the velocity, it follows that there is a point where the retarding and accelerating forces will be equal, and that beyond this, the body will move with a uniform velocity equal to that which it had acquired down to this point. The buoyant effort of the air is equal to the weight of the volume displaced, or $P\frac{d}{D}$; in which P is the weight and D the density of the projectile, and d the density of the air. When the projectile meets with a resistance equal to its weight, we shall have,

$$P\left(1-\frac{d}{D}\right)=A\pi R^2v^2\left(1+\frac{v}{r}\right).$$

in which the weight of the displaced air is transferred to the first member of the equation. As the density of the air is very slight compared to that of lead or iron, the materials of which projectiles are made, $\frac{d}{D}$ may be neglected. Making this change, and substituting for P, $\frac{4}{3}\pi R^3D$ (g having been divided out of the second member, should be omitted in the first), the expression for the *final velocity* reduces to

$$v^2\left(1+\frac{v}{r}\right)=\frac{4\ RD}{3\ A}$$

The resistance on the entire projectile for a velocity of 1 foot, is $A\pi R^2$; dividing this by $\frac{P}{g}$, or the mass, we get the resistance on a unit of mass. Calling this $\frac{1}{2c}$, we have,

$$\frac{1}{2c}=\frac{A\pi R^2}{\frac{P}{g}},\text{ or }2gc=\frac{P}{A\pi R^2}.$$

Substituting for P its value in the equation of vertical descent, we have,

$$2gc=v^2\left(1+\frac{v}{r}\right);$$

from which we see that v depends only on c; but

$$c=\frac{2\ RD}{3\ gA};$$

hence, the final velocity of a projectile falling in the air is directly proportioned to the product of its diameter and density, and inversely proportional to the density of the air, which is a factor of A. The expression for the value of (c) shows, that the retarding effect of the air is less on the larger and denser projectiles. To adapt it to an oblong projectile of the pointed form, the value of D should be increased, (inasmuch as its weight is increased in proportion to its cross section), while that of A should be diminished. It follows, therefore, that for the same caliber an oblong projectile will be less retarded by the air than one of spherical form, and consequently with an equal and perhaps less initial velocity its range will be greater. The value of (c) for service projectiles will be found ready calculated in the Tables of Fire. For the purpose of determining the velocity which a projectile loses by the resistance of the air, in moving through a certain distance, x, the force of gravity may be disregarded; in which case the trajectory described will be a right line.

Let V be the initial velocity, and v the remaining velocity at the end of the distance x.

The expression for the resistance of the air is, as we have seen,

$$Q = A\pi R^2\left(1+\frac{v}{r}\right)v^2.$$

But we know that the retarding force of the air is equal to the mass of the projectile against which it acts, multiplied by the first differential coefficient of the velocity, regarded as a function of the time, with its sign changed, and that $\frac{P}{g}$ is the mass of the projectile. We have, therefore,

$$\frac{Qg}{P} = -\frac{dv}{dt} = \frac{g}{P}A\pi R^2\left(1+\frac{v}{r}\right)v^2.$$

Recollecting that $P = \frac{4}{3}\pi R^3 D$, and that $2c = \frac{4}{3}\frac{RD}{gA}$, the equation reduces to,

$$\frac{dv}{dt} = -\frac{v^2}{2c}\left(1+\frac{v}{r}\right).$$

Integrating this equation between the limits 0 and x, which correspond to V and v, we have,

$$t = 2c\left(\frac{1}{v}-\frac{1}{V}\right) - \frac{2c}{r}\log.\frac{1+\frac{r}{v}}{1+\frac{r}{V}}$$

To obtain a relation between the space and velocity; we have $v = \frac{dx}{dt}$, or $dt = \frac{dx}{v}$; substituting this in the equation for the intensity of the retarding force, and reducing, we have,

$$dx = -2c\frac{dv}{v\left(1+\frac{v}{r}\right)}$$

Integrating between the same limits as in the preceding case, we have,

$$x = 2c\log.\frac{1+\frac{r}{v}}{1+\frac{r}{V}} \text{ or } 1+\frac{r}{v} = \left(1+\frac{r}{V}\right)e^{\frac{x}{2c}} \quad \ldots(1).$$

Solving this equation with reference to v, we have,

$$v = \frac{r}{\left(1+\frac{r}{V}\right)e^{\frac{x}{2c}}-1} \quad \ldots\ldots\ldots(2).$$

Substituting in the above equations we have,

$$t = 2c\left(\frac{1}{v}-\frac{1}{V}\right) - \frac{x}{r} \quad \ldots\ldots(3).$$

The logarithms in the above equations belong to the Napierian system, and are obtained by multiplying the corresponding common logarithm by $2.3026 \cdot e = 2.713$.

Equation (1) gives the space passed over by a certain projectile when the velocities at the commencement and end of the flight, are known.

Equation (2) gives the remaining velocity when the initial velocity and the space passed over are known.

Equation (3) gives the time of flight when the velocities at the beginning and end and the space passed over are known.

The distance at which the velocity V is reduced to v, and the duration of the trajectory, being proportional to c, are directly proportional to the product of the diameter and density of the projectile, and inversely proportional to the density of the air. This fact shows the great advantage, in point of range, to be derived from using large projectiles over small ones, of solid projectiles over hollow ones, of leaden projectiles over iron ones, and of oblong projectiles over round ones. See *Didion's Formulas*, *Equations of Motion of Projectiles* and *Trajectory*.

RES JUDICATA.—In law, a term meaning that the subject matter of an action has been already decided by a court of competent jurisdiction, and if so, a plea setting up the *res judicata* is a sufficient defense. In order to be binding, however, the suit in the former case mast have been between the same parties.

RESPECTANT.—In Heraldry, a term employed to describe two animals borne face to face. Beasts of prey rampant when so borne, are, however, said to be *rampant combatant*. Also written *Respecting*.

RESSAIRDAR.—In the East Indies, a native officer in a native cavalry regiment who commands the left troop of a squadron.

RESSALAH.—The Indian term for a squadron of native cavalry.

RESSALDAR.—In the East Indies, a native officer in a native cavalry regiment. He commands the right troop of a squadron, and on parade leads the squadron. *Ressaldar Major* is the native commandant of a native cavalry regiment.

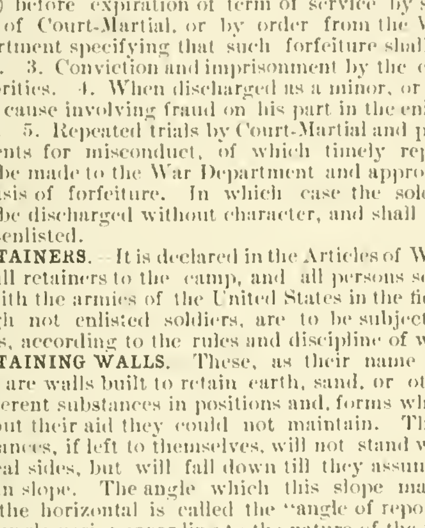
REST.—1. In tactics, a word of command, whereby the men are brought to a position of rest; as parade rest in place rest, etc. 2. A support for the muzzle of a gun in aiming and firing. The Arbalest or cross-bow, and the earlier hand fire-arms were always thus supported, and the long guns of the Moors and Arabs are still universally provided with a device of this kind. In civilized countries the rest is employed by the sharp-shooters and in practice-firing. It may consist of a stake or picket, whose pointed end is driven in the ground, the gun resting in a crotch at the upper extremity; or, as in some of the European armies, of a device having a screw-point, by which it may be attached to a tree or other support. 3. In a lathe, a piece of iron for holding the turning tool, fixed at the end of a slide by a set-screw; the slide can be moved at right angles to the bar of the lathe, and the whole can be fixed at any part of the bed between the centers. 4. In Heraldry, the name usually given to a charge, varying considerably in the different representations. It appears at too early a date to be what it is often said to be—a spear rest. It is sometimes called an organ-rest, and in old rolls, a clarion—and is most likely a representation of some musical instrument like the pandean pipe. It was a rebus badge of the Clares.

REST ON ARMS.—A position in the Manual of Arms, executed as follows: Being at a carry, the Instructor commands: 1. *Rest on*, 2. ARMS. Raise the piece vertically with the right hand, advancing it slightly, grasp it with the left hand at the lower band, the forearm horizontal; reverse it with both hands, the muzzle dropping to the front, the butt passing between the breast and the right forearm; place the muzzle upon the left toe, the barrel to the right, the left hand slipping up the stock, the back to the left. (Two.) Carry the right foot three inches to the rear; at the same time place the hands upon the butt, the right hand uppermost, the left knee slightly bent. (THREE.) Incline the head toward the hands. 1. *Carry*, 2. ARMS. Grasp the small of the stock with the right hand, back to the right; carry the piece with the right hand opposite the right shoulder, barrel to the front and vertical, forearm horizontal; grasp the piece at the lower band with the left hand, back to the left, the thumb pointing downward; bring the right foot by the side of the left. (Two). Reverse the piece with both hands, the butt passing between the breast and right forearm; resume the carry with the right hand. (THREE.) Drop the left hand by the side. See *Manual of Arms*, *Fig.* 13.

RETAINED PAY. In the United States service, this pay is retained from the soldier until the expiration of his term of service, and is forfeited unless he shall have served honestly and faithfully to the date of discharge, or for any of the following causes: 1. Desertion during the period of enlistment. 2. When discharged (by way of punishment for an offense) before expiration of term of service by sentence of Court-Martial, or by order from the War Department specifying that such forfeiture shall be made. 3. Conviction and imprisonment by the civil authorities. 4. When discharged as a minor, or for other cause involving fraud on his part in the enlistment. 5. Repeated trials by Court-Martial and punishments for misconduct, of which timely report shall be made to the War Department and approved as basis of forfeiture. In which case the soldier shall be discharged without character, and shall not be re-enlisted.

RETAINERS.—It is declared in the Articles of War, that all retainers to the camp, and all persons serving with the armies of the United States in the field, though not enlisted soldiers, are to be subject to orders, according to the rules and discipline of war.

RETAINING WALLS. These, as their name implies, are walls built to retain earth, sand, or other incoherent substances in positions and forms which without their aid they could not maintain. These substances, if left to themselves, will not stand with vertical sides, but will fall down till they assume a certain slope. The angle which this slope makes with the horizontal is called the "angle of repose." This angle varies according to the nature of the material; for example, that of moist soil is about 45°,



ac, revetment; b, bottom of ditch, level of ground within the work; de, top of rampart; fgh, parapet; ik, banquette; kle, mass of earth supported by revetment; m, center of gravity of mass; n, point of greatest pressure on revetment.

while fine sand assumes an angle of about 30°. The drawing shows a retaining wall of masonry built in permanent fortification. Prior to Vauban's time the scarp revetment or retaining wall was commonly raised to the top of the parapet; but as in this case the artillery of a besieger played on the top of the wall, and ruined it soon after the siege commenced, that engineer adopted the principle—thenceforth followed—of raising it no higher than the crest of the glacis, or about 7 feet above the natural ground, leaving the parapet above of sloped earth only. When the main ditch is 24 feet deep, the scarp revetment will be about 30 feet high. Additional strength is imparted to the revetment wall by massive buttresses at every 15 feet, called *counterforts*, and these, again, are sometimes connected and strengthened by masonry arches outside the revetment. The revetment forms a terrible barrier to an assaulting party.

In estimating the requisite thickness of the wall, it must be taken into account that the wall may give way in various manners; it may be overturned, or it may slide as a whole along its base DB, or the upper parts may give way, while the base remains. From these data, mathematical formulæ have been worked out, which determine the thickness requisite for different situations and materials, such as that given by M. Poncelet for ordinary materials, and within ordinary limits:

$$x = .285(H + h).$$

Where H, the height of the wall, and h, the additional height of the bank above the top of the wall, being given, x, the thickness of the wall, can be found. These formulæ, however, are not of much practical value, on account of the varying nature of the data on which they are founded, and of the excess of strength requisite in all such constructions, to allow for causes of failure which cannot be foreseen or provided for in the calculations. Practical experience is found to be the only safe guide in all such considerations. In the construction of a retaining wall, a great desideratum is, that the earth behind it be well drained; for if water be allowed to accumulate behind the wall, the earth gets into a semi-fluid state, in which it gives a very much increased pressure on the wall. For this purpose, holes are left through the wall called "weeping holes;" these holes are about 9 inches high and 2 inches wide, and are generally placed about 1 for every 36 sq. ft. of wall. Also stones without mortar are frequently built up behind the wall, so forming an open stratum, into which the water drains, and is thence carried off through the weeping-holes.

RETALIATION.—War is not carried on by arms alone. It is lawful to starve the hostile belligerent, armed or unarmed, so that it leads to the speedier subjection of the enemy. When the commander of a besieged place expels the non-combatants, in order to lessen the number of those who consume his stock of provisions, it is lawful, though an extreme measure, to drive them back, so as to hasten on the surrender. Commanders, whenever admissible, inform the enemy of their intention to bombard a place, so that the non-combatants, and especially the women and children, may be removed before the bombardment commences. But it is no infraction of the common law of war to omit thus to inform the enemy. Surprise may be a necessity. Public war is a state of armed hostility between sovereign nations or governments. It is a law and requisite of civilized existence that men live in political, continuous societies, forming organized units, called states or nations, whose constituents bear, enjoy, and suffer, advance and retrograde together, in peace and in war.

The citizen or native of a hostile country is thus an enemy, as one of the constituents of the hostile state or nation, and as such is subjected to the hardships of the war. Nevertheless as civilization has advanced during the last centuries, so has likewise steadily advanced, especially in war on land, the distinction between the private individual belonging to a hostile country and the hostile country itself, with its men in arms. The principle has been more and more acknowledged that the unarmed citizen is to be spared in person, property, and honor as much as the exigences of war will admit. Private citizens are no longer murdered, enslaved, or carried off to distant parts, and the inoffensive individual is as little disturbed in his private relations as the commander of the hostile troops can afford to grant in the overruling demands of a vigorous war.

The almost universal rule in remote times was, and continues to be with barbarous armies, that the private individual of the hostile country is destined to suffer every privation of liberty and protection, and every disruption of family ties. Protection was, and still is with uncivilized people, the exception. In modern regular wars of the Europeans, and their descendants in other portions of the globe, protection of the inoffensive citizen of the hostile country is the rule; privation and disturbance of private relations are the exceptions.

Commanding Generals may cause the magistrates and civil officers of the hostile country to take the oath of temporary allegiance or an oath of fidelity to their own victorious government or rulers, and they may expel every one who declines to do so. But whether they do so or not, the people and their civil officers owe strict obedience to them as long as they hold sway over the district or country, at the peril of their lives. The law of war can no more wholly dispense with retaliation than can the law of nations, of which it is branch. Yet, civilized nations acknowledge retaliation as the sternest feature of war. A reckless enemy often leaves to his opponent no other means of securing himself against the repetition of barbarous outrage.

Retaliation will, therefore, never be resorted to as a measure of mere revenge, but only as a means of protective retribution, and, moreover, cautiously and unavoidably; that is to say, retaliation shall only be resorted to after careful inquiry into the real occurrence, and the character of the misdeeds that may demand retribution. Unjust or inconsiderate retaliation removes the belligerents further and further from the mitigating rules of a regular war, and by rapid steps leads them nearer to the internecine war of savages.

Modern times are distinguished from earlier ages by the existence, at one and the same time, of very many nations and great governments related to one another in close intercourse. Peace is their normal condition; war is the exception. The ultimate object of all modern war is a renewed state of peace. The more vigorously wars are pursued, the better it is for humanity. Sharp wars are brief.

Ever since the formation and coexistence of modern nations, and ever since wars have become great national wars, war has come to be acknowledged not to be its own end, but the means to obtain great ends of state, or to consist in defense against wrong; and no conventional restriction of the modes adopted to injure the enemy is any longer admitted; but the law of war imposes many limitations and restrictions on principles of justice, faith, and honor.

RETARDATION.—The velocity a ball loses in consequence of a resisting medium is termed *retardation*. This varies with the degree of resistance, and the weight of the ball. In case of ordinary spherical projectiles retardation will vary as $\frac{d^2\ v^3}{d^3}$ (d=the diameter of the ball, and v=its velocity). If two shot of different diameters, but of equal density, be fired under similar circumstances, it appears from this that the shot of the larger diameter will range to a greater distance than the other; consequently for equal ranges, the elevation of the piece from which the larger shot is fired may be reduced, and the chances of its striking the object fired at, will be greater, the trajectory being less curved.

The effect of a pressure or resistance (R) acting on a projectile or other body is to cause acceleration or retardation (f) in velocity, and the amount of it is known from the elementary law in dynamics expressed by the proportion, $R : w :: -f : g$, where w is the weight of the projectile in pounds; or retardation (f) $= -\frac{R}{w}g$. Here we notice that *retardation* varies inversely as the weight of the projectile. Retardation is negative acceleration. It is subject to the same laws, but is the opposite to it in sign. Hence, the minus sign in the proportion above.

RETIARIUS.—A kind of gladiator who fought in the amphitheater during the time of the Romans. He was dressed in a short coat, having a *fuscina*, or trident, in his left hand, and a net, from which he derived his name, in his right. With this he endeavored to entangle his adversary, that he might then with his trident easily dispatch him. On his head he wore only a hat tied under his chin with a broad ribbon.

RETINUE.—The body of retainers who follow a prince or other distinguished person; a train of attendants.

RETIRADE.—In fortification, a retrenchment, which is generally made with two faces, forming a re-entrant angle, and is thrown up in the body of a work, for the purpose of receiving troops, who may dispute the ground inch by inch.

RETIRE.—A bugle-sound intimating to skirmishers that they are to fall back. In the United States service, this call is termed "to the rear."

RETIRED FLANKS.—In fortification, those made behind the line which joins the extremity of the face and the curtain towards the capital of the bastion.

RETIRED LIST.—The list of officers retired from an Army. To maintain a reasonably low age among the officers actively employed, it is essential that an army should have some fixed scale for the retirement of the old and enfeebled officers. In the British Army, this matter is well regulated, and in most instances the retiring officer is allowed a step of honorary rank; which higher rank, however, does not carry present nor prospective advantage.

In the United States service, the whole number of officers of the Army on the Retired List can not at any time exceed four hundred, and any less number to be allowed thereon may be fixed by the President at his descretion. Retired officers of the Army may be assigned to duty at the Soldiers' Home, upon a selection by the commissioners of that institution, approved by the Secretary of War; and a retired officer is not assignable to any other duty. Any retired officer may, on his own application, be detailed to serve as professor in any college; but while so serving, such officer is allowed no additional compensation. Upon the application of any college, university, or institution of learning incorporated under the laws of any State within the United States, having capacity at the same time to educate not less than one hundred and fifty male students, the President may detail an officer of the Army on the Retired List to act as president, superintendent, or professor thereof; and such officer may receive from the institution to which he may be detailed the difference between his retired and full pay, but will not receive any additional pay or allowance from the United States.

When any officer has served forty-five years as a commissioned officer, or is sixty-four years old, he may be retired from active service at the discretion of the President. And all such are retired upon the actual rank held by them at the date of retirement; but are withdrawn from command and from the line of promotion, as are all officers on the Retired List. They are entitled to wear the uniform of the rank on which they may be retired. They continue to be borne on the Army Register, and are subject to the Rules and Articles of War, and to trial by General Court-Martial for any breach thereof. The pay of officers on the Retired List is ¾ of the pay of the rank upon which they are retired. When wholly retired from the service, they are entitled to receive, upon retirement, one year's pay and allowances of the highest rank held by them, whether by staff or regimental commission, at the time of their retirement.

RETIREMENT.—In the British Army, a Royal Warrant, introducing and regulating compulsory retirement from the army was issued in 1877. Voluntary retirement on half pay is allowed to officers after not less than 12 years' service. Officers below the rank of Major, who have served in their present rank for seven years without promotion, are to be placed on half-pay after a total service of 20 years; Majors after 27 years, and higher officers after varying periods. As to age, a Colonel, who has not retired on other grounds, must, unless special exception be made, retire at the age of 63 years, Lieutenant Colonel at 60 years, Major at 58 years, and officers of lower rank at 55 years—the pension varying according to circumstances. In 1878 there were 370 officers on retired full-pay, costing £132,000, and 1,578 on half-pay, costing £280,000; but these numbers include nearly all Staff Officers, and many on temporary half-pay on account of sickness, private affairs, etc.

In the United States service, Department Commanders, from time to time, report to the Adjutant General of the army the names of officers belonging to their Departments who are incapacitated for active service or command, with a view to their being brought before a Retiring Board. The reports in each separate case contain a specific statement of facts, and the names of witnesses to prove them. Habitual intemperance, gambling, low company, or other vices that tend to corrupt an officer and lower the professional standard, are causes sufficient to bring an officer before a Board, to be wholly retired. When ample testimony establishes the fact that an officer has, through vicious indulgences, slighted or neglected his ordinary duties to such a degree as to make it evidently unsafe to intrust him with a command or responsibility that rightfully belongs to his grade, and when it is shown that such habits have continued for such length of time as to make a permanent reformation improbable, this fact, rather than the present condition of the officer when he appears before the Board, weighs in the verdict as to his incapacity for active duty. Officers on the Retired List are amenable to the Rules and Articles of War, and subject to trial by Court-Martial for a violation thereof. It is made the duty of all officers of the army who may become cognizant of flagrant violations of military law by any retired officer to report the same to the Adjutant General of the army for the action of the General. See *Discharge*, *Pension*, *Retired List*, *Retiring Board*, and *Superannuation*.

RETIRING BOARD.—The Secretary of War, under the direction of the President, from time to time, assembles an Army Retiring Board, consisting of not more than nine nor less than five officers, two-fifths of whom are selected from the Medical Corps. The Board, excepting the officers selected from the Medical Corps, is composed, as far as may be, of seniors in rank to the officer whose disability is inquired of. The members of the Board are sworn in every case to discharge their duties honestly and impartially.

A Retiring Board may inquire into and determine the facts touching the nature and occasion of the disability of any officer who appears to be incapable of performing the duties of his office, and has such powers of a Court-Martial and of a Court of Inquiry as may be necessary for that purpose.

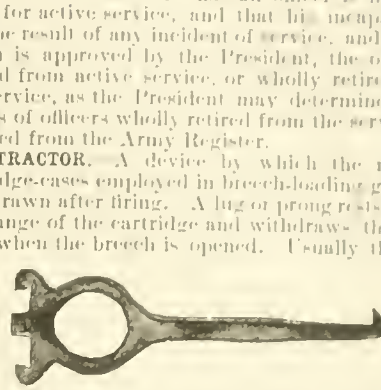
When the Board finds an officer incapacitated for active service, it finds and reports the cause which, in its judgment, has produced his incapacity, and whether such cause is an incident of service.

The proceedings and decision of the Board are transmitted to the Secretary of War, and are laid by him before the President for his approval or disapproval and orders in the case.

When a Retiring Board finds that an officer is incapacitated for active service, and that his incapacity is the result of an incident of service, and such decision is approved by the President, said officer is retired from active service and placed on the list of retired officers.

When the Board finds that an officer is incapacitated for active service, and that his incapacity is not the result of any incident of service, and its decision is approved by the President, the officer is retired from active service, or wholly retired from the service, as the President may determine. The names of officers wholly retired from the service are omitted from the Army Register.

RETRACTOR. A device by which the metallic cartridge-cases employed in breech-loading guns are withdrawn after firing. A lug or prong rests behind the flange of the cartridge and withdraws the spent shell when the breech is opened. Usually the posi-



tive movement of the notched extractor-plate loosens the shell from the bore, and after passing a certain point a spring comes into play, and gives a sudden impulse to the shell, which throws it clear of the fire-arm. The drawing represents the Bridgeport tool, worked by hand, which is quite effective, and avoids the possibility of failure to act.

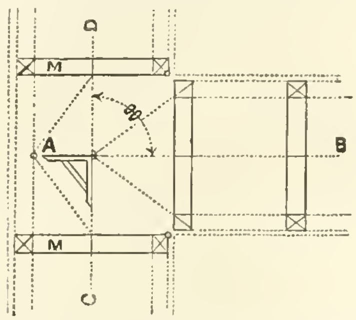
RETREAT. A retrograde movement of a force, with the intention of avoiding an encounter with a hostile body in the front. The greatest exertion of talent is requisite in a General to conduct an able retreat, more depending on arrangement and coolness than even in the preliminaries of a battle. When the enemy pursue, if the retreat is not to degenerate into a rout, the retreating army must be covered by a powerful rear-guard, which from time to time must hold the pursuers at bay, while the artillery-train and baggage pass defiles, cross streams, and overcome other special obstacles. A strong retreat is made when the rear is formed by a line of solid battalions, of which alternate masses retreat, while those intervening face about and oppose the enemy; the latter afterward retreating between and to the rear of those which retreated in the first instance. The retreat is thus continued by alternate halting and falling back on the part of each corps.

RETRENCHMENT. In fortification, a defensive work, comprising at least ditch and parapet within some other work of a fortress, and intended as a place of retreat for the defenders, whence they may prolong the defense, or capitulate after the faces of the work itself have fallen into the enemy's hands. The retrenchment bears a considerable resemblance to the *réduit* except that it is almost always of earth. Retrenchments are made in ravelins, and the re-entering *places d'armes* at the time of constructing those works. A retrenchment is thrown across the gorge of a redan or bastion, or from shoulder to shoulder, when it is apprehended that the salient angle will fall into the possession of the besiegers; these retrenchments are usually made when wanted. Such a retrenchment across the interior of the Redan at Sebastopol caused the sanguinary repulse of the British on Sept. 8, 1855.

RETURN GALLERY.—In fortification, a gallery which leads from another gallery. The line, C D, in the drawing, is the axis of a gallery of departure, and A B that of the return. The line A B is the interior line of the gallery frames; C D the interior line of the same; E F that of the sheeting. The corresponding lines for the remaining half of the gallery of departure, and those of the return, will be readily recognized. The frames M and M bound the entrances or *Landings* to the returns.

The frames M, M', of the landing, in the gallery of departure, are put so far apart that, were the return gallery all of one piece, it could be shoved in or out between them. The same idea also regulates the relative positions of the landing frames of the gallery of departure, and the return gallery in all other cases.

In oblique returns, where the angle between the axes of the two galleries is 45° or greater, the return is run directly from the main gallery. The first frame of the return being an oblique one, having its stanchions and sills cut with a suitable obliquity, so that, when the frame is placed along side of the main gallery, the outside of its stanchions will lie parallel to the axis of the return. The position of the land-



ing frames M, M′, is so determined that one of the exterior lines of the sheeting of the return will intersect the exterior edge of the stanchion of M at o, and the other the interior edgn of M′ at o′. When the angle between the axes is less than 45°, it would give too wide a landing in the gallery of departure to run the return directly from it. A short rectangular return must first be made to serve as a landing to the oblique return. To determine the position of the rectangular return, so that it shall be the shortest practicable, set off the lines of the gallery of departure and of the oblique return in the usual manner, draw a line parallel to the axis C D, and at the thickness of the gallery frame of the reetangular return from the exterior line of the sheeting; the point where this line cuts the exterior line of the sheeting of the oblique return, will be the position of the interior edge of the stanchion of the gallery frame of the rectangular return: having next drawn the lines of this return, the position of the other frame, will be at the point, where the outside line of the stanchions of the rectangular cuts the outside line of the sheeting of the oblique return. See *Gallery*.

RETURNS.—The official accounts, reports, or statements, rendered to Superior Officers. Commanders of Departments, Regiments, Corps, and Posts make to the Adjutant General's Office in Washington monthly *Returns* of their respective commands on the forms furnished, and according to the directions printed on them. In like manner Captains make monthly *Returns* of their companies to Regimental Headquarters. Regimental *Returns* are made in the name of the Colonel, and those of the company in the name of the Captain, whether those officers be present or absent. Monthly returns of Military Departments are sent direct to the Adjutant General of the Army and to Division Headquarters. Every Commander of a separate body of troops—either Division, Brigade, Regiment, or Detachment—whether engaged in campaign, field-service, or occupying a temporary camp, or simply in transit from one post to another, makes the monthly Returns required by the Regulations. Any detachment so far separated from the main body to which it belongs as to render it impracticable for the Commander of the main body to make the muster and inspection enjoined by Regulations, is a separate command within the meaning and for the purpose of the law. These Returns exhibit separately the several Regiments and Detachments, and Staff Corps, and the strength of each garrison within the command.

After any action or affair a Return of the killed, wounded, and missing is made, in which the name, rank, and regiment of each officer and soldier is specified, with such remarks and explanations as may be requisite for the Records of the Department of War to establish the just claims of any individual who may have been wounded, or of the heirs and representatives of any killed in action. The *nature of the wound*, the *time* and *place* of its occurrence, the Company, Regiment, or Corps, and the name of the Captain, Colonel, or other Commanding Officer, should always be carefully stated. A copy of this return is promptly forwarded *direct* to the Adjutant General of the army. After every battle, skirmish, or other engagement, Commanding Officers of Regiments, or detached portions thereof, forward direct to the Adjutant General of the army duplicates of the Returns, to be transmitted through intermediate Commanders, of killed, wounded, and missing A Return of all property captured is made by the Commanding Officer of the troops by whom such capture was made to the Adjutant General, at Washington, that the property may be disposed of according to the orders of the War Department.

REVEILLE.—The beat of the drum about break of day, to give notice that it is time fo rthe soldiers to rise, and for the sentinels to forbear challenging. The *reveille-gun* is fired just before the first note of reveille is sounded.

REVEIL MATIN.—An ancient French 96-pounder, double cannon.

REVERBERATORY FURNACE.—A furnace so constructed that matter may be heated in it without coming in direct contact with the fuel. It consists essentially of three parts, viz., a fire-place at one end; in the middle, a flat bed or sole, on which the material to be heated is placed; and at the other end a chimney to carry off the smoke or fume. Between the fire-place and the bed, a low partition-wall, called a fire-bridge, is placed, and the whole built over with a flat arch, dipping toward the chimney. The flame plays over the fire-bridge, and is reflected, or *reverberated*, on the material beneath; hence the name.

REVERONI SYSTEM OF FORTIFICATION.—The enceinte of this system consists of a bastion front casemated on a peculiar principle. The guns are placed on a "bascule," and are only exposed when actually firing. Their recoil lowers them and closes the embrasure. In rear is an earthen retrenchment, while earthen counterguards in front are defended by the casemated flank of a ravelin. The reduit of this work is also casemated.

REVERSE.—1. A change for the worse, or partial defeat. 2. A movement by which an artillery carriage is placed on the same ground, but facing in the opposite direction. To execute the *reverse*, the lead-driver, after gaining seven yards in that direction, moves his horses toward the left, so that the extreme part of the curve described by the off horse will be fourteen yards from the *line of departure* (or line occupied by the heads of the leaders at the beginning of the movement), and that, after passing three yards to the left of the original left flank of the team and carriage, they will return to the ground occupied by the carriage at the beginning of the movement. The swing-driver follows the lead-driver. The wheel-driver directs his horses so that the right limber-wheel describes a loop, which, extending seven yards to the right and eleven to the front of the line of departure, passes a little to the left of the original left flank and then returns, bringing the hind-wheels in such a position that the rear of the carriage occupies the line of departure. The pairs in front move according to their distances from the pole, and must keep out of the way of the wheelers, who control the carriage. On the completion of the reverse, the drivers move off their horses in the new direction. In reversing at a *trot*, or *gallop*, the loop is opened a little, and the gait moderated so as not to incur the risk of upsetting the carriage. *This rule is general.* If the carriage have but two pairs of horses, the lead-driver moves as above prescribed for the swing-driver; if but a single pair, the driver moves as prescribed for the wheel-driver. See *Countermarch*.

REVERSE ARMS.—That position in the Manual of Arms, executed as follows: The Instructor commands 1. *Reverse*, 2. ARMS. Raise the piece vertically with the right hand, while advancing it slightly; grasp it with the left hand at the lower band, the forearm horizontal; at the same time grasp the gun at the small of the stock with the right hand. (Two.) Reverse the piece, the muzzle dropping to the front, the butt passing between the breast and right forearm; the right hand grasping the small of the stock at the height of the shoulder, the barrel to the front and vertical; the fingers of the left hand extended, and joined in front of the barrel, the little finger at the lower band. (THREE.) Press the muzzle to the rear with the left hand, the piece inclined at an angle of forty-five degrees; steady it in this position by pressure of the right elbow against the body; carry the left hand behind the back and grasp the piece between the bands.

1. *Carry*, 2, ARMS. Let go the piece with the left hand, and regrasp it in front at the lower band, back of the hand to the left, the thumb pointing downward, the right forearm horizontal, the barrel vertical. (Two.) Reverse the piece with both hands, the butt passing between the breast and right forearm; quickly resume the carry with the right hand. (THREE.) Drop the left hand by the side.

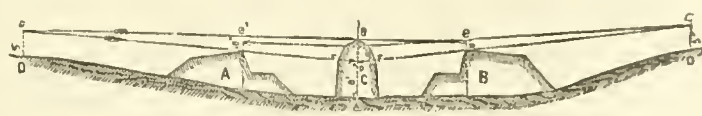
When necessary to march long distances with arms reversed, the piece may be changed to a corresponding position under the left arm by the commands: 1. *Left Reverse*, 2. ARMS. The piece is placed under the left arm with the right hand, the left hand carried to the small of the stock, and the right hand behind the back.

The piece is similarly restored by the commands: 1. *Reverse*, 2. ARMS. See *Manual of Arms*, Fig. 12.

REVERSED.—In Heraldry, the term applied to a charge turned upside down.

REVERSE DEFILEMENT.—When a work is placed in a hollow formed by two eminences, and is exposed to both a direct and reverse fire from them, it cannot be defiled by direct means, without giving it a relief generally too great for field works. To avoid this, the method of reverse defilement must be resorted to.

Suppose the work defiled, and a section be made by vertical planes passing through the highest points, O and O'. If in this plane a vertical A B, be drawn, corresponding to the capital of the work, and eight feet be set off on this vertical from the point, A, and two verticals be drawn through the points, O and O', and five feet be set off on each of them; and then the points C' and C, be joined with D, it is obvious that the interior crest of the parapet, A, being placed on the line, C D, will screen all the ground in the rear of it, as far as the capital, from the direct fire from O. The parapet, B, being regulated in a similar manner, will screen all the ground behind it as far as the same line. But the fire from O' would take the parapet A in reverse, and that from O the parapet B; to prevent this, a *traverse* must be erected on the line of the capital, and a sufficient height be given to it to screen both A and B from a reverse fire. To effect this, let eighteen inches be set off above the interior crests of A and B; the point, E, being joined with C', and the point E' with C; it is here also obvious, that if the top of the traverse be placed on the line C E', it will effectually screen both the parapets from all reverse fire; because every shot that strikes the top of it will pass at least eighteen inches above the two parapets, and, since the banquettes are four feet three inches below the interior crests, the shot must pass five feet nine inches above the banquettes which will be quite sufficient to clear the head of the men when on the banquettes. This illustration explains the spirit of the method of reverse defilement.



The traverse is finished on top like the roof of a house, with a slight pitch; its thickness at the top should seldom exceed ten feet, and will be regulated by the means the enemy can bring to the attack; its sides are made with the natural slope of the earth; but, when the height of the traverse is considerable, the base of the side slopes would occupy a large portion of the interior space: to remedy this, in some measure, the portion of the sides which are below the planes of direct defilement, may be made steeper than the natural slope; the earth being retained by a facing of sods, etc.

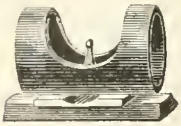
When the salient of the work is to be arranged for defense, the traverse cannot then be extended to the salient angle; it is however usual to change its direction within some yards of the salient, and unite it with the face most exposed. Traverses are also used to cover faces exposed to an enfilade fire; for this purpose they are placed perpendicular to the face to be covered. If several are required, they may be placed twenty or thirty yards apart; each traverse should be about twenty-four feet long, and thick enough to be cannon proof. As the traverses require a large quantity of earth, and much time and labor for their construction, their length should not be greater than is indispensably requisite to form a good screen. This may be determined by drawing lines from the dangerous points to the furthest point of the line to be screened; the one which intersects the line of the traverse furthest from the salient will give the best length of the required traverse. The lines drawn from O and O' to E and A, cut the line of traverse at A and C, thus requiring the traverse to be run back to *a* to cover each face and flank. The difficulty of defilement, owing to the great relief that may be required for the parapets, the labor of erecting the traverses and the room which they occupy within the work, which is frequently wanted for the defense, restricts its application mostly to enclosed works, which are to remain occupied during some time, and whose position, from some point to be defended, cannot be shifted.

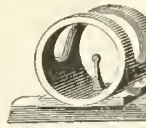
The case of defilement here examined is that of works open at the gorge; the same principles, and similar methods, would be applied to enclosed works. After the plan of the work has been regulated, the arrangement of the traverses next demands the attention: the only rule that can be laid down is, to place them in the most favorable position to intercept the reverse and enfilading fire of the enemy: and if there should be a choice with respect to several positions, to select the one which will give the lowest traverse. If it is not even probable that a commanding eminence will be occupied by the enemy, nevertheless should the defense be not impaired, it will be better to place the work beyond the cannon range of the eminence. See *Defilement*, and *Plane of Defilement*.

REVERSE FIRE.—In gunnery, when the shot strikes the interior slope of the parapet at an angle greater than 30°, it is called *reverse fire*.

REVERSE FLANK. The extremity of the division furthest from the pivot flank. See *Outward Flank*.

REVERSIBLE SIGHT. A front sight recently introduced by the Winchester Arms Company. The drawing shows the manner of its construction and use. By revolving the sight on its base, 90° horizontally, it changes in appearance from an open sight to a globe sight. It thus permits the marks-


As Open.


As Closed.

man to use either form of sight at will. It may be readily detached from the barrel and replaced by a sight of any other form.

REVETMENT.—The interior slopes of the parapets of permanent and field-works, as well as in some cases the sides of the ditches of the latter, require revetments to enable them to stand at that slope which is necessary, and to endure the action of the weather. The materials made use of in the construction of field-revetments are: fascines, gabions, hurdles, sod, sand-bags, and timber. In siege operations, and in fact in all operations in active warfare, vast quantities of these materials are required, and are daily consumed, in the construction of breastworks, parapets, batteries, magazines, and a variety of miscellaneous purposes. Large quantities, then, must be prepared or manufactured by the ordinary troops of the line, superintended by their own officers, who should be acquainted with all the details necessary for their production.

In permanent fortifications, the revetments are retaining walls of masonry built for the purpose of holding back the earth of which the works are composed. The most ordinary position of such revetments is for the escarp and counterscarp of the ditch. The more important of these two is the escarp, which has to hold back the great mass of earth represented by the rampart, parapet, banquette, etc. It is usually of solid brickwork or stone, 5 feet thick at the top, and sloping outward as it descends (on the ditch-side only) to the extent of 1 in 6. Prior to Vauban's time, the escarp revetment was commonly raised to the top of the parapet: but as in this case the artillery of a besieger played on the top of the wall, and ruined it soon after the siege commenced, that engineer adopted the principle—thenceforth followed —of raising it no higher than the crest of the glacis, or about 7 feet above the natural ground, leaving the parapet above of sloped earth only. When the main ditch is 24 feet deep, the scarp revetment will be about 30 feet high. Additional strength is imparted to the revetment wall by massive buttresses at every 15 feet called *counterforts*, and these, again, are sometimes connected and strengthened by masonry arches outside the revetment. The revetment forms a terrible barrier to an assaulting party. See *Fascine Revetment, Gabion Revetment, Hurdle Revetment, Pisa Revetment, Plank Revetment, Sand-bag Revetment, Scarp Revetment, Sod Revetment,* and *Timber Revetment.*

REVIEW.—In military parlance, a review is the inspection by some staff-officer of any body of troops in parade order. Reviews always comprise a march past the inspecting-officer in column, and a general salute in line; to these is frequently added a mock-battle, for the amusement of spectators, and the practicing of the troops themselves in warlike maneuvers. The following is the manner of reviewing a battalion of the United Sates Army:

Dismounted Troops.—The reviewing officer takes his post in front of the center of the battalion, the point being indicated by a marker or camp-color previously established by the Adjutant; the Adjutant also posts markers at the points where the column will have to change direction in order that the right flank, in passing, shall be at six or eight yards from the reviewing officer. The battalion being in line, bayonets fixed, the Colonel in front of and facing the center commands: 1. *Prepare for review*, 2. *Rear open order*. 3 MARCH. At the third command. the ranks are opened; and the Colonel superintends the alignment of the company officers and the front rank; the Leutenant Colonel the rear rank, and the Adjutant the line of file-closers. The Colonel, seeing the ranks aligned, returns to the right of the line of company officers, faces to the left, commands: FRONT, and, passing in front of the company officers to the center, places himself, facing to the front, six yards in front of the line of Field Officers, opposite the center of the battalion. The reviewing officer now approaches a few yards toward the Colonel and halts, when the Colonel faces about and commands: 1. *Present*, 2, ARMS. At the second command, the officers and men present arms; the color also salutes, should the rank of the reviewing officer entitle him to it, in which case the band, trumpeters, or field-music sound a march, flourishes, or ruffles, according to his rank; arms having been presented, the Colonel faces about and salutes. The reviewing officer acknowledges the salute by touching or raising his hat, after which the Colonel faces about and brings the battalion to carry arms. The Colonel then joins the reviewing officer, who proceeds to the right of the band, and, passing in front of the company officers to the left of the line, returns to the right, passing in rear of the file-closers.

While the reviewing officer is going around the battallion, the band plays, ceasing when he leaves the right of the band to return to his station; the Colonel returns to his post in front of the center, and commands: 1. *Close order*, 2. MARCH. At the command *march*, the company officers return to their places in line; the field, staff, and non-commissioned staff, remain in their places. The reviewing officer having taken his position, the Colonel commands: 1. *Companies right wheel*, 2. MARCH. At the second command, the battalion breaks into column of companies; the staff (excepting the Adjutant) place themselves in the order of rank from right to left, on a line equal to the front of the column, six yards in front of the leading Captain; the Lieutenant-colonel on a line with the leading company, the Major on a line with the rear company, the Adjutant on a line with the second company from the front, the Sergeant-major on a line with the second company from the rear, each six yards from the left flank of the column; the non-commissioned staff, excepting the Sergeant-major, place themselves, in the order of rank from right to left, on a line equal to the front of the column, six yards in rear of the file-closers of the rear company; the band wheels to the right and takes post twelve yards in front of the staff. The Colonel then commands: 1. *Pass in review*, 2. *Forward*, 3. *Guide right*, 4. MARCH. At the fourth command, the column steps off, the officers remaining in the positions above prescribed, the band playing; the column changes direction, without command from the Colonel, at the points indicated, the Colonel taking his place six yards in front of the staff immediately after the second change; the band having passed the reviewing officer, wheels to the left out of the column, and takes post in front of, and facing, the reviewing officer, where it remains till the rear of the column has passed, when it countermarches and returns to its place before the review, ceasing to play as the battalion approaches its original position. The Colonel and staff, except the Adjutant, salute together when the Colonel is at six yards from the reviewing officer, and return to the carry together when the Colonel has marched six yards behind him. The other officers, and the non-commissioned staff, salute and return to the carry at the points prescribed for the Colonel. In saluting, all officers turn the head, and look toward the reviewing officer. Non-commissioned officers in command of subdivisions salute as prescribed for a Sergeant. Staff and non-commissioned staff officers without swords do not salute.

If entitled to a salute from the color, the color salutes when at six yards from the reviewing officer, and is raised when six yards beyond him; as the colors salute, the trumpeters or field-music sound a march, flourishes, or ruffles, according to his rank, the band continuing to play. The reviewing officer acknowledges only the salute of the Colonel and the color. The Colonel having saluted, places himself on the right of the reviewing officer, where he remains till the rear of the battalion has passed, when he rejoins the battalion. The head of the column having executed a second change of direction to the left, after having passed the reviewing officer, the Colonel commands: *Guide left;* and when it arrives on the original ground wheels it into line to the left, opens the ranks as in the previous case, presents arms, and salutes; the salute being acknowledged by the reviewing officer, terminates the review. Should it be desirable to march past the reviewing officer again, and in double time, instead of changing the guide and forming line as above, the Colonel commands: 1. *Double time*, 2. MARCH; and, at the second change of direction, places himself at the head of the column. The band, previously notified, remains in its position opposite the reviewing officer, and plays in double time. In passing in review in double time, there is no saluting; the Colonel having passed the reviewing officer, places himself on his right, and the review is concluded as already explained. After the review, the Colonel causes the battalion to perform such maneuvers as the reviewing officer may direct. When desirable that a battalion should be reviewed before an Inspector junior in rank to the Commanding Officer, the Commanding Officer will receive the review, and will be accompanied by the Inspector.

Mounted Troops.—The reviewing officer takes his post in front of the center of the battalion, the point being clearly indicated by a guidon, previously established by the Adjutant; the Adjutant also posts principal guides at the points where the column will have to change direction in order that the right flank in passing, shall be at six or eight yards from the reviewing officer. The battalion being in line, the Major in front of and facing the center, commands: 1. *Prepare for Review*, 2. *Rear Open Order*, 3. MARCH. At the *third command, the battalion* takes open order as prescribed. The reviewing officer now approaches a few yards toward the major, and halts when the Major faces about and commands: 1. *Draw*, 2. SABER, 3. *Present*, 4. SABER. At the fourth command, the officers and men present saber; the standard also salutes, should the rank of the reviewing officer entitle him to it, in which case the band or trumpeters sound a march, or the flourishes, according to his rank: sabers having been presented, the Major faces about and salutes. The reviewing officer acknowledges the salute by touching or raising his hat, after which the Major faces about and commands: 1. *Carry*, 2. SABER. The Major then joins the reviewing officer, who proceeds to the right of the band, and, passing in front of the officers to the left of the line, returns to the right, passing in rear of the file-closers.

While the reviewing officer is going around the battalion, the band plays, ceasing when he leaves the right of the band to return to his station; the Major returns to his post in front of the center, and commands: 1. *Close order*, 2. MARCH. At the command *march*, the company officers return to their places in line; the field, staff, and non-commissioned staff, remain in their places. The reviewing officer having taken his position, the Major breaks the battalion into column of companies or platoons, right in front. At the command *march* for breaking into column, the staff (excepting the Adjutant) place themselves in the order of rank from right to left, on a line equal to the front of the column, six yards in front of the chief of the leading sub-division. The Field Officers, Adjutant, and the Sergeant-major, take post as prescribed in column; the non-commissioned staff, excepting the Sergeant major place themselves in the order of rank, from right to left, on a line equal to the front of the column, six yards in rear of the file closers of the rear subdivision; the band takes post fifteen yards in front of the staff. The Major then commands: 1. *Pass in review*, 2. *Forward*, 3. *Guide right*, 4. MARCH. At the third command, the field officers, Adjutant, and Sergeant-major, remain on the left flank of the column. At the fourth command, the column steps off, the band playing; the column changes direction, at the points indicated, without command from the Major, the major takes his place six yards in front of the staff immediately after the second change of direction; the band, having passed the reviewing officer, wheels to the left out of the column and takes post in front of and facing the reviewing officer, where it remains till the rear of the column has passed, when it returns to its place before the review, ceasing to play as the battalion approaches its original position. The Major and staff, except the Adjutant, salute together, when the major is at six yards from the reviewing officer, and return to the carry together when the Major has marched six yards beyond him. The other officers, and the non-commissioned staff, salute and return to the carry at the points prescribed for the major. In saluting, all officers turn the head, and look straight toward the reviewing officer. Non-commissioned officers in command of subdivisions, salute as prescribed in the School of the Soldier Dismounted. If entitled to a salute from the standard, the standard salutes when at six yards from the reviewing officer, and is raised when six yards beyond him; as the standard salutes, the trumpeters sound a march, or the flourishes, according to his rank, the band continuing to play. The reviewing officer acknowledges only the salute of the Major and of the standard. The Major, having saluted, places himself on the right of the reviewing officer, where he remains till the rear of the battalion has passed, when he rejoins the battalion. The head of the column having executed second change of direction to the left, after having passed the reviewing officer, the Major commands: *Guide left*; and when the battalion arrives on the original ground, the Major wheels it into line to the left, opens the ranks, presents saber, and salutes as before: the salute having been acknowledged by the reviewing officer, the review is ended. Instead of changing the guide and wheeling into line, the Major may command, 1. *Companies* (or *platoons*), 2. *Right forward*, 3. *Fours right*, 4. MARCH; and form the line, by wheeling by fours to the left.

Artillery.—The battalion being in line, its commander executes a left about and commands: 1. *Prepare for review*. At this command, each captain adds: 2. *Action*, 3. FRONT, 4. *Right*, 5. DRESS, 6. FRONT, 7. *Draw*, 8. SABER, which are executed as prescribed for the review of a battery. The Captains having taken their posts, the battalion Commander faces to the front. The reviewing officer now approaches the battalion Commander, and halts at thirty yards from him to receive the salute. The battalion Commander then faces toward the line and commands: 1. *Present*, 2. SABER. Sabers being presented, the battalion Commander executes a left about and salutes. The reviewing officer having acknowledged the salute, the battalion Commander faces toward the line and commands: 1. *Carry*, 2. SABER. He then joins the reviewing officer, who proceeds to the right of the trumpeters, and, passing in front of the officers to the left of the line, returns to the right, passing in rear of the Chiefs of caisson. The trumpets are sounded while the reviewing officer is going round the battalion, until he leaves the right to return to his station; the battalion commander returns to his post in front of the center and commands: 1. *Limber*, 2. FRONT, 3. *Platoons*, 4. *Right wheel*, 5. MARCH, 6. *Battalion*, 7. HALT. Executed in each battery; each Captain, at the command *halt*, causes his cannoneers to mount, and then places himself with the croup of his horse four yard sin front of the head of the horse of the chief of his leading platoon; the Adjutant and Sergeant-major place themselves fourteen yards from the left flank of the column, the former abreast of the leaders of the leading carriage of the column, the latter abreast of the leaders of the rear carriage of the column; the trumpeters take post, with the croups of the rear-rank horses fourteen yards in front of the head of the horse of the Captain of the leading battery. The battalion Commander then commands: 1. *Pass in review*, 2. *Forward*, 3 *Guide right*, 4. MARCH. At the third command, the Adjutant and Sergeant-major remain on the left flank of the column. At the command *march*, the column passes in review according to the principles prescribed for the review of a battery, except that each Captain remains at the head of his battery after saluting the reviewing officer; the battalion Commander, immediately after the second change of direction, places himself with the croup of his horse four yards in front of the head of the horse of the Captain of the leading battery, and, having passed the reviewing officer, places himself on his right, where he remains until the rear battery has passed, when he rejoins the battalion. The trumpeters begin to sound when at forty yards from the reviewing officer, and wheel out of the column as previously explained. The head of the column having executed a second change of direction to the left, after passing the reviewing officer, the battalion Commander commands: *Guide left;* and, when the battalion arrives on the original ground, he wheels it into line to the left, prepares it for review as before, presents saber, and salutes; the acknowledgment of the salute by the reviewing officer terminates the review.

The following general rules are observed for reviews of brigades and larger bodies of troops: All mounted officers remain mounted. A camp-color is planted to indicate the post of the reviewing officer while the troops are passing in review. Another camp-color is planted fifty yards from the first, to indicate the point where each battalion is brought to a carry before passing the reviewing officer. The staff of the reviewing officer is in single rank, six yards in his rear; the flag and orderlies place themselves three yards in rear of the staff. When other officers and personages accompany the reviewing officer, they place themselves on the left of the staff of the reviewing officer; their own staffs and orderlies place themselves in their rear. The trumpeters, or field-music, of each brigade, if there be no regimental bands, are consolidated on the right, in rear of the brigade band. Brigades are arranged in line from right to left according to the rank of brigade commanders, the senior on the right; if in three lines, the senior Commander is in front. Divisions are arranged in the same manner. When more than one brigade is to be reviewed, the staff-officers, after the reviewing officer passes along the front of each brigade, may remain near its left, while the reviewing officer goes to receive the salute from the next brigade; on his return they rejoin him and accompany him as before. The staff-officers in passing around the troops, ride in one or more ranks, according to the number. The troops pass in review in quick time. Before the head of the column approaches the post of the reviewing officer, he goes wherever he can best observe the movements of the troops. The Colonels repeat commands as prescribed in brigade revolutions. Whenever the General of brigade faces toward the line to give commands, the Colonels face about at the same time; they also resume their front at the same time with the general. While the troops are on the march, the Colonels cause the arms to be carried at a *right shoulder*, *support*, or *carry*. The arms of each battalion are brought to a *carry* when the leading company arrives at fifty yards from the reviewing officer. Generals of divisions and corps, and their staff-officers, draw their swords when they take their places in column before passing in review; the swords are returned immediately after placing themselves on the right of the reviewing officer. In reviews of divisions and corps, each battalion, after its rear has passed the reviewing officer thirty yards, takes the double time for one hundred yards in order not to interfere with the march of the column in rear. The troops having passed the reviewing officer, return to their camps by the most practicable route, being careful not to delay the march of the troops in their rear.

When reviewing a brigade in line, each Colonel takes his post, facing the front, thirty yards in front of the center of his battalion: the General takes post, facing to the front, thirty yards in advance of the line of Colonels, opposite the center, his staff takes post in single rank six yards in his rear, the orderlies three yards in rear of the staff. The line being formed, the General faces about and commands: 1. *Prepare for review*, 2. MARCH. At the first command, the Colonels add: *Rear open order*. At the command *march*, each battalion executes the movement as prescribed for the review of a battalion; the Colonel after commanding *front* returns to his post, thirty yards in front of the center of his battalion. The Colonels having resumed their posts, the General faces to the front. The ranks being open, the reviewing officer, accompanied by his staff, approaches the General, and halts at thirty yards in front of him to receive the salute. The General then faces to the left about and commands: 1. *Present*, 2. ARMS. The arms being presented, the General and Colonels face to the left about and salute. The reviewing officer having acknowledged the salute, the General faces about, and commands: 1. *Carry*, 2. ARMS, and resumes his front. The General and staff then return their swords, and join the reviewing officer, the General placing himself on his right, the staff place themselves on the right of the staff of the reviewing officer. The reviewing officer then goes to the right of the line, passes in rear of the line of Colonels to the left, and returns in rear of the file-closers to the right, whence he proceeds to his post, in front of the center of the brigade. While the reviewing officer is passing in front and in rear of each battalion, it stands at *carry arms*, the remainder of the time the Colonel causes it to stand at *parade rest*. The battalions are brought to the carry at the signal *attention* from the General given after the reviewing officer leaves the right of the line. While the reviewing officer is passing around the line, the brigade band plays. If there be regimental bands, instead of a brigade band, each plays while the reviewing officer is passing in front and in rear of its battalion. When the reviewing officer leaves the right of the line after passing around the troops, the General returns to his post and draws his sword; the staff draw their swords at the same time. The General then faces about and commands; 1. *Close order*, 2. MARCH. The reviewing officer having taken his post, the General commands: 1. *Companies* (or *divisions*) *right wheel*, 2. MARCH. At the second command each battalion forms in column of companies or divisions, in the order prescribed for review of a battalion, and each Colonel brings his battalion to *right shoulder arms*; the pioneers promptly place themselves twelve yards in front of the Colonel of the leading battalion, the brigade band twelve yards in front of the pioneers; the General is thirty yards in front of the band, his staff in single rank, six yards in his rear, his orderlies three yards in rear of the staff. The General then commands: 1. *Pass in review*. 2. *Forward*, 3. *Guide right*, 4. MARCH. The column passes in review according to the principles prescribed for the review of a battalion. The General having saluted, places himself on the right of the reviewing officer, his staff at the same time place themselves in single rank on the right of the staff of the reviewing officer, the orderlies place themselves in rear of the staff. The band wheels out of the column, places itself opposite the reviewing officer, and continues to play till the rear has passed, when it follows the rear battalion; the trumpeters, or field-music, sound the march, flourishes, or ruffles, as the color of each battalion salutes. If there be regimental bands, each wheels out of the column after passing the reviewing officer, and ceases to play as soon as the rear company of its battalion has passed. The band then marches on the flank of the battalion and places itself in its rear after the band of the battalion next in rear has wheeled out of the column. The rear of the column having passed the reviewing officer, the battalions, unless otherwise directed, return to their quarters, and the General and staff salute the reviewing officers. The salute being acknowledged, terminates the review.

When reviewing a brigade in line of masses, the General and staff face to the front. The reviewing officer having halted at thirty yards from the General, the latter faces about and commands: 1. *Present*, 2. ARMS. The salute being acknowledged, arms are carried; the reviewing officer then passes around the brigade as before, the battalions remaining at a *carry;* if there be regimental bands, but one plays while the reviewing officer is passing around the troops. The reviewing officer having taken his post, the General commands: 1. *Battalions*, 2. *Change direction by the left flank*, 3. MARCH, 4. *Guides*, 5. POSTS. The General then commands: 1. *Pass in review*, 2. *Forward*, 3. *Guide right*. 4. MARCH. At the third command, the Colonel of the first commands: 1. *Take wheeling distance*, 2. *Guide right*. At the command *march*, the leading battalion takes wheeling distance; the other battalions, by command of their Colonels, take wheeling distance in time to follow the battalion preceding in the order prescribed for review. If the General commands: 1. *In column of companies, pass in review*, each Colonel, as soon as his battalion has taken wheeling distance, commands: 1. *Right by companies*, 2. MARCH, 3. *Guide right*.

When reviewing a division in line, the brigades are formed in line as prescribed for the review of a brigade, with an interval of sixty yards between brigades. On the arrival of the reviewing officer, the Major General commanding the division causes his trumpeter to sound the *attention;* at this signal, repeated in each brigade, the brigade Commanders prepare the brigades for review, after which the Commanders of the center and left brigades bring them to *order arms* and *parade rest*. The reviewing officer and General of division then go to a point thirty yards in front of the General of the right brigade and halt, when the General of brigade commands: 1. *Present*, 2. ARMS. The salute being acknowledged by the reviewing officer, the General commands, 1. *Carry*, 2. ARMS. The reviewing officer accompanied by the General of division, then goes to the right of the right brigade, passes along its front to its left, and proceeds in front of the General of the center brigade to receive the salute. The General of the centre brigade causes the *attention* to be sounded when the reviewing officer approaches its right, and *presents arms* as before explained. Having received the salute, the reviewing officer goes to the right of the center brigade, passes along its front to the left, and then proceeds to a point thirty yards in front of the General of the left brigade, which brigade is presented as explained for the second. The General having passed along the front of the left brigade, returns to the right of the division, passing in rear of the line. The band of each brigade plays as the reviewing officer passes along the front of the brigade, and also while he is passing in its rear. If there be regimental bands instead of a brigade band, each plays while the reviewing officer is passing in front and rear of its battalion. When the reviewing officer passes the right of the division from the rear, the General of the division causes the *attention* to be sounded. At this signal the brigade Commanders close the ranks, wheel into column of companies or divisions to the right and command: 1. *Pass in review*, 2. *Forward*, 3. *Guide right*. The General of division orders the *forward* sounded, which being repeated, the division marches in review, conforming to the principles prescribed for the review of a brigade. When the column is formed the staff of the General of division, except the Adjutant General and Aides-de-camp, place themselves in single rank thirty yards in front of the General of the leading brigade, the division flag and orderlies in their rear. While the troops are approaching the reviewing officer, the General of division, and Generals of brigades, accompanied by their Adjutants General and Aides-de-camp, go where they can best observe the march, each placing himself in front of his staff, when the head of his column arrives at fifty yards from the reviewing officer. The General of division having saluted, places himself on the right of the reviewing officer; his flag, staff, and orderlies, at the same time promptly place themselves on the right of the staff and the orderlies of the reviewing officer.

Each brigade Commander having saluted, places himself on the right of the General of division; his staff, flag, and orderlies, at the same time arrange themselves on the right of the staff and orderlies of the division. The band of each brigade ceases to play as soon as the colors of the rear battalion have saluted the reviewing officer.

When reviewing a division of infantry in three lines, each brigade is in line, the distance between brigades being one hundred yards. The division is prepared for review at the signal *attention ;* the brigades are successively presented to the reviewing officer, as previously explained, except that the reviewing officer passes around each brigade, in front and rear, before proceeding to receive the salute of the brigade next in rear. Having passed around the rear brigade, the General of division causes the *attention* to be sounded. At this signal, which is repeated, each brigade commander closes ranks and wheels into column of companies or divisions to the right. The General of the leading brigade gives the commands for passing in review; the Generals of the center and rear brigades bring them to *order arms* and *parade rest* or *in place rest*. At the signal *forward*, repeated in the leading brigade, the brigade moves forward; the Generals of the other brigades give the commands for marching in review, causing them to change direction to the left, or half left, in time to follow at sixty yards in rear of the brigade preceding. The review is completed as previously explained.

When reviewing a division in line of masses, each brigade is formed as prescribed for review in line of masses. The arms are presented, and the reviewing officer passes around the brigades, as prescribed for the review of the division in line. Each brigade, while the reviewing officer is passing in its front and rear, stands at *carry arms*, the remainder of the time the General causes it to stand at *parade rest*. The reviewing officer having passed around the troops, the signal *attention* is given, at which the Generals of brigade cause their battalions to change direction by the left flank; the General of the leading brigade gives the commands for passing in review in column of companies or divisions; the Generals of the other brigades bring them to *order arms* and *parade rest* or *in place rest*. At the signal *forward*, repeated in the leading brigade, the brigade moves forward, the battalions executing the movement successively as explained in the review of a brigade in line of masses. The Generals of the center and rear brigades give the commands for marching in review in time to follow the brigade preceding at the distance of sixty yards. In passing around the division, the reviewing officer may pass between the different battalions from front to rear, and from rear to front.

A corps of infantry, in line of masses, or in three lines of masses with a distance of one hundred yards between divisions, is reviewed as follows: On the arrival of the reviewing officer, the General commanding the corps causes the *attention* to be sounded, which is repeated by the trumpeters of the Generals of division; each division is presented by brigade, as explained for the review of a divison in line of masses; the General of division, accompanied by his staff, joins the reviewing officer and corps commander, in front of his right brigade, and accompanies them to receive the salutes from the brigades, and while passing in front and in rear of his division; he then remains near the right of his division. The reviewing officer having passed around the troops, the General commanding the corps causes the *attention* to be sounded, which being repeated by the trumpeters of division and brigade commanders, each brigade is formed in column of masses to the right. The General commanding the corps then causes the *forward* to be sounded, which being repeated by the trumpeters of the first division, the first division executes the movement, as previously explained; the other divisions stand *in place rest*, the Generals causing the *forward* to be sounded in time to follow the divison preceding at a distance of one hundred yards. The troops may march in review in column of masses. If there be regimental bands only, the one at the head of each brigade wheels out of the column, when opposite the reviewing officer. While on the march and passing in review, but one band in each brigade plays at a time. On approaching the reviewing officer, the General commanding the corps places himself about fifty yards in front of the General of the first division; his staff place themselves in single rank six yards in his rear, the flag and orderlies three yards in rear of the staff. The General having saluted, places himself on the right of the reviewing officer: the staff, followed by the flag and orderlies, place themselves on the right of the staff and orderlies of the reviewing officer. The Generals of division, while their divisions are passing in review, place themselves on the right of the corps commander: each brigade commander, in like manner, places himself on the right of the division commander; their staffs, followed by their flags and orderlies, place themselves on the right of the staff and orderlies of corps or division commanders. When more than one corps is to be reviewed, the reviewing officer does not go to the front of each brigade commander to receive the salute. The Generals of brigade facing the line present arms and salute as the reviewing officer arrives opposite his right; he then causes arms to be carried and resumes his front. The march in review is conducted as explained for a corps. When troops of different arms are reviewed in line they are arranged from right to left in the following order: one, infantry; two, mounted artillery; third, cavalry. In the same arm, regulars, volunteers, and militia are posted in line from right to left in the order named.

REVISION.—A re-examination for any correction. Where an officer, who orders a Court-Martial, does not approve their proceedings, he may, by the custom of war, return them to the Court for *Revision*, and no additional evidence can be taken on such *Revision*.

When a record is returned to the Court for *Revision*, the subsequent proceedings thereon should be recorded as follows:

REVISION.

——— BARRACKS,

———, — ——,

——, 188 .

The Court reconvened with closed doors, pursuant to the following order, at ten o'clock A. M.:

(*Here insert copy of order.*)

PRESENT:

* * *

ABSENT.

* * * *

The communication from the Commanding General, Department of the ———, of date ———, 188 . or memorandum) containing the instructions to the Court, and the reasons of the reviewing authority for requiring a reconsideration of the findings (or sentence, or correction of the record), was then read to the Court by the Judge Advocate, and is attached to the record and marked "———."

The Court then maturely deliberated upon and considered the said communication, and the reasons set forth for revision; and, on motion, (*a.*) now revoke the foregoing findings, and having maturely considered the evidence adduced, find, etc., etc.; *or* (*b.*) now revoke the foregoing sentence, and do sentence, etc., etc., *or*, (*c.*) respectfully adheres to the foregoing findings and sentence, ———; *or*, (*d.*) corrects the record by, etc., etc.

——— ———,
Colonel, —— *U. S. Artillery*,
President.

——— ———,
1st Lieutenant —— *U. S. Artillery*,
Judge Advocate.

It is always proper for the Court, should it so desire, to give the reasons for adhering to its original findings and sentence.

No witnesses, not previously called, can legally be examined before a reconvened Court.

When, however, a Court has erred in its rulings in the rejection of a witness for supposed incompetency, or in rejecting offered documentary evidence, or in not permitting a proper and legal question to be put to a witness, or in refusing to summon a certain material witness asked for by the prisoner, and the reviewing authority has reconvened the Court for a reconsideration of its action, the Court may, should it concur in the views submitted, proceed to remedy such error by revoking its findings and *sentence*, and correct the record by permitting the introduction of the excluded testimony. Before the Court thus proceeds to correct the record, the prisoner and his counsel must resume their seats and the record so state. In consequence of receiving such excluded testimony, the other party may have to call witnesses in rebuttal, which is authorized. See *Courts-Martial*.

REVOLUTION.—Any extensive change in the Constitution of a country suddenly brought about. The two most important events in modern history known under this name are the English Revolution of the 17th century, and the French Revolution of the 18th. The former began in the early part of the reign of Charles I., with the struggle between that King and his Parliament. In 1642 the struggle became a civil war, in which the Parliament obtained the ascendency, and brought Charles to the block in 1649. A Republic followed, under the Protectorate of Oliver Cromwell, which was succeeded in 1660 by the restoration of Monarchy in the person of Charles II.; but the arbitrary rule of James II. brought the King and the people again into antagonism; and, James having fled the country, William III. was called to the throne under such conditions and safe-guards as secured the Balance of the Constitution. The French Revolution was a violent reaction against that Absolutism which had come in the course of time to supplant the old feudal institutions of the country. It began with an outbreak of insurrectionary movements at Paris in July, 1789, including the destruction of the Bastille. On January 21, 1793, King Louis XVI. was beheaded. The Christian religion was deposed, the sacredness of the republic and worship of reason solemnized, and a disastrous reign of blood and terror followed; which was brought to an end in 1794, when Robespierre himself suffered on the guillotine the fate to which he had condemned countless multitudes of his countrymen. Among other important revolutions in the modern world are the American Revolution of 1775, by which the United States threw off their dependence on Great Britain; the French Revolution of

1830, which drove Charles X. into exile, and raised Louis Philippe, Duke of Orleans to the throne by the will of the people; as also the Revolution of 1848, when France rose against Louis Philippe, and adopted for a time a republican form of government, the revolutionary contagion spreading temporarily over most of Continental Europe. By the Italian Revolution of 1859-60, the various minor Sovereigns of Italy were driven into exile, and the whole of the peninsula became, with the incorporation of the Roman Territories in 1870, subject to Victor Emmanuel. The following observations, in 1869, prior to the third French Republic, are pertinent.

The French Revolution is an event so extraordinary that it must needs be the starting-point in any series of considerations on the affairs of our own time. Nothing of importance happens in France that is not a direct consequence of this capital fact, which has thoroughly changed the whole condition of life in that country. Like all that is great, heroic, bold, like everything which exceeds the common measure of human strength, the French Revolution will continue to be for centuries the subject about which the world will talk, upon which they will divide, which will be the occasion of their friendships and their hatreds, which will furnish the subject of dramas and novels. In one sense, the French Revolution is the glory of France, the French epopee, par excellence; but, almost always, nations who have in their history an extraordinary event, expiate it by long suffering, and often by the loss of their national existence. It was thus with Judaea, with Greece, and with Italy. For having created things which are unique, by which the world lives and thrives, these countries have passed through centuries of humiliation and national death. National life is something limited, mediocre, confined. To do what is extraordinary, of universal interest, these narrow trammels must be rent asunder; but in rending them the nation itself is rent; for the nation is but an assemblage of prejudices and stationary ideas which mankind as a whole would refuse to accept. The nations which created religion, art, science, empire, the church, the papacy (all things universal and not national), were more than nations; but at the same time less than nations in the sense that they were the victims of their work. We think that the Revolution will have for France analogous consequences, but less durable, because the work of France was less great and universal than the work of Judæa, Greece, and Italy. The exact parallel of the present situation of that country seems to be that of Germany in the seventeenth century. In the sixteenth century, Germany accomplished for mankind a work of the first order—the Reformation. She expiated it in the seventeenth by an extreme political abasement. It is probable that the nineteenth century will in like manner be considered in the history of France as the expiation of the Revolution. Neither nations nor individuals can with impunity deviate from the middle course, of feasibility and practical good sense.

If the Revolution has given to France a poetic and romantic position of the first order, it is certain, on the other hand, that, in view merely of the requirements of ordinary statesmanship, it has led her into a strange path. The end which France sought to reach by the Revolution was that which all modern nations pursue: a frame of society just, honest, humane, guaranteeing the rights and the liberty of all with the least possible sacrifice of the rights and the liberty of each. France is to-day, after shedding rivers of blood, still very far from this end; while England, which has not proceeded by the way of revolutions, has almost reached it. France, in other words, offers the strange spectacle of a country tardily striving to come up with the nations she once scorned as laggards, and learning in the school of the peoples to whom she had claimed to give lessons,—painfully striving to accomplish by imitation the work in which she fancied she displayed a high degree of originality. The cause of this historic singularity is very simple. In spite of the extraordinary ardor which animated her, France, at the end of the eighteenth century, was very ignorant of the conditions upon which it is possible for a nation and mankind itself to exist. Her prodigious undertaking implied many errors; she utterly misunderstood the laws of modern liberty. Whether we regret it or rejoice at it, modern liberty is by no means the liberty of antiquity nor that of the republics of the Middle Ages. It is much more real, but much less brilliant. Thucydides and Machiavelli would not in the least understand it; and yet a subject of Queen Victoria is a thousand times more free than was ever any citizen of Sparta, of Athens, of Venice, or of Florence. No more of those feverish republican agitations full of grandeur and danger; no more of those cities filled with a refined, active, and aristocratic population; but in their stead, great inert masses, where intelligence is confined to the few, but which give a powerful help to civilization, in putting at the service of the State, by means of taxation and the conscription, a marvellous treasure of abnegation, docility, and goodwill. Of this form of social life, which is assuredly that which least consumes a nation and best preserves its strength, England has given us the model. England has arrived at the most liberal form of government which the world has yet known, solely by the development of the institutions she possessed in the Middle Ages, and not by revolutions. Liberty in England is not derived from Cromwell, nor from the republicans of 1649. It is the result of her entire history; it springs from her equal respect for the rights of the King, the rights of the nobility, the rights of the commons, and of corporations of every kind. France followed the opposite course. The King had long since made a clean sweep of the rights of nobles and commons,—the nation made a clean sweep of the rights of the King. She proceeded philosophically in a matter where she should have proceeded historically; she thought liberty was to be established by the sovereignty of the people and in the name of a central authority, whereas liberty is only to be won by successive petty, local conquests, by slow reforms. England, who does not pride herself upon any philosophy; England, who has never broken with her traditions, except in a single moment of temporary aberration, followed by a prompt repentance; England, who, instead of the absolute dogma of the sovereignty of the people, admits only the more moderate principle that there can be no government without the people nor against the people—England is to-day a thousand times freer than France, who once so proudly raised the philosophic banner of the rights of man. The truth is, that popular sovereignty is not the foundation of constitutional government. A State so established, after the French fashion, is too strong; while far from guaranteeing all liberties, it absorbs all of them; and its form is either the popular convention, or else despotism. The natural result of the Revolution could not, after all, have been anything very different from the Consulate and the Empire; the natural result of such a conception of society could not have been anything else than a system of administration, a net-work of prefects, a narrow civil code, a machine for squeezing the nation, a swaddling-band in which it was impossible for it to live and grow. Nothing is more unjust than the hatred with which the French radical school regard the work of Napoleon. The work of Napoleon, if we except some errors which were personal to that extraordinary man, is, in fine, nothing more than the revolutionary programme realized in its possible parts. Had Napoleon never existed, the final constitution of the Republic would not have differed essentially from the constitution of the year VIII. A very false idea, in many respects, of human society is in fact at the bottom of all French revolutionary attempts. The original error was at first hidden under the magnificent outburst of enthusiasm for liberty and the right which filled the first years of the Revolution; but this fine enthusiasm once spent, there remained a social theory which was dominant under the Directory, the Consulate, and the Empire, and marked its impress deep upon all the creative efforts of the time. According to this theory, which we may well qualify as materialism in politics, society has nothing of a sacred or religious character. It has only one end, which is, that the individuals composing it may enjoy the greatest possible sum of well-being, without concerning themselves about the ideal destiny of mankind. Why talk about elevating and ennobling the human conscience? The only question is how to satisfy the greatest number, to assure to all a sort of happiness, vulgar and relative only it must assuredly be, for a generous mind would disdain such happiness, and would revolt against the social system which aimed to secure it. In view of an enlightened philosophy, society is a great providential fact; it is established, not by man, but by nature itself, in order that intellectual and moral life may be developed on the surface of our planet. There is no such thing in political philosophy as man isolated from all companionship. Human society, the mother of every ideal, is the direct product of the supreme will, which has decreed that the good, the true, the beautiful, shall have their contemplators in the universe. This transcendent function of humanity is not performed by means of the simple coexistence of individuals. Society is a hierarchy. Every individual composing it is noble and sacred, every being (even the animal) has its rights; but all are not equal; all are members of a vast body, parts of an immense organism, which is accomplishing a divine work. The negation of this divine work is the error into which French democracy easily falls. Considering the only object of society to be the satisfaction of the individual, they are led to disregard the rights of ideas, the supremacy of mind. Not comprehending, moreover, the inequality of races, because ethnographical differences have in fact disappeared within her limits from time immemorial, France has learned to conceive of social perfection as a kind of universal mediocrity.

If man did not assume the right of making the animal kingdom subordinate to his needs, human life would become impossible. It would be scarcely more possible were we to hold to the abstract conception which makes us regard all men as bringing with them into the world equal rights to wealth and social rank. Such a state of things, though just in appearance, would be the end of all virtue; there would be, inevitably, war and hatred between the two sexes, since nature has created here, in the very heart of the human species, an undeniable difference in the part to be played by each. The well-to-do citizen thinks it right that, after destroying royalty and hereditary nobility, we should stop at hereditary wealth. The working man thinks it right that, having abolished hereditary wealth, we should stop at the inequality of the sexes, and even, if he be a person of some sense, at the inequality of strength and capacity. The most ardent utopian, having suppressed, in imagination, all inequality among men, still admits man's right to make use of animals according to his needs. And yet, it is no more just that one man should be born rich, than it is that another should be born with a social distinction; neither the one nor the other has earned his position by his own labor. Nobility, it is always argued, has its origin in merit; and as it is perfectly clear that merit is not hereditary, it is easy to show that hereditary nobility is an absurdity. The fallacy of this reasoning consists in the everlasting error of making the state the arbiter of a sort of distributive justice. The object of rank, regarded as an institution of public utility, was not to reward, but to stimulate merit; to render certain kinds of merit possible, and even easy. Had it no other effect than to show that justice is not to be looked for in the official constitution of society, it would not be altogether useless. The device "To the most worthy," rarely applies in politics.

The middle class is somewhat self deceived, therefore, in thinking to establish society on a just basis, by means of its system of competitive examinations, special schools, and regular promotion. A man of the people can easily demonstrate that a child born of poor parents is excluded from these competitions, and he will maintain that perfect justice will not be done until all are placed from their birth in identically the same conditions. In other words, if the notion of distributive justice for each individual be rigorously carried out, no organized society is possible. A nation which should follow out such a programme would condemn itself to incurable weakness. Suppressing the right of inheritance and thereby destroying the family, or leaving it optional, it would soon be got the better of, either by those portions of its own people who still adhered to the old order of things, or by foreign nations who still retained these ancient principles. The race which triumphs is always that in which the family and property are most strongly organized. Humanity is a mysterious ladder, a series of resulting forces proceeding one from the other. The many laborious generations of very hard working common people and peasants render possible the existence of a well-to-do and frugal middle class, which in its turn renders possible the man exempt from material labor, and devoted wholly to matters of universal interest. Each in his station is the guardian of traditional usages which are of importance to the progress of civilization. There is but one morality, there is but one knowledge, there is only one education. There is a single intellectual and moral whole, one glorious work of the human mind to which all, except the egoist, contribute, however small a part, and in which, in different degrees, all share. We ignore human nature unless we admit that whole classes of men must live by the glory and the enjoyments of others. The democrat regards as a dupe the peasant of the old regime, who works for his noble masters, loves them, and rejoices in the high estate maintained by others at the expense of his own toil. Doubtless all this is absurd, where life is narrow and confined, where everything is done within closed doors, as in our time. In the present state of society, the advantages that one man has over another have become things personal and exclusive: to enjoy the pleasure or the rank of another seems mere foolishness: but it has not always been so. When Gubbio or Assisi saw the wedding cavalcade of its young Lord file past, no one was jealous. Then all shared the life of all: the poor man enjoyed the wealth of the rich man, the monk the pleasures of the worldling, the worldling the prayers of the monk; for all, there was art, poetry, religion. Can the cold considerations of the economist supply the place of all this? Will any such considerations suffice to bridle the arrogance of a democracy confident in its strength, and which, not having been stopped by the fact of royalty, is very likely not to be stopped by the fact of property? Will there be voices eloquent enough to make youths of eighteen accept the reasoning of the aged, to persuade whole classes—young, ardent, believing in pleasure, and upon whom enjoyment has not yet palled—that it is not possible for all to enjoy, for all to be well-bred, delicate, virtuous even, in a refined sense, but that there must of necessity be learned, well-bred, refined, virtuous people of leisure, in whom and by whom the rest have their enjoyment and their taste of the ideal? Events will show. The superiority of the church, and the strength which still assures her a future, lies in the fact that she alone understands this, and makes others understand it. The church well knows that the best men are often the victims of the superiority of the so-called higher classes; but she knows also that nature has intended that human life should have many stages. She knows and she confesses that it is the ignorance of many that makes possible the education of one; that it is the toil of many that permits the noble life of a small number: but she does not call these privileged, nor those wronged, for the work mankind has to do is, in her eyes, one and indivisible. Abrogate this great law, assign to each individual the same rank, with equal rights, with no bound of subordination to a common task; you have egoism, mediocrity, isolation, hardness of heart, an impossibility of true living, something like the life of our day, the saddest life ever lived, even for the man of the people. Looking only at the rights of individuals, it is unjust that one man should be sacrificed to another man; but it is not unjust that all should be brought into subjection to the one great purpose which mankind is working out. It is for religion to explain these mysteries, and to offer in the ideal world superabundant consolations for all the sacrifices made here below.

This is what the Revolution, after it had lost the grand and sacred enthusiasm of its earlier days, did not sufficiently understand. The Revolution became finally irreligious and atheistic. The society men dreamed of in those sad days following the fever fit when they were striving to collect their scattered senses, was a sort of regiment composed of materialists, and in which discipline held the place of virtue. The wholly negative basis which the hard and unimaginative men of that day assigned to French society can only produce a surly and ill-mannered people: their code, the offspring of distrust, lays down as a first principle that the value of everything may be estimated in money, that is to say in pleasure. The whole moral theory of these so-called founders of our laws may be summed up in jealousy. Now jealousy is the foundation of equality, but not of liberty; putting man constantly on his guard against the encroachments of his neighbors, it renders courtesy between the several classes impossible. There can be no society without affection, without traditions, without respect, without mutual amenity. With its false notion of virtue which it confounds with the stern vindication of what each one regards as his right, the democratic school fails to see that a nation's great virtue consists in submitting to traditional inequalities. For this school the most virtuous race is not the race which practices self-sacrifice, devotion to duty, idealism in all its forms, but the most turbulent, that which makes the most revolutions. The most intelligent democrats are much surprised when they are told that there really are virtuous races still in the world—the Lithuanians, for example, the Ditmarschers, the Pomeranians—races that are still feudal, full of vigorous reserved strength, understanding duty like Kant, and for whom the word revolution has no meaning. The first result of this ill-natured and superficial philosophy, too soon substituted for that of the Montesquieus and the Turgots, was the suppression of royalty. To minds imbued with a materialistic philosophy, royalty necessarily seemed an anomaly. Very few persons, in 1792, understood that the continuance of good things requires to be guarded by institutions which are, if you please, a privilege for some but which are organs of national life, without which certain needs must necessarily suffer. These little fortresses, in which were deposited for safe-keeping treasures belonging to society, seemed feudal castles. All the time-honored subordinations of rank, all historic covenants, all symbols were repudiated. Royalty was the first of these covenants, a covenant dating back a thousand years, a symbol which the puerile philosophy of history, then in vogue, could not comprehend. No nation has ever created a legend more complete than that of this grand Capetian monarchy, a sort of religion, born at St. Denis, consecrated at Rheims by the assembly of bishops, having its rights, its liturgy, its holy ampulla, its oriflamme.

To every nationality there is a corresponding dynasty, in which are incarnated the genius and the interests of the nation; a national consciousness is never fixed and firm until it has contracted an indissoluble alliance with a family which binds itself by the contract to have no interest distinct from that of the nation. Never was this identification so perfect as between France and the house of Capet. It was more than a monarchy, it was a priesthood. Priest and King, like David, the King of France wears the cope and holds the sword. God enlightens him in his judgments. The King of England troubles himself little about justice—he defends his right against his Barons; and the Emperor of Germany cares still less—he is forevermore hunting among his Tyrolese mountains, the round world, meanwhile, rolling on as it may; but the King of France! he is just, surrounded by his valiant men and his solemn clerks, wielding his hand of justice, he is like Solomon. His coronation, imitated from that of the kings of Israel, was something so strange and unique. France had instituted an eighth sacrament, administered only at Rheims, the sacrament of royalty. The consecrated King performs miracles; he is invested with an "order"; he is an ecclesiastical personage of the first rank. To the Pope, who summons him to answer in the name of God, he replies, pointing to his sacred unction, "I, too, am of God." He allows himself unparalleled liberties with the successor of St. Peter: once he causes him to be buffeted and declared a heretic; at another time he threatens to have him burned alive; backed by his experienced doctors of the Sorbonne, he reprimands him, he deposes him. His most perfect type, notwithstanding, is a canonized saint, Saint Louis, so pure, so humble, so simple and so strong. He has his mystic adorers; the good Jean Darc makes no distinction between him and St. Michael or St. Catherine: this poor girl literally lived upon the religion of Rheims. Incomparable legend! sacred fable! And yet the vulgar knife designed for striking off the heads of criminals was lifted against it! The murder of the 21st of January, is, from the idealist's point of view, the most hideous act of materialism, the most shameful avowal of ingratitude and baseness, of ignoble meanness and forgetfulness of the past, that was ever made.

Do we mean to say that the old dynasty, whose very memory the newly-organized society sought to obliterate with that peculiar rancor which is only felt by the parvenu toward the great noble to whom he owes everything—do we mean to say that this ancient dynasty was not guilty of serious errors? Certainly it was, and if we were now writing a general philosophy of French history, we should show that the King, the nobles, the clergy, the parliaments, the cities, the universities of ancient France, had all of them failed in their duty, and that the revolutionists of 1793 merely set their seal to a series of faults, whose consequences still weigh heavily. Greatness must always be expiated. France had conceived of her monarchy as something unlimited. A King after the English fashion, a sort of stadtholder, paid and armed to defend the nation and maintain certain rights, was for her an absurdity. From the 13th century, the King of England, constantly at strife with his subjects, and hampered by charters, is to French poets an object of derision: he is not powerful enough. The French Monarchy was too sacred a thing; the anointed of the Lord is not to be controlled. Bossuet was logical in making the theory of the King of France square with the Holy Scriptures. Had the King of England possessed this tincture of mysticism, the barons and commons would not have succeeded in checkmating him. The French Monarchy, to produce that brilliant meteor, the reign of Louis XIV., absorbed all the powers of the nation. When once the State had been constituted into this powerful unity, under the hand of one man, it was inevitable that France should look upon herself as being what the great King had made her,—an all-powerful central authority, with liberties destroyed; and, regarding the King as a superfetation, should treat him like the mold which becomes useless when once the statue is cast. Thus Richelieu and Louis XIV. were the great revolutionists, the true founders of the Republic. The exact pendant to the colossal royalty of Louis XIV. is the Republic of 1793, with its frightful concentration of power, an unheard-of monster, the like of which had never been seen. Examples of republics are not rare in history; but these republics are cities, or small confederated states. A centralized republic of thirty millions of souls is absolutely without precedent. Given up for four or five years to the vacillations of drunken men, like a Great Eastern in danger of shipwreck, the enormous machine sank into its natural place, into the hands of a powerful despot, who, at first, with prodigious skill, succeeded in organizing the new movement, but who ended like all despots. Become insane with pride, he brought upon the country, which had put itself at his mercy, the most cruel humiliation that a nation can endure, and brought about the return of that dynasty which France had expelled with the most degrading insults.

The analogy of such a course of events with what took place in England in the seventeenth century is easily perceived. Every one was struck by it in 1830, when a national movement substituted for the legitimate branch of the Bourbons, a collateral branch more disposed to recognize the new needs. Louis Philippe must have seemed a William III., and it was natural to hope that the final result of so many convulsions would be the peaceable establishment of constitutional government in France. With this consoling thought, a sort of peace, a little quiet and oblivion of the past, stole over the poor, troubled French mind; there was a general amnesty, even for follies and crimes. It was a great mistake; a surprise, the most inconceivable known in history, was successful; a band of mad-caps whom a constable's staff should have sufficed to restrain, overturned a dynasty upon which the sensible part of the nation had based all their political faith and all their hopes. An hour's want of reflection on the one hand, and an hour of weakness on the other, sufficed to sweep away a theory conceived by the best minds, with, apparently, the most tempting chances of success. Why this singular disaster? Why did not what happened in England also happen in France? Why was not Louis Philippe a William III., the glorious founder of a new era in the history of the country? Will it be said that it was the fault of Louis Philippe? That would be unjust. Louis Philippe made mistakes; but then all governments must be permitted to make them. Whoever should undertake the conduct of human affairs on condition of being infallible and impeccable, would not reign a day. At all events, if Louis Philippe deserved to be dethroned, William III. deserved it much more. What Louis Philippe was chiefly reproached with—unpopularity, inability to make himself loved, a taste for personal power, indifference to external pomp, relapses toward the legitimist party to the detriment of the party which had made him King; attempts to re-establish the royal prerogative—might have been still more strongly urged against William III. Why, then, were the results so different? Doubtless it was owing to the difference of time and country. Events, historically important, make take place among a serious and heavy people, firm believers in hereditary right, and who have an invincible repugnance to driving their sovereign to extremities, which would be impossible at an epoch of intellectual levity and reasoning folly. Besides, the republican movement of 1649 was infinitely less deep than that of 1792. The English movement of 1649 did not go so far as to establish an imperial authority. Cromwell was no Napoleon. Finally, the English republican party had no second generation. Crushed under the restoration of the Stuarts, decimated by persecution or taking refuge in America, it ceased to have any considerable influence upon public affairs in England. In the eighteenth century, England seems to have made a business of expiating, by a sort of exaggerated loyalty and orthodoxy, her momentary lapses in the middle of the sixteenth. More than a hundred and fifty years had to pass away before the death of Charles I. ceased to weigh upon politics, and men could venture to think freely, without feeling obliged to affect an unbounded attachment to legitimacy. Things would have taken nearly the same course in France if the royalist reaction of 1796 and 1797 had carried the day. The Restoration would then have been accomplished much more frankly, and the Republic would have been in the history of France only what it is in that of England, an incident without consequences. Napoleon, by his genius, aided by the marvelous resources of France, saved the Revolution, gave it a form, an organization, an unprecedented military prestige. The weak and unintelligent restoration of 1814 could by no means uproot an idea which had been deeply seated in the national mind, and which had enlisted the sympathies of a whole, energetic generation. France, under the Restoration, and under Louis Philippe, continued to live on the memories of the Empire and the Republic. Whilst in England, from the date of the restoration of Charles II., and after 1688, the republic was the object of unceasing execration, and a man was ill-thought of in society who spoke of Charles I. without calling him the martyr King, or of Cromwell without adding the epithet usurper—in France it became the rule to write histories of the Revolution in a strain of apology and admiration. It was unfortunate that the father of the new King had taken a considerable part in the Revolution; people accustomed themselves to consider the new dynasty as a compromise with the Revolution, not as the heir by substitution of a lawful inheritance. A new republican party, rallying around a few old patriarchs, survivors of 1793, came into existence. This party, which had played an important part in July, 1830, but since then had failed to give prevalence to its absolute theoretical ideas, made incessant attacks upon the new government. The change in England, in 1688, was not in the least revolutionary, in the sense in which we understand the word: the change was not brought about by the people; it violated no right, unless it were that of the dethroned king. With the French, on the contrary, 1830 unchained the forces of anarchy, and deeply humiliated the legitimist party. That party, comprising, in many respects, the most solid and the most moral portions of the community, made cruel war upon the new dynasty, either by keeping altogether aloof from it, thus preventing its being settled upon the sole basis upon which a dynasty is founded—the solidly conservative element; or else by its connivance with the republican party. Thus the government of the house of Orleans failed to obtain a firm foundation; a breath overturned it. Everything had been pardoned to William III., nothing was pardoned to Louis Philippe. The monarchical principle was strong enough in England to undergo a transformation: it was not so in France. Certainly if the republican party had had in England, under William III., the importance which it had in France under Louis Philippe—if that party had had the support of the Stuart faction—the constitutional establishment of England would have been short-lived. Here England profited by the immense advantage she has in her aptitude for colonization. America was the waste-weir of the republican party; without that, this party would have remained as a virus in the mother country, and would have prevented the establishment of constitutional government. Nothing that is strong and sincere is lost in the world. These republican exiles were the fathers of the men who, in the latter part of the eighteenth century, carried on the War of Independence. The revolutionary element in England, instead of being a dissolvent, thus became creative; English radicalism, instead of tearing the mother country in pieces, produced America. If France had been a colonizing, instead of a military nation; if the bold and enterprising element, which in other countries furnishes colonists, were with the French capable of anything besides conspiracies and fighting for abstract principles we should have had no Napoleon: the republican party, expelled by the reaction, would have emigrated about the year 1798, and would have founded, far away, a new France, which, in accordance with the law of colonies, would now doubtless be an independent republic.

A gross error of historical philosophy contributed to warp the national judgment upon this grave question of the forms of government; it was this very example of America The republican school were forever citing this example as good and easy to follow. Nothing could be more superficial. That colonies accustomed to govern themselves in an independent fashion should break the ties which bind them to the mother country, and these ties broken, should dispense with royalty and provide for their common safety by a federative pact, there is nothing in this but what is natural. For a colony to sever itself from the throne in this way, as a cutting is severed from a tree, carrying its own germ of life with it, is in accordance with the immutable principles of colonization principles which are among the conditions of human progress, of that of the Aryan race in particular. Virginia and Carolina were republics before the war of independence. That war changed in no respect the internal constitution of the States; instead it only cut the cord, now grown irksome, which bound them to Europe, and substituted for it a federal union. Here was no revolutionary work. There was at the bottom of this great movement an eminently conservative conception of right, an aristocratic and law-abiding spirit of provincial liberty. In like manner, whenever the slight tie which binds Canada and Australia to England shall be broken, those countries, accustomed to govern themselves, will continue their independent existence almost without perceiving the change. If France had undertaken in earnest the colonization of Algeria, Algeria would have had a chance of becoming a republic sooner than France. Colonies, formed of persons who find themselves cramped in their native land, and who seek a greater liberty than they have at home, are always nearer a republic than the mother country, tied by her old habits and her ancient prejudices. Thus, there has continued to exist in France a party which does not permit the development of constitutional royalty, the radical republican party. The situation of France was very different from that of England; side by side with the Right, the Left, and the Center, there was an irreconcilable party, utterly refusing to accept the existing government; not saying to the government, "Do such a thing and we are with you;" but giving it to understand: "Whatever you do, we shall be against you." The republic is in a sense the final goal of every human society; but we can conceive of two very different methods of reaching it. To establish the republic with a high hand, by destroying every obstacle, is the dream of ardent minds. There is another way, less violent and more sure; to preserve the old royal families as precious monuments and souvenirs of the past, is not merely the foolish fancy of an antiquary; dynasties thus preserved become in certain critical moments extremely convenient wheels in the machinery of constitutional government. Will the countries which, like England, have followed this course, ever attain to the perfect republic, with no hereditary dynasty and with universal suffrage? As well ask if the hyperbola ever touches its asymptotes. What matters it, since it comes so near that the distance is inappreciable to the eye? This is what the French republican party does not understand. For the form of a republic it sacrifices the substance. Rather than follow a high road already laid out, with, to be sure, some windings, it prefers to plunge over precipices and through bogs. Rarely do we see so little political tact and so little discernment joined to so much honesty. The year 1848 laid bare the ulcer, and established to the satisfaction of every disciplined mind the fundamental principle of the philosophy of French history. The revolution of 1848 was not an effect without a cause (such an assertion would be absurd; it was an effect entirely out of proportion to its apparent cause. The shock was nothing, the ruin was immense. There happened in 1848 what would have happened in England, if William III. had been swept away by one of those fits of strong dissatisfaction which his government excited. In that case the history of England would have been turned upside down. In England, the people's attachment to legitimacy, and their dread of the republic, were sufficiently strong to enable the new dynasty to get over momentary difficulties. In France, on the other hand, the moral degeneracy of the nation, its want of faith in royalty, together with the very great energy of the republican party, sufficed to overturn a throne which had but a ruinous foundation. Then it was that the disastrous situation in which France has remained ever since the Revolution became apparent. If the Revolution and the Republic had taken root less deeply in France, the house of Orleans, and with it parliamentary government, would have been securely consolidated; had the republican idea been dominant, it would, after divers alternations of action and reaction, have carried the country, and the Republic would have been founded. Neither the one nor the other of these two suppositions were realized. The republican spirit was strong enough to prevent the permanent establishment of constitutional royalty; it was not strong enough to establish the Republic. Hence, a false and singular position, and one calculated to prepare the way for a melancholy downfall. What happened in 1848 might happen many times again; let us endeavor to discover the secret law, the hidden reason of this.

When we see a man die of a cold, we conclude, not that a cold is a mortal malady, but that the man was consumptive. The disease which occasioned the death of the government of July was in like manner so slight, that we must admit the patient's constitution to have been of the frailest. The slight agitation about the banquets was one of those which a government ought to be able to support, if it have any capacity of life in it. Why, with every appearance of health, was the government of July so feeble? It was because it had not that which gives to a government good lungs, a sound heart, and a healthy stomach; we mean the serious adherence of the influential portions of the community. The thoroughly humane feeling which restrained Louis Philippe from giving battle, while its indulgence implies a distrust of his own right, does not suffice to explain his fall. The republican party which effected the revolution was an imperceptible minority. In a country where the government was less centralized, and where opinions were less divided, the majority would have resisted: but the provinces had as yet no idea of opposing a movement emanating from Paris; besides, if the faction which took part in the movement of the 24th of February, 1848, was insignificant, the number of those who might have defended the vanquished dynasty was not great. The legitimist party were the victors, and without building barricades, had, on that day, their revenge. The Orleans dynasty, in spite of its thorough uprightness, and its rare honesty, had not known how to speak to the heart of the nation, nor to make itself loved. In presence of this revolution thus brought about by a turbulent minority, what was France to do? A country which has no unanimously accepted dynasty is always a little awkward and embarrassed in its movements. France yielded: she accepted the Republic insincerely, not believing in it, and fully decided to be false to it. The opportunity was not wanting. The vote of the 10th of December was a plain repudiation of the Republic. The party which made the revolution of February was subjected to the law of retaliation. If we may be allowed to use a vulgar expression, they had played France a very scurvy trick; France played them a scurvy trick in return. She was much like some honest citizen whom the most mischievious boys should lay hold of on any day of great riot, and should clap the red cap of liberty upon his head; and the worthy man would let them do as they pleased for the sake of peace, but would probably cherish some resentment. The surprise of the ballot responded to the surprise of the uprising. Assuredly, the conduct of France would have been more dignified and more loyal, if, on the announcement of the revolution, she had openly resisted, politely arrested the functionaries of the provisional government at the very outset, and convoked in all the departments some sort of general council which would have re-established the monarchy. But several reasons, too readily apparent to be in much need of explanation, rendered this course impossible at that time. Besides, a nation which has been granted universal suffrage always becomes somewhat given to dissembling. It has in its hands an all-powerful weapon, which renders civil wars needless. When we are sure that the enemy will be obliged to pass through a defile of which we are the masters, and where he will be forced to receive our fire without returning it, we do not go out of our way to attack him. France waited, and, in December, 1848, inflicted a disastrous repulse on the republican party. If February had proved that France was not much attached to the constitutional monarchy of the house of Orleans, the vote of the 10th of December proved that she cared no more for the Republic. The political weakness of this great country was shown in the strongest light. What shall we say of what happened afterward? We do not like *coups d'etat* any more than we do revolutions; we do not like revolutions, for the very reason that they always lead to *coups d'etat*. We cannot, however plausible it may appear, admit the fundamental pretension of the party of 1848. That party in the name of we know not what divine right, arrogates to itself a power which it accords to no other, claiming to have made itself so absolutely the master of France that the illegalities committed in order to break the fetters with which it had bound the country, ought to be considered as crimes, whilst its own revolution of February is only a glorious deed. This is inadmissible. *Quis, tulerit Gracchos de seditione querentes?* He who uses the sword shall perish by the sword. If the muskets aimed at M. Sauzet and the Duchess of Orleans, on the 24th of February, 1848, were innocent, the bayonets which invaded the chamber on the 2d of December, 1851, were not guilty. In our view, each of these acts of violence was a dagger-stroke aimed at the country—a wound reaching to the most vital parts of her constitution, one step further into a labyrinth that has no issue.

The Emperor Napoleon III., and the little group of men who shared his confidence, brought to the government of France a programme which, though not founded upon history, was not wanting in originality: namely, to revive the traditions of the Empire, turn to account its glorious legend, still so well preserved among the people, give voice to the popular sentiment on this subject by means of universal suffrage, obtain by this suffrage a delegation of powers binding on the future and establishing hereditary right, and, in accordance with a cherished idea of the French nation, call for a dynastic election; at home, the personal government of the Emperor, with a show of parliamentary government skillfully reduced to a nullity; abroad, a brilliant and active policy, restoring gradually to France by war and diplomacy, the place in the front among the nations of Europe, which she held sixty years ago, and which she lost in 1814. France, for seventeen years, has allowed this experiment to be tried, with a patience which might be called exemplary, if it were ever good for a nation to carry forbearance too far when her destinies are at stake. How has the experiment succeeded? What have been its results? Can it be said, in the first place, that the new Napoleonic house has been founded; that is to say, has it rallied around it those sentiments of affection and personal devotion which alone give strength to a dynasty? We must not deceive ourselves in this matter. Selfishness, scepticism, indifference toward its rulers, the persuasion that no gratitude is due to them, have totally withered the heart of the nation. The question has become one of self-interest. The wealth of the community having greatly increased, if the question were proposed in these terms: *revolution—no revolution*, the second proposition would obtain an immense majority; but often a country which has no desire for a revolution does all that is needed to produce one. At all events those sentiments of tender affection and fidelity with which the nation once regarded her kings, are no longer to be thought of. The persons having for the Napoleonic dynasty the same sentiments that a royalist of the Restoration had for the royal family, might easily be counted. There are almost no Napoleonic legitimists; this is a fact with which the government cannot be too deeply impressed. That part of the programme of the Emperor Napoleon III. which relates to the military glory and the preponderant position of France, was not without grandeur; and those who, looking to the general interests of civilization, are grateful to the Emperor for the war of the Crimea and that of Italy, cannot judge with severity the whole foreign policy of the second empire; but it is clear that France as a nation, is by no means in harmony with such views. If it were possible to submit it to the universal suffrage, the plebiscite, *no war*, would obtain a much greater majority even than *no revolution*. The France of to-day is, beyond all doubt, no more heroic than she is sentimental. The preponderance of one European nation over the rest has, moreover, become impossible in the present state of society. The threatening intentions imprudently expressed on the French side of the Rhine (and it is not the government which has been in this respect the most culpable, or the most wanting in tact) have kindled a feeling among the Germanic nations, which will subside the moment they shall be reassured with regard to the ambition they may have attributed to the French. From that moment, the influence of Prussia in the Germanic body will cease—an influence which has no other plea for its existence than the fear of France. From that moment, also, will probably cease the desire for political unity,—a desire so little in conformity with the Germanic spirit, and which has never been among the Germans anything but an impatiently tolerated defensive measure against a strongly organized neighbor. The change of this single point in the original plan of the Emperor Napoleon III. would suffice to modify everything connected with the internal government of the country. The Emperor Napoleon III., never even imagined that he could carry on the government without an elective chamber; he sincerely hoped that he might for a long time, if not permanently, control the elections. It was a scheme which could only be realized by the aid of constant wars and constant victories. Personal government can only be maintained on condition of being always and everywhere glorious and successful. How could it be expected.

unless the country were kept constantly dazzled by a marked prosperity, that it would go on forever casting into the ballot-box the vote which the administration put into its hand? It was inevitable that, one day or another, France would wish to use the powerful weapon that had been left in her hands, and that she should take a responsible part in her affairs. In politics, we cannot long play with appearances. It was to be expected that the semblance of parliamentary government which the Emperor Napoleon III. had always kept up, would become a serious reality. The elections of 1869 transferred this supposition into the domain of established facts. The elections of May and June, 1869, showed that the law of French society cannot be that of Roman Cæsarism. Roman Cæsarism was equally in the beginning a despotism, surrounded by republican fictions; the despotism destroyed the fictions: with France on the contrary, the representative fictions destroyed the despotism. This did not occur under the first empire, because the mode of electing the legislative body was then completely illusory. Nothing proves more clearly than the events of those months of 1869 how surely the ideal of government originated by England imposes itself, of necessity, upon every state. It is often said that France is not fitted for such a government. France has certainly shown that she thinks otherwise; at all events, if that were true, we should say there is no hope for France. A liberal form of government is an absolute necessity for every modern nation. Those which cannot accommodate themselves to it, will perish. In the first place, the liberal regime will give to the nations which have adopted it an immense superiority over those which cannot adapt themselves to it. A nation which is not qualified for liberty of the press, nor for the liberty of holding meetings, nor for political liberty, will certainly be surpassed and vanquished by the nations which are fit to be trusted with these liberties. These last will always be better uniformed, better taught, more thoughtful, better governed.

There is still another reason why, if France be condemned to the fatal alternative of anarchy, or despotism, her destruction is inevitable. There is no issue from anarchy except through a great military state, which, besides ruining and exhausting the nation, can only maintain its ascendancy on condition of being constantly victorious abroad. The rule of military restraint at home leads inevitably to foreign war. A vanquished and humiliated army cannot exercise that restraint energetically. Now, in the presente state of Europe, a nation which is systematically obliged to engage in foreign wars, is a nation lost. Such a nation will be constantly provoking against itself coalitions and invasions. This is why the unstable condition of the internal government of France was for her an external danger, and made her a warlike nation, notwithstanding that the general sentiment of her people is very pacific. The equilibrium of Europe requires that all the nations of the continent should have nearly the same political constitution. An *ebrius inter sobrios* cannot be allowed to disturb this harmony. Thus, from whatever point we set out, we arrive at this conclusion, that France must enter without delay upon the path of representative government. A preliminary question naturally suggests itself here: Will the Emperor resign himself to this change? Will he so far modify a programme which is for him, not a mere ambitious calculation, but a faith, an enthusiasm, the religious belief which explains his whole life? After having cherished, to the verge of fanaticism, an ideal which alone he holds to be noble and grand, but which France has rejected, will he not feel an invincible disgust for that government of peace, of economy, of small ministerial battles, which has always appeared to him the personification of decadence, and which is associated in his mind with the memory of a dynasty held by him in small esteem? Will he venture outside of that circle of second-rate counsellors and ministers in which he seems to take delight? Can a sovereign, invested by the popular vote with the plenitude of popular rights, be a parliamentary monarch? Is not the *plebiscite* a rejection of constitutional monarchy? Has such a government ever resulted from a *coup d'etat*? Can it coexist with universal suffrage? The respect due to the person of the sovereign prohibits the examination of these questions. Considerations of race and blood, which were formerly decisive in history, have lost much of their force. Substitutions which would have been impossible under the ancient may have become possible. Family characteristics, which were formerly inflexible, so that a Bourbon, for example, was only suited to play a particular part, are now susceptible of much modification. The historic *role* and the race are no longer inseparable things. That an heir of Napoleon I. should accomplish a work antagonistic to Napoleon I. is not a thing absolutely inadmissible. Public opinion has become so thoroughly the sovereign master that names and men are only what it makes them. The *a priori* objections raised by certain persons against the possibility of a constitutional future with the Bonaparte family are consequently not decisive. The Capet family, which became well and truly the representative of French nationality, and of the third estate (*tiers état*), was in the beginning ultra-Germanic, ultra-feudal. As architecture forms a style out of faults and the mistakes of inexperience, so a nation may, if it pleases, turn to advantage its own misdeeds. We enjoy the benefits of royalty, though royalty was established by a series of crimes; we profit by the results of the Revolution, though the Revolution was a tissue of atrocities. It is a sad law of human life that we become wise only when we are worn out. We have been too difficult to please, we have rejected excellence; we rest satisfied with mediocrity through fear of something worse. The coquette who has refused the most brilliant offers of marriage often ends by accepting the most commonplace. Those who have dreamed of a republic without republicans, please themselves in like manner with imagining a reign of the Bonaparte family without Bonapartists a condition of things in which that family, freed from the compromising companionship of those who enthusiastically prepared the way for its second accession, would find its best supporters, its safest counsellors, among those who have not helped to make it what it is, but have accepted it, as a thing desired by France, and as capable of opening some issue out of the strange perplexity into which fate has led. It is very true that there is no example of a constitutional dynasty resulting from a *coup d'etat*. The Viscontis, the Sforzas, tyrants born of republican discords, are not the stuff of which legitimate monarchies are made. Such monarchies are founded only by the peculiar sternness and hauteur of the Germanic race in barbarous and ignorant ages, when oblivion is possible, and when mankind lives in that mysterious darkness which is the foundation of respect. *Fata viam invenient*. . . . The strange defiance which France has shown to all the laws of history compels us to great reserve in such inductions. Let us go higher; and, neglecting whatever the accident of to-morrow may disconcert, let us inquire what reasons exist in the nation why one should have a constitutional monarchy, what grounds there are for hoping for its success, what fears may be entertained in regard to its permanent establishment.

We have seen that the peculiar feature of France, a feature which widely separates her from England and the other European states (Italy and Spain, up to a certain point excepted), is, that the republican party constitutes a considerable element of her population. This party, which was strong enough to overturn Louis Philippe, and to impose its theory on the country for a few months, was, after the 2d of December, the object of a sort of proscription. Has it consequently disappeared? No, indeed! The progress it has made in these last thirty years has been very perceptible. Not only has it kept possession of the majority in Paris and the large cities, but it has gained whole districts of country besides; the entire circuit of the environs of Paris now belongs to it. The democratic spirit, such as we know it in Paris, with its rigidity, its dogmatic tone, the deceptive simplicity of its ideas, its petty suspicions, its ingratitude, has conquered certain rural cantons in a surprising manner. In many a village the relations of farmers and farm servants are exactly those of workmen and employers in a manufacturing town; peasants will talk their surly, radical, jealous politics to you with as much assurance as the workmen of Belleville, or of the Faubourg Saint Antoine. The idea of equal rights for all, a way of considering the government as a mere public service which is paid for, and to which neither respect nor gratitude is due, a sort of American impertinence, the pretension to be as wise as the best statesmen, and to reduce politics to the mere consultation of the wishes of the majority—such is the spirit which gains ground more and more, even in the country. Will, however, the republican party ever succeed in becoming the majority, and in securing the triumph of American institutions in France? It is essential to that party to be always in the minority. If they were finally to effect a social revolution, they might create new classes, but these classes would become monarchical the moment they became wealthy. The most pressing interests of France, the character of her mind, her good qualities and her defects, make royalty a necessity to her. The very moment a radical party shall have overturned a monarchy, the journalists, the literary men, the artists, the men of intellect, the men of the world, the women, will conspire together to establish another; for the monarchy corresponds to the deeply-felt needs of the nation. Our amiability alone suffices to make us bad republicans. The charming exaggerations of the old French politeness, the courtesy which "places us at the feet" of those with whom we have intercourse, is the very opposite of that stiff, rough, dry manner which the ever-present consciousness of his rights gives to the democrat. France excels only in the exquisite; she loves only what is elegant; she can only be aristocratic. They are a race of gentlemen; their ideal has been created by gentlemen, not, like that of America, by honest citizens and serious men of business. People habituated to such things as these are only satisfied with a high-bred society, a court and princes of the blood. To hope that great and fine French works will continue to be produced in a democratic community (*dans un monde bourgeois*) where no inequality is admitted but that of wealth, is a delusion. The generous and imaginative people who expend the most fervor upon the republican utopia are the very persons who would be the least able to accommodate themselves to such a state of society. They who pursue so eagerly the American ideal forget that the American race has not a very brilliant past; that it has never had a nobility; that it is occupied exclusively in business and the pursuit of wealth. Our ideal can only be realized under a government shedding splendor upon all that approaches it, and creating distinctions outside of wealth. A society where a man's merit and his superiority over another can only be shown in industrial pursuits and in commerce, is antipathetic; not that industrial pursuits and commerce do not seem to us honorable, but because we see plainly that the best things (for example, the functions of priest, magistrate, scholar, artist, and man of letters) are the inverse of the commercial and industrial spirit; for the first duty of those who undertake these functions is not to seek to enrich themselves, and never to consider the commercial value of what they do. The republican party may therefore prevent the establishment of any liberal government whatsoever, for it will always have it in its power, by inciting seditions, to force any government to arm itself with repressive laws, to restrict the liberties of the people, and to strengthen the military element. Whether it be capable of establishing itself, is doubtful. The hatred between it and the peaceable portion of the community will continue to grow more and more envenomed, for more and more it will seem to the whole country to be a perpetual marplot. It will succeed, we fear, only in provoking a kind of periodical crisis, followed by violent expulsions, which the conservative party will maintain to be purifications, but will in truth be debilitations, and which will, in any case, wear upon the constitution of France in a deplorable manner. In these convulsive vomitings, excellent elements, essential to the life of a nation, will be thrown out, together with the impure elements. As it happened after 1848, liberal ideas will suffer from their inevitable association with a party which, being full of generous illusions, has great attractions for youthful imaginations, and which, besides, holds a great part of its programme in common with the liberal school. It is to be feared that long-standing habits of mind, a certain rigidity, a great deal of routine, and the custom of judging everything by the Parisian standard (a custom easy to be understood in a party which was at the outset essentially Parisian), will lead that party to believe that revolutions like those of 1830 and 1848 may be repeated. Nothing could be more fatal. The time for Parisian revolutions is over. We found this opinion less upon the material changes which have taken place in Paris, than upon two causes which, it seems to us, will have an enormous influence upon the destinies of the future.

One is the establishment of universal suffrage. A people in possession of this suffrage will allow no revolutions to be made by its capital. If a revolution should take place in Paris (a thing which is fortunately impossible), we are persuaded that the departments would not accept it; that barricades would rise across the railways to stay the spread of the conflagration, and to prevent provisions from reaching the capital; and that the disturbance at Paris, soon reduced to starvation, would be but short lived. The emancipation of the provinces has made great progress since 1848. Another fact, moreover, ought to be taken into great consideration. The whole philosophy of history is governed by the question of armament. Nothing has so much contributed to the triumph of the modern spirit as the invention of gun powder. Artillery has destroyed chivalry and feudalism, given strength to monarchs and to States, definitively checkmated barbarism, rendered impossible those strange cyclones of the Tartar hordes, which, gathering in the heart of Asia, came shaking Europe to its foundations, and terrifying the Christian world. The nice application of science to the art of war in our day will lead to revolutions almost as grave. War will become more and more a scientific and mechanical problem; the richest, the most scientific, the most ingenious nation will have the advantage. If we examine the effects of this change upon the internal affairs of States, it is clear that the application, on a large scale, of science to armaments will be to the sole profit of governments. The effect of artillery was to destroy, one after the other, all feudal castles; one discharge of some improved engine will stop a revolution. At epochs when arms are imperfect, a citizen is almost the equal of a soldier; but as soon as the aggressive process becomes a learned matter, requiring exact instruments and demanding a special education, the soldier has an immense superiority over the unarmed multitude. There is every reason, therefore, to believe that revolutions begun by citizens, will henceforth be crushed in the bud. The Jesuits, with their usual sagacity, understand this, as is seen by their getting possession of the avenues to the School of St. Cyr and to the Polytechnic School. They foresee the future of those who know how to handle dexterous weapons and disciplined forces, and they perceive, very clearly, that the advantage in this respect is with the old aristocracy, less absorbed than the citizen class by industrial pursuits, or by lucrative civil positions, and therefore more capable of abnegation. France, then, seems destined for a long time still to escape the republic, even if the republican party should have the numerical majority. There is in the nation a constantly increasing mass of people destitute of any religious ideal, and rejecting every social principle superior to the will of the individual. The remaining mass, not yet converted to these egotistical views, is daily diminished, by means of the primary school, and by the use of universal suffrage; but against this rising tide of aggressive ideas, which, being young and inexperienced, make no account of difficulties, higher interests and needs array themselves, and demand that society be organized and directed by a principle of reason and knowledge distinct from the will of the individual. The democrat ever imagines that the mind of the nation is clearly made up; he does not allow that there can possibly be anything in the least obscure, hesitating, or contradictory in public opinion; to count the votes and to do the will of the majority, seem to him very simple things: but these are delusions. For a long time to come, public opinion will have to be guessed at, foreseen, supposed, and, up to a certain point, guided. Hence, there are monarchical interests which, the moment a republic is established, become formidable, even in the opinion of those who have set up, or allowed others to set up, the republic. The movement which is going on in the popular classes, tending to give to each individual a more and more precise consciousness of his rights, is a fact so evident that it would be sheer madness to wish to oppose it. The true policy is to provide for it, and to accommodate ourselves to it. The men of science have never sought means to arrest the tide; they have done better; they have so well determined the laws of this phenomenon, that the navigator knows, from minute to minute, the state of the sea, and profits greatly by it. To prevent the rising tide from carrying away the necessary embankments, and causing, as it retires, fatal reactions, is the essential thing. Now, judging from appearances, this is just what will happen, so long as the French democracy shall be led by that acrimonious, quarrelsome, conceited Jacobism which agitates the country, sometimes, even, gives it an impulse, but will never guide it to a settled constitution. That party may make a revolution, but it will not reign more than two months afterward. Even if it should succeed in obtaining a majority of votes, which is not very probable, it would still establish nothing, for the elements at its disposal, though excellent for purposes of agitation, are unstable, easily disunited, and totally incapable of furnishing the solid materials of a construction. Its strength, though great, is partly a strength of circumstance. It has happened to us a dozen times, during an electoral campaign, to hear the following dialogue: "We are not satisfied with the government; it costs too much; it governs for the benefit of those who do not think as we do; we shall vote for the most radical opposition candidate." "Then you are revolutionists?" "Not at all; we only want to make an impression on the government; to force it to change its course; to hold it vigorously in check." "But if the chamber is composed of revolutionists, the government is upset." "No; there will only be twenty or thirty of them; and then the government is so strong! It has the chassepots!" This naive reasoning shows how much the radical party deceives itself when it imagines that the country desires it for its own sake. A great part of the country uses it as a rod with which to chastise the established authorities, not as a staff upon which to lean. "They elect us, therefore they like us," would be, on the part of the honorable members of the so-called advanced opposition, the most dangerous of conclusions. They are elected in order to give the government a lesson, and with the conviction that the government is strong enough to bear the lesson. But when this shall no longer be the case, when it shall be perceived that the existence of the government has been endangered, there will be a counter movement; so that the radical party is subject to this strange law, that its hour of victory is the beginning of its defeat. Its triumph is its end: often those who have voted for it, and urged it on, themselves applaud its proscription.

The maintenance of order has, in fact, become in European communities so imperious a condition, that long civil wars are impossible. The example is often quoted of those famous Greek and Italian republics which created an admirable civilization in the midst of a political state, very analogous to the Reign of Terror; but no conclusions can thence be drawn applicable to a society like ours, whose machinery is much more complicated. Spain, the Spanish republics of America, even Italy, can endure a greater degree of anarchy than France, because these are countries where life is easier, where there are fewer sources of wealth, where material interests and credit have been less developed. The Reign of Terror at the end of the last century was the suspension of life. In our day it would be still worse. As a being of simple structure can exist under many very different conditions, whilst animals finely organized, like man, have such restricted limits that slight changes in their habits produce death, so our complicated civilizations cannot support crises. They have, if we may say so, a delicate temperament; a degree, more or less, kills them. A week of anarchy would cause incalculable losses: at the end of a month, perhaps, the railway trains would cease running. We have created mechanisms of infinite precisions, tools and engines whose motive power is confidence, and which all presuppose a profound public tranquility, a government firmly established and at the same time thoroughly controlled. We know that in the United States matters are managed otherwise; there, a degree of disorder is endured, which would in France excite cries of alarm. This comes from the fact that the constitutional foundations of the United States are never really in danger. These little-governed American States resemble those European countries where the dynasty is not brought in question. They respect the law and the constitution, which to them represent the European doctrine of legitimacy. To compare countries like ours, having socialistic tendencies, and where so many people look to a revolution as to a means of improving their condition, with such States as these, completely exempt from socialism, and where men, wholly occupied with their private affairs, ask very little protection from the government, is the greatest mistake in philosophical history that can be committed.

The need of order felt by old European societies, coinciding with the improvements in arms, will, on the whole, give to the governments as much strength as they are daily losing through the progress of revolutionary ideas. Like religion, the cause of order will have its fanatics. Modern societies have this peculiarity, that they are extremely placable so long as their existence is not in danger, but become pitiless so soon as they begin to have doubts of their own stability. A community that has been frightened is like a man that has been frightened: it has lost something of its moral courage. The means employed by the Catholic Church in the 13th and in the 16th centuries, to defend its threatened existence, will be resorted to by modern society under more expeditious and less cruel, but not less terrible, forms. If the old dynasties be powerless here, or if, as is probable, they refuse to accept power under conditions unworthy of them, recourse will be had to the Italian *paciers* and *podestas* of the Middle Ages, to whom will be entrusted the entire business of reconstructing society in accordance with a bloody programme drawn up beforehand. Chance dictators, analogous to the Generals of Spanish America, will alone undertake such tasks. As, however, the European races have a fund of fidelity which they never part with, and as, moreover, there will remain for a long time to come survivors of the ancient dynasties, there will probably be a return to legitimacy after each of these cruel dictatorships. More than once again in the future, the traditional rulers will be entreated to resume their task, and to restore, at whatever cost, to the nations which of old made covenants with their ancestors, a little peace, good faith, and honor. Perhaps they will require much solicitation, and will make conditions about which there will be no dispute. In view of certain occurrences like those which have recently taken place in Greece, in Mexico, and in Spain, the democratic party sometimes says, with a smile, "There are no more kings to be found" A return of barbarians, that is to say, a new triumph of the least intelligent and least civilized portions of mankind over the more intelligent and more civilized, seems at the first glance impossible. Let us have a clear understanding upon this point. There still exists in the world a reservoir of barbaric forces, almost wholly under the control of Russia. So long as the civilized nations retain their powerful organization, the part which this barbarism has to play is reduced almost to nothing; but if (which Heaven forbid!) the leprosy of egoism and anarchy should cause the destruction of the Western States, barbarism would assuredly resume its proper function, which is to restore the manhood of corrupt civilizations; to bring about a vivifying return to instinct, when reflection has put an end to subordination; to show that the spirit which leads men to devote themselves freely to death, through fidelity to a chief (a thing which the democrat holds to be base and foolish), is that which makes a people strong, and gives them the earth for a possession. We must not, therefore, shut our eyes to the truth that the democratic theories, carried out to their furthest limit, would result in utter weakness. A nation which should follow this plan, repudiating all idea of glory, of social *eclat*, of individual superiority—having for its sole object the contentment of the materialistic desires of the masses—that is to say, aiming only to procure the satisfaction of the greatest number, would lay itself completely open to conquest, and endanger its very existence. How shall we prevent these sad results, which we have sought to point out as possibilities, and not as things distinctly feared? By the reactionary plan? By restraining, extinguishing, crushing, governing more and more? No, a thousand times no! That policy has been the origin of the whole evil; it would be the means of utter ruin. The liberal programme is at the same time the truly conservative plan. Beyond all doubt a constitutional monarchy, limited and controlled; decentralization; less government; an exceedingly strong organization of the commune, the canton, and the department; a strong impulse given to individual activity in art, intellect, science, trade, manufactures and colonization; a policy decidedly pacific; an abandonment of all projects of territorial aggrandizement in Europe; the development of a good system of primary instruction, and of a superior instruction, capable of giving to the morals of the educated class the basis of a sound philosophy; the formation of an upper legislative chamber, chosen by many various modes of election, and providing, together with the simple numerical representation of all the citizens, for the representation of divers interests, functions, specialties and aptitudes; in social questions, government neutrality; entire liberty of association; gradual separation of church and state, an all-important condition in the opinion of the religious world;—such is the dream of those who seek by the aid of calm reflection, unblinded by an intemperate patriotism, a practicable pathway. In some respects, this is a policy of penitence, implying the confession that, for the moment, it concerns us less to continue the Revolution than to correct it. It often seems that France is passing through a period of fasting, a sort of political regimen, during which the attitude which best becomes Frenchmen is that of the sensible man who is expiating the errors of his youth; or rather that of the mistaken traveller, finally obliged to take the long way round the hill he had at first attempted to scale. Revolutions, like civil wars, are strengthening, if we come out of them; they kill if they last.

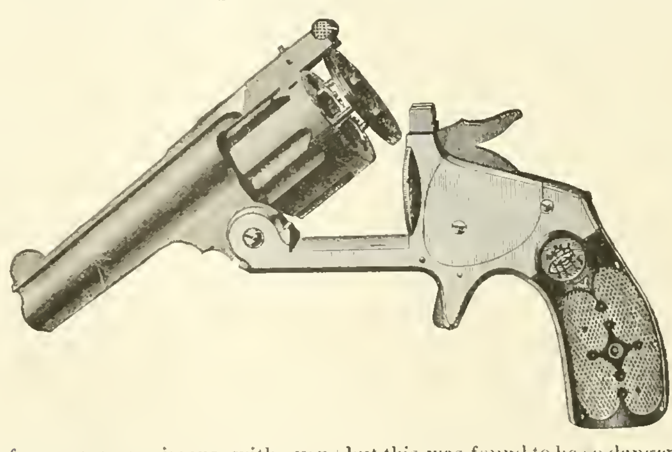
In general, the mistake of the French liberal party is in not understanding that every political construction should have a conservative basis. In England parliamentary government was not possible until after the exclusion of the radical party, an exclusion which was effected with a sort of frenzy of legitimacy. Nothing is assured in politics until the heavy and solid parts of the nation, which are its ballast, have been enlisted in the cause of progress. The liberal party of 1830 were too ready to believe they could carry their purpose by main force, in direct opposition to the legitimists. The estrangement or the hostility of the latter party is still the great misfortune of France. Withdrawn from common life, the legitimate aristocracy refuses to society what it justly owes—patronage, examples and lessons of noble living, of grave and dignified manners. The vulgarity, the total want of education, the great ignorance of the art of living, the ennui, the absence of respect, and the puerile parsimony of provincial life, which prevail in France, are all owing to the fact that those who ought to furnish the country with the type of the gentleman, fulfilling public duties with universally recognized authority, fly from society, and more and more give themselves up to a solitary and retired life. The legitimist party is in one sense the indispensable substructure of every political foundation amongst the French; even the United States have, after their manner, this essential basis of all society, in their religious souvenirs, heroic in their way, and in that class of moral, high-toned, grave, and weighty citizens who are the stonds with which the edifice of the State is built. The rest is but sand; nothing durable is made of it, whatever talent, whatever warmth of heart, even, is brought to the work. This provincial party which is day by day becoming conscious of its strength, what does it think? what does it wish? Never were views more clearly defined. This party is liberal, not revolutionary; constitutional, not republican; it wishes the control of authority, not its destruction; the end of personal government, not the overthrow of the dynasty. We do not doubt that if, in time past, the government had taken a positive stand, had given up the system of official candidates, the artificial subdivision of districts (*circonscriptions*), and allowed the elections to be made spontaneously by the nation, the result would have been to return a chamber decidedly imbued with these principles, and which, being considered by the nation as representing its wishes, would have had sufficient strength to get safely over the most difficult crises. The day will inevitably come when it will be as hard to understand why the Emperor Napoleon III. did not seize this means of obtaining from the country a second signature to his marriage contract with the state, and of dividing with the nation the responsibility of a doubtful future, as it is to comprehend why Louis Philippe did not see in the co-operation of men of capacity a means of enlarging the bases of his dynasty. The provinces, in fact, take the elections much more seriously than Paris. Having no political life except once in every six years, they give to the elections an importance which Paris, with her habitual levity, does not accord to them. Paris, only intent on making her radical protest, sees in the elections, not a choice of grave delegates, but an opportunity for ironical manifestations. The provinces do not understand such finessing; their deputies are really their representatives, and they firmly adhere to them. A chamber freely elected without interference from the administration, would it have been dangerous for the dynasty? Would the radical opposition have been represented in it by an increased number of deputies? We think just the contrary. In a great number of cases the election of hostile, or even abusive candidates, has been a sort of protest against the official or obsequious candidate. The system of official candidates completely disturbs the working of elections and impairs their trustworthiness, not only by the direct pressure exerted by the administration in favor of its own candidates, but especially by the false position in which it places the independent voter. The aim of the latter is, in general, no longer to surely choose the candidate who best represents his various opinions, or whom he thinks the most capable of serving the country, but to set well aside, at whatever cost, the official candidate. Consequently, no more shades of opinion, no more personal preferences. Since extreme opinions find an assured favor with the mass, with whom bold assertions and noisy declamation have greater force than more moderate views; and as the democratic party has also the control of a genuine fanaticism, and an organization which no other party has the liberals fall in with the current, and adopt, in spite of their repugnance, the radical candidate. It is a very wide-spread error in France, to think that we must ask more to obtain less; and that the radical opposition is the instrument of progress, the impelling force of the government. This is true of the moderate opposition, but not of the radical party, which is an obstacle to progress, an impediment to concessions, owing to the terror it inspires and the repressive measures it occasions. Now, more than ever, the aim of politics should be, not to solve questions, but to leave them to time. The life of nations, like that of individuals, is a compromise between contradictions. Of how many things we must say, that we cannot live with them or without them, and yet we still live! Prince Napoleon wittily said, a few years since, to those who would postpone the enjoyment of liberty till there are no longer in France either rival dynasties or a revolutionary party: "You will wait a long time." History will not blame the policy of those who, in such a state of things, shall resign themselves to live by expedients. Suppose that a member of the elder or of the younger branch of the Bourbon family should one day reign in France, it will not be because a majority of the French nation have become legitimists or Orleanists, but because a turn in fortune's wheel has made some member of the house of Bourbon the useful man of the moment.

France has allowed her dynastic attachments so completely to die out, that even legitimacy could only be restored by accident, and with a transitory title. The positivism to-day has so done away with all metaphysics, that one of the narrowest of ideas is gaining credence; namely, that the more recent a popular vote is, the greater its force; so that, after the lapse of some fifteen years, this strange kind of reasoning is held: "The generation which voted such a plebiscite has in part died; the vote has lost its validity, and needs to be renewed." This is contrary to the idea of the Middle Ages, according to which, the older an agreement the more binding it was. It is in one sense the negation of the national principle; for the national principle, like religion, supposes compacts independent of the will of the individual, compacts transmitted and received from father to son as a heritage. By refusing to the nation the power to bind the future, all contracts are reduced to life, or rather, we should say, to time contracts; the more ardent republicans would, we think, like them even to be annual, at least until they get what they call direct government, when the national will would be no more than the caprice of an hour. With such political notions, what becomes of the integrity of the nation? How deny the right to the succession when all is made to depend upon the material fact of the momentary will of the citizens? The truth is, that a nation is something different from the collection of units of which it is composed; that it cannot be in any measure dependent upon a mere vote; that it is, in its way, an idea, an abstract thing, superior to the will of individuals. Nor can the art of governing be reduced to a simple consultation of universal suffrage, that is to say, to the ascertaining and executing what the greater number considers to be for its interest. This materialistic conception contains at bottom an appeal to strife. In proclaiming itself the *ultima ratio*, universal suffrage starts from the idea that a majority in numbers is an indication of strength, and that if the minority does not give way to the views of the majority, they will run every risk of being beaten. But this reasoning is not exact, for the minority may be more energetic and better versed in the management of arms than the majority. "We are twenty, you are one," says universal suffrage; "yield, or we will force you to it!" "You are twenty, but I am in the right; and, though but one, I can force you to yield," will reply the armed man. *Fata viam invenient!* Happy he who, like Boethius, can, amid the ruins of a world, write his *Consolation of Philosophy*. The future of France is a mystery which baffles all sagacity. Other countries, indeed, are occupied with grave problems: England, with a calm which we cannot sufficiently admire, is solving bold questions which with us are thought to be the exclusive province of utopianism; but the discussion is everywhere circumscribed everywhere there are closed lists, laws of combat, heralds and judges. In France, the constitution itself, the form and even to a certain extent the very existence of society, are continually at stake. Can any country bear up under such a state of things? We are reassured by the reflection that a great nation is, like the human body, a machine most admirably constructed, carefully weighted and balanced; also that it creates for itself the organs it needs; and that, if it has lost them, it supplies itself with new ones. It may be, that in our revolutionary ardor we have carried amputation too far; that, thinking only to drive away diseased superfluities, we have touched some organ essential to life, so that the patient's obstinacy in not recovering may arise from some lesion we have made in his vital parts. This is a reason for being more cautious in future, and for allowing the patient, robust after all, though dangerously ill, to heal his internal wounds, and return to the normal conditions of life. But let us make haste to admit that faults as brilliant as those of France have their redeeming side. France has not lost the scepter of intellect, of taste, of refined art, of atticism; for a long time to come she will still engage the attention of the civilized world, and will be to the public of Europe the subject of bets and wagers. The affairs of France are of such a nature that foreigners become interested in them and quarrel about them, as much and often more than they do with regard to the affairs of their own countries. The most troublesome thing about her political condition is the element of the unforeseen; but the unforeseen has two aspects; by the side of the bad chances are the good ones, and we should be by no means surprised if, after a series of sad misfortunes, France were to enjoy years of singular splendor. If, weary at last of astonishing the world, she would make up her mind to a sort of political appeasement, what an ample and glorious compensation she might find in the paths of private enterprise. How she might rival England in the peaceful conquest of the globe, and in the subjection of all inferior races to the sway of her civilization! France is very capable of everything except mediocrity. Wharever she suffers, she suffers it, after all, for having attempted too great impossibilities. Whatever misfortune the future may reserve for her, and were her fate one day to excite the pity of the world, the world will not forget that she tried bold experiments by which all profit; that she loved justice to the verge of folly; and that her crime, if of crime she be guilty, was to have believed, with a generous imprudence, in an ideal incompatible with human infirmities.

REVOLUTIONARY TRIBUNAL.—The name specially given to the infamous Court of Judgment—the most extreme republican will scarcely affirm that it was a Court of Justice—instituted by the French Convention in March, 1793, on a motion made by Danton, who considered that such a Court had become necessary, inasmuch as the recent disasters that had befallen the national armies on the frontiers had led to dangerous conspiracies against the Revolutionary Government. Its members were chosen from the various Departments, and their appointment was ratified by the Convention. Their function was to sit in judgment on all persons accused of crimes against the State, and from their sentence, delivered with appalling promptitude, there was no appeal. During the "Reign of Terror," when Fouquier-Tinville was "Public Accuser," it acquired a horrible notoriety, abolishing soon almost all forms of justice, neither hearing witnesses on behalf of the accused, nor allowing him an opportunity of defense, but blindly executing the orders of the "Committee of Public Safety," which was merely a tool in the hands of Robespierre. In the Provinces, similar Tribunals, under the name of "Revolutionary Committees," were established, the Commissaries General of which, as, for instance, Carrier, shot or drowned *Suspects* in crowds.

REVOLVER.—A weapon which, by means of a revolving breech or revolving barrels, can be made to fire more than once without reloading. The invention is very far from new, specimens, with even the present system of rotation, being still in existence, which were manufactured at the beginning of the 17th century. Probably the first revolver to suggest itself was one in which several barrels were mounted on an axis, and made to revolve by the action of the trigger, so that their powder-pans came successively under the action of the lock. This principle was never entirely abandoned, and in the reign of George IV. was produced a pistol called the "Mariette," which had from four to twenty-four small barrels bored in a solid mass of metal, made to revolve as the trigger was drawn back. At close quarters, such a pistol would doubtless have been useful; but its great weight and cumbrous mechanism rendered aim extremely unsteady. Contemporaneously from the first with the revolving barrels, went forth the formation of a revolving chamber or breech, pierced with several cylindrical apertures to receive the charges. Being made to revolve, each motion brought a chamber into line with the one barrel, common to all, whereupon the weapon was ready for use. Numerous patents for this principle have been taken out, including one by the celebrated Marquis of Worcester in 1661. Various improvements were made, especially in the mode of causing revolution, an American, by the name of Elisha H. Collier, patenting such a weapon in the United States and England about 1818. In 1835 Colonel Samuel Colt brought to a conclusion experiments of some years' standing, and patented his world-renowned Colt's revolver, which was a great advance on all previous attempts, and is substantially still in use. Colt's revolver consists of one rifled barrel of considerable strength, and a massive chamber perforated with six or seven barrels, which are brought into a line with the barrel by action of the trigger. Each chamber has its nipple for a cap, which is brought under the hammer by the motion which brings the chamber or breech-piece round. In the most recent form of this revolver, the capped nipple disappears, the cap being contained within the cartridge. The hammer is discharged by the trigger, and acts nearly horizontally in a forward direction. Under the pistol is a fixed lever-ramrod, which is used in loading the chambers. Besides all this, by withdrawing a bolt, which can be done in a moment, the entire breech-piece can be taken out, and replaced by another ready charged, so that by carrying a spare breech-piece, a person may fire twelve shots in less time than another could fire three if he had to load between the shots. Colt's revolvers are now extensively used in the naval and military services of America and Europe.

The principal rivals of Colt's revolver have been the Deane and Adams, and Smith and Wesson revolvers, although many more of various sorts have been patented in the interval. The Deane differed in that it could be fired by merely pulling the trigger without also raising the hammer with the finger, as in Colt's; but this was found to be so dangerous in practice that the inventors soon substituted an arrangement under which it could be fired either by the trigger or by raising the hammer; and lastly, they introduced the great improvement of a spur behind the trigger, which must be pressed by the middle finger, while the forefinger discharges the piece through the trigger. The drawing represents the American Arms Co.'s extracting revolver, using Smith and Wesson's cartridges, caliber 38. This revolver is very simple, performing its office in a satisfactory manner, with little liability of getting out of order, and is easily taken apart by the most unskillful. Its operation is as follows: After firing the cartridges, open the arm as in Smith & Wesson's, and, by turning it over, a quick movement will throw out the empty shells; or, turning it half-way over and pulling the extractor



ring quickly back with the fingers, the shells fall into the hand or on the ground. The revolver principle has also been successfully applied to the manufacture of a kind of revolving guns for small projectiles, which are really aggregates of small-arms. The Gatling gun, a revolver of this class, in which the several barrels turned round a common axis, was used during the American civil war. But the best known gun of this description is the French *mitrailleuse* or *mitrailleur*, of which so much was heard during the Franco-German war. That most commonly used had a group of 25 barrels, surrounded by a bronze sheathing, and movable breech-piece; it was fired by means of a crooked handle or winch at the right-hand side. The range of such guns in a level plain is not great; but among fortifications, or in a narrow valley, they may be used with very deadly effect. See *Colt Revolver, Hotchkiss Revolving Cannon, Remington Revolver, Schofield-Smith & Wesson Revolver*, and *Smith & Wesson Revolver*.

REVOLVING-GEAR.—The mechanism or gearing, in machine guns, by which the shaft is revolved. It consists of a toothed wheel, fastened to the shaft, and worked by an endless screw, on a small axle, which passes transversely through the case at right angles to the shaft, and is furnished outside the case with a hand-crank: and thus the lock-cylinder, carrier, and barrels are revolved. See *Gatling Gun*, and *Traversing-gear*.

REVOLVING GUN. A breech-loading machine devised for fog-signaling, to avoid the labor of sponging and ramming home, as in the common guns formerly used for that purpose. The fore part consists of a barrel open at both ends; the breech front abuts in a close-fitting joint against the mouth of a chamber, formed in a horizontal wheel containing five chambers. A passage communicates through the top of the breech-carrier with the rear of the chamber next to the barrel. This passage is so arranged by means of a catch-spring that the communication is interrupted, except when a chamber is exactly fitted to the barrel, and then only can the gun be fired. This gun is not adapted to warfare, being constructed merely to fire blank cartridge. The weight of the gun is 35 cwt.

REVOLVING TARGET. A very cheap and simple construction designed by General George W. Wingate, and used to some extent by the United States Army. To construct this target a pit is first dug about 15 feet long, 8 feet deep, and 6 feet wide for targets of the third class, and of proportionate dimensions for targets of the second and first classes. A stout upright post is placed in the ground and firmly braced, its upper end being level with the top of the pit. An iron pin, at the suitable height, projects from this upright post, and serves as the axis upon which the target revolves. Two targets are connected by a cross-piece, through the center of which the pin or pivot passes. When the upper or exposed target is hit, the marker raises a disc denoting the value of the shot, and places it for a moment over the point struck; he then pushes the other target laterally and up to the perpendicular, patches the bullet-hole just made, and stands ready to repeat as soon as the target then up is hit.

REWARD.—A recompense given for good service. Rewards are either *honorary* or *pecuniary*. Of the former, titles, orders, and crosses are conferred on officers and men as marks of distinction for gallantry and good conduct and services rendered to the country. The most recent reward for military merit is the Victoria Cross. Of the latter is the Good Service Pension. This reward is an annuity generally of £100, and is granted to General or Field Officers who have passed a distinguished military career either in the field or in good service to the State. It can be enjoyed by the recipient, in addition to his regular pension, until he succeeds to the Colonel's allowance. In the Indian Army, an officer receiving an enhanced pension, in addition to his regular pension, would not be allowed to retain the reward for distinguished service if the aggregate sums received by him exceeded £1,000 a year. Meritorious Non-commissioned Officers receive the Good-conduct Rewards in the shape of annuities of £10, £15, or £20 each.

RHANA SYSTEM OF FORTIFICATION. The singular features of this system point out the absurdity of abstract calculations applied to the *art of fortification*. The bow and arrow, the sword, shield, and lance are combined in this outline.

RIBADOQUIN.—An ancient 1 or 1¼ pounder gun. Also a powerful cross-bow for throwing darts.

RIBANDS. Scantlings of wood about 15 feet long and 4 inches square, and used in rack-lashing gun platforms to keep the platform secure; they are also used for mortar platforms. Two ribands accompany each platform.

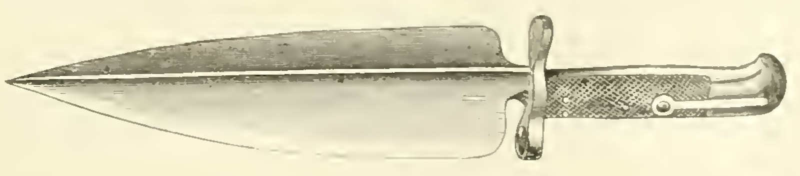
RIBAUD.—A soldier of the Foot-Guards of Philip Augustus of France; afterwards this term was applied only to the most infamous characters. *Ribaudaille* was a term of reproach formerly applied to cowardly soldiers. Philip of Valois thus called his Genoese mercenaries, who he thought had betrayed him.

RIBAUDEQUIN.—1. A chariot bristling with spears, used in the fourteenth century for the defense of camps, having small cannon fixed on the framework of the car. *Ribaudequins* were usually placed on two-wheeled carriages and used as a check against a cavalry charge. 2. The name given to *organ guns*, which consisted of a number of tubes placed in a row like those of an organ, evidently the forerunners of the modern *mitrailleurs*. 3. A warlike machine in the form of a bow, containing 10 or 15 feet in its curve. It was fixed upon the wall of a fortified town, for the purpose of casting out a prodigious javelin, which sometimes killed several men at once.

RIBBON.—In Heraldry a diminutive of the ordinary called the bend, of which it is one-eighth in width.

RIBBON COCKADES.—In the British service, the cockades which are given to recruits, and are commonly called the *colors*.

RICE TROWEL BAYONET. This bayonet, the invention of Colonel Edmund Rice, United States Army, consists of the ordinary musket-bayonet, the blade of which is shortened and welded to a thin curved triangular plate of steel. It is intended to be used as a trowel for intrenching purposes, being then detached from the musket; the loop connecting the shank and base of the blade serves as a stiffening brace, and also to guard the fingers from abrasion in the act of digging. A similar blade can be affixed to the ordinary sword-bayonet handle, which, though heavier than that first described, affords a more convenient grasp to the hand.



The soldier should never be separated from an intrenching tool of some description. Many are the instances recorded where it was impossible to forward the *intrenching tools* to the front until after the exigency for their use had passed and the men were compelled to use tin plates, tin cans, fragments of canteens, knives, sticks, etc., in order to get temporary shelter from the enemy's most galling fire.

The writer is a firm advocate of the *trowel bayonet*, having given it numerous practical tests on the Western Prairies in engagements with hostile Indians, and when it was necessary to make cover while open to the fire of sharp-shooters.

General Miles indorses its usefulness as follows: "I am fully satisfied that its utility and value are as well established as that of any article carried by the soldier; that it would increase the efficiency of any army; and that it should be universally adopted by the entire army. If the opinion of officers commanding troops in the field is considered of value, I believe that opinion is decidedly in favor of its adoption."

The art of utilizing cover is of importance, and the soldier who carries in compact form the means of erecting cover at will, possesses advantages over an enemy not so provided; and if the instrument used for this purpose is also available as an offensive weapon, his advantage becomes still more apparent.

In future operations of armies, hasty field entrenchments must play a most important part. The best authorities, from Napoleon I. down to the most scientific soldier of this day, all agree in the opinion that each soldier should carry his own intrenching tool. By giving each soldier a trowel-bayonet, he is supplied with a light, strong, and serviceable intrenching tool; no addition is made to the weight he is obliged to carry; and he is provided with a weapon as formidable as the triangular or sword bayonet.

The *trowel bayonet* requires the digger to work on his knees. This is but a slight drawback when the work is of short duration, and it is even an advantage when it is being carried out under the enemy's fire, as a man offers in this position a smaller mark for bullets and shrapnel.

Although but little used to earth-works, infantry soldiers will soon attain a great rapidity of execution, for it will be to their interest to get quickly under cover. See *Clitz Intrenching-tool* and *Farrow Knife-trowel and Tent-peg.*

AT WORK.

RICOCHET.—In gunnery, the bounding of a shot along the ground, which takes place when a gun is fired low. Ricochet firing is found extremely useful both in its actual and moral effect in clearing the face of a ravelin, bastion, or other rather long line of fortification. If well directed the ricochet shot bounding along will dismount guns, scatter the gunners, and greatly intimidate the garrison. Vauban first introduced ricochet firing at the siege of Philipsburg in 1688. The defense against this sort of attack consists in earthen traverses along the threatened line, or in a bonnet at the point of parapet nearest the enemy. In the field, ricochet, where the shot or shell is made to bound forward at least ten times, produces most disastrous and demoralizing effects on masses of cavalry and infantry, whom it hews down in long lines. Spherical projectiles are more certain of ricochet than those of elongated form; with the latter the first graze usually causes them to *tumble*, after which their motion is both feeble and erratic. The pieces principally employed for ricochet firing are the 8-inch howitzer and the 8 and 10 inch siege mortars. The first two may be used when the angle of fall is less than ten degrees.

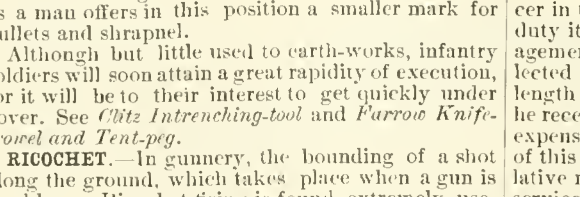
RIDEAU.—A rising ground or eminence, commanding a plain, sometimes almost parallel to the works of a place. It is a great disadvantage to have rideaus near a fortification, which terminate on the counterscarp, especially when the enemy fire from afar; they not only command the place, but facilitate the enemy's approaches.

RIDER.—In artillery carriages, a piece of wood, which has more height than breadth; the length being equal to that of the body of the axle-tree, upon which the side-pieces rest in a four-wheel carriage, such as the ammunition wagon, block-carriage, and sling-wagon.

RIDGE.—In fortification, the highest part of the glacis proceeding from the salient angle of the covered-way.

RIDING ESTABLISHMENT.—The School at Woolwich, established for the instruction of the men of the artillery in riding. It was formed on the organization of the horse artillery under the Duke of Richmond, when Master General. It continued, as a mixed department, with the Royal Artillery until the year 1809, when it was made into a separate and distinct establishment. It consists of 7 officers, 218 men, and 144 horses.

RIDING-MASTER.—In the British service, an officer in the cavalry, military train, and artillery, whose duty it is to instruct the officers and men in the management of their horses. He is most commonly selected from the ranks; his pay is 9s. a day, rising by length of service to 10s. 6d. and 12s.; besides which he receives £7 per troop per annum for riding-house expenses; and he is believed to make some profit out of this allowance. The Riding-master has the relative rank of Lieutenant, and, after an aggregate service of 30 years, including at least 15 years as Riding-master, he has the right to retire on 10s. a day, with the honorary rank of Captain. See *Rough Rider*.



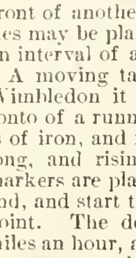
RIDING-SCHOOL.—To perfect the troopers in managing their horses and in using their arms, they are exercised in running at the *heads* and *rings*. This is done in the riding-school. For this exercise, four posts—two, 5 feet 6 inches high, and two, 2 feet 6 inches high called *head-posts*, are used; also, two posts called *ring-posts*, so made that the upper part, which supports a horizontal arm, may be raised and lowered; from the arm which extends over the center of the track is suspended an iron ring 4 in. in diameter, so arranged that it can be easily carried away with the saber. These posts are placed along the sides of the track, on the inside, in the following order: twenty yards from one end a tall head-post, two yards from the track; forty yards farther, a ring-post; twenty yards farther and twenty yards from the other end, one yard from the track, a short head-post. The posts are arranged on the other side of the track in a similar manner, the tall post being opposite the first short post, and the short post opposite the first tall post. On each of the four head-posts, and on the ground on each side, half-way between the tall head-post and the ring-post, one yard from the track, is placed a canvass or leather *head* stuffed with hay.

Each trooper, when he comes near the first tall head-post, brings down his pistol, fires at the head with blank cartridge, and continuing on the track, returns pistol draws saber, taking the position of guard, and, when on the opposite side of the school, takes the head on the tall post by a *right* or *front cut;* the head on the ground *against infantry, right cut;* the ring at *tierce point*, and the head on the short post, *against infantry, right point.* The heads may be also taken by executing *right point*, and in *quarte point*, at the head on the tall post; *against infantry right point* at the head on the ground; and against *infantry front point* at the head on the short post. After the troopers become skillful in the use of their sabers to the right, the exercises may be repeated to the left; then with stirrups crossed, and finally with the horses bare back. Hurdles and bars may also be placed on the track. See *Horsemanship.*

RIDING THE WOODEN HORSE. A punishment formerly resorted to, not only in the British Army, but in the armies of other nations. The horse is described as made of plank, roughly nailed together, forming a sharp ridge to represent the back of the horse; it was then supported by posts to serve as the legs of the animal, about 6 or 7 feet long, the whole being placed on a movable truck. When a soldier or soldiers had to undergo punishment, they were placed on this horse, with their hands tied behind their back, and frequently muskets were tied to their legs, to prevent the horse, as was humorously observed, from kicking off.

RIFLE ASSOCIATIONS. General instructions for the formation of rifle associations in different localities, together with a form of by-laws, will be found annexed to the Annual Report of the National Rifle Association for the years 1874 and 1875. Those Associations should confine their attention, in the main, to practice with military rifles, not only on account of the advantages to be obtained from training the National Guard and the public to the use of military weapons, but because the number of those using long-range rifles will of necessity be limited. It will be found advantageous for such association to employ markers by the month, and for the members using them to be charged a certain sum an hour. When not occupied in marking these men can be used in improving the range. Boys should never be allowed to serve as markers. Care should be exercised in the selection of score-keepers in matches. Unless reliable men are employed, the danger of incorrect scoring, through fraud or carelessness, will be very great, and accidents are apt to occur. Volunteer scorers may be relied on for a short match, but not for a meeting lasting several days. In all competitions, the prizes should be more numerous than valuable, and a number provided from which previous winners of prizes should be excluded. In this way young shots may be encouraged, and the danger of having all the prizes carried off by a few men avoided. In matches each man, upon entering, should receive a register ticket, 3×4 inches. The tickets for the different matches, as well as for different distances in the same match, are designated by different colors. Each one should be numbered and contain blanks for the name of the marksman, the target, and hour at which he is to shoot, and his score, having a coupon attached containing similar blanks. The assignments of the targets should be made by lot, after all the entries are received, and be at once posted upon the bulletin board (which should be placed in a central position), directing numbers so and so to shoot at such and such targets. Teams should be kept together. Competitors should then proceed to the targets to which they find they are assigned, and hand their tickets to the score-keepers, who should place them in a tin frame holding ten. The men should be called up in twos (except in long-range competitions, when they fire in succession), who fire alternately till they have fired their sighting and scoring shots. As each man's shot is signalled, the scorer should call his name and the value of the shot, as "Brown—four," at the same time entering it upon his ticket. When the score is completed, he should add it up, and announce the aggregate "Smith—ten," etc. and tear off the coupon (which is a duplicate of the ticket, and give it to the man), retaining the ticket, which he should hand to the Superintendent, who should take it into headquarters. Any alteration on the ticket should always be required to be initialed. Any man delaying the match should be passed, and any one acting discreditably disqualified from competing in other matches. The latter regulation should be rigidly enforced in all cases. Communications with the competitors, during a match, should be by notices posted upon the bulletin board. This they should be required to watch, and their neglect to do so never be accepted as an excuse. In order to secure an equality, target rifles, unless handicapped, should not be permitted in military matches. Interesting matches are frequently made by permitting them to be used at longer distances, as at 800 yards as against military rifles at 500 yards. Special military rifles, with small bores and heavy charges, should be discriminated against in a similar manner. The best way to sort out the tickets is to have a board provided with nails, each of which is numbered from the highest possible score downwards. By having each ticket punched with a hole the size of the nail, it can be placed upon the one bearing a number corresponding to the score entered on it, and all confusion in arranging them avoided. The entries for each match should be kept in a separate book. If not, delay and inconvenience will be inevitable, as they have of necessity constantly to be referred to. The general arrangements for a match should be placed in the hands of the Executive Committee or Officer, who should attend to all details. They should carefully watch both markers and scorers. The knowledge that this is being done will do much to prevent carelessness in the marking. Protests and complaints not having a substantial foundation should be discouraged. All protests should be heard and decided upon the spot, whenever practicable. If delayed, it is difficult to ascertain the facts in regard to them. While every endeavor should be made to insure fairness in making a decision, when once made it should be firmly adhered to. The greatest benefit in developing good shots and building up an interest in rifle practice will be found to result from badges offered for competition monthly, not to become the property of the winner until won a certain number of times. The longer the struggle for these, badges continues the more their possession is valued The securing of a proper range is the main obstacle with which a new rifle association has to contend. The land should be purchased, if practicable; if not, it may be leased. Its location is most important. If not easy of access, it will not be successful. Beyond the erection of the necessary butts and targets, no buildings, with the exception of a small storehouse, are necessary. If, however, a building should be provided for the residence of the range-keeper and the storing of the rifles, etc., of the members, it will form a great convenience. The question of laying out the range and the targets should be fully understood. If iron targets are used, twelve will be sufficient for an ordinary range. This will allow three third-class targets and two second-class, to be used together, and permit of their being converted into two first-class targets, for long-range matches. These can be put up in different manner upon different days, so as to permit the members to practice at any distance by coming at a certain time. Whether the targets should be placed in pairs or upon a line depends upon the ground, and also how it is to be used. If the range is to be used for military class-firing, the targets should be so placed as to allow of their being used simultaneously at the same distances, without one firing party being in front of another. For other practice the firing parties may be placed in front of one another, provided an interval of at least 150 feet is preserved.

A moving target adds interest to the range. At Wimbledon it consists of a running deer; at Toronto of a running man. In both cases the target is of iron, and runs upon a railway about 60 feet long, and rising at each end about 5 feet. The markers are placed behind a shot-proof butt at each end, and start the figure at a signal from the firing-point. The descent gives it a speed of about 5 miles an hour, and it must be hit while moving. To shoot at a mark of this description with success requires the best qualities of a rifleman, and much experience. See *National Rifle Association.*



RIFLE-CANISTER.—These are very similar in general appearance to those used in smooth-bore cannon. As shown in the drawing, the case is of sheet-iron or tin, with fringed ends which are turned over and soldered or riveted to iron or zinc discs. The balls are of iron or zinc packed in rozin or coal-dust, sometimes in discs of wood. They are fitted with solder studs or rings of lead on the outside to take the rifling, or with an expanding cup. See *Canister-shot, Case-shot*, and *Projectiles.*

RIFLE-CANNON.—The general adoption of rifled small-arms necessitated the introduction of rifled cannon. It is plain that the principle has application to all sizes of projectiles, and would therefore be used for the heaviest ordnance as well as for the smallest. Contemporaneous attempts so to adapt it have not been wanting, but they are in many cases isolated in point of time and connection. The first persevering and rational efforts to apply the rifle principle to cannon were initiated some twenty years since; and the names of Wahrendorff, Cavalli, Lancaster, and others, are identified with the first efforts to overcome the difficulties—of no ordinary character—that beset the question. The yielding nature of lead renders the application of the rifle principle of easy accomplishment in the case of small-arms; but such is not the case with rifle-cannon, where the projectiles are made of iron. The application of this principle to cannon also required an increase of strength in the piece. The greater the weight and the length of a projectile, the greater is the opposition from inertia and friction which it offers in the bore to the expansion of the ignited charge, and this opposition is considerably augmented if the projectile is constrained to travel through the bore in a spiral course. Hence it is not difficult to comprehend why a rifled gun must be of a stronger, tougher, and more elastic material than is necessary for a smooth-bore gun in which the spherical projectile yields promptly to the first impulse of the powder-gas to which it presents half its surface, and bounds freely forward through the bore, almost unimpeded by friction; while the strain on the gun is immensely relieved by the comparatively great windage. Again, as the explosive power of a cartridge, and the inertia and friction of a projectile, increase as the cubes of their respective weights, while the surface of the chamber and the base of the projectile against which the powder-gas acts increases only as the squares, it follows that the larger the charge and the heavier the projectile, the harder and stronger must be the inner barrel.

The progress of the art of war depends essentially upon that of the sciences and manufactures, for the manner of fighting depends upon the character of the arms which we possess. These will be more effective, as their mode of construction is more perfect, and as the means employed in their manufacture produce greater strength and precision. This is particularly the case with reference to cannon, in evidence of which we have only to call to mind the great revolution in warfare which has taken place since their introduction, and which is continually taking place as the means of perfecting cannon increase. It is only in recent years that our knowledge of the metallurgy of iron, and also our ability to manufacture and handle, with any degree of skill, large masses of that metal, have rendered possible the fabrication of the enormous pieces of the present day. But now the great improvements which have been introduced in the manufacture of iron, in the fabrication of cannon, and in the facilities for the transportation and handling of heavy guns, render possible the success of cannon of mammoth proportions. In designing rifle-cannon, the practicability of manufacture and the durability of structure must be ascertained. The weight, caliber, length, system of rifling, weight and shape of projectile, etc., etc., must be all scientifically calculated so as to insure excellence in range, accuracy, and penetration; and then each and all of these constructional details are liable to alteration, should the thorough trial of a specimen gun render any amendment advisable. The first comprehensive experiment with rifled cannon appears, from all accounts, to have been made in Russia, about 1836, on the invention of a Belgian, but did not prove successful. In 1845, Cavalli, a Sardinian officer, experimented with a breech-loading cannon which was rifled with two grooves, for a plain iron projectile, adapted to fit them. In the next year, Wahrendorff, of Sweden, fitted heavy projectiles to take the rifling by affixing lead to their elongated sides by means of grooves cut in them. And not long after this, Timmerhaus, of Belgium, invented an expanding *sabot*, which, being fitted to the base of the projectile, was forced into the rifle-grooves, and thus gave rotation. In these early experiments we find the germs of the leading systems of the present day. The solid projectile, fitted to enter the grooves of the gun; the compression of a soft covering on the projectile by the lands of the gun; and the expansion of the rear of the projectile by the pressure of the powder to fill the grooves of the gun.

The object of rifling a gun is to increase its accuracy of fire, and, by enabling elongated to be substituted for spherical projectiles, to obtain from it longer ranges. Rifling diminishes the deviations of ordinary projectiles, due to the following causes: 1st. Want of uniformity in figure and weight around the longitudinal axis of the projectile, passing through the center of gravity.

2d. Position of the center of gravity, before or behind the center of figure. 3d. Resistance of the air. I. By rotating the projectile around its longitudinal axis, the direction of these deviations is so rapidly shifted from side to side, that the projectile has no time to go far out of its course either way. II. The velocity of this rotation is such as to make the axis stable on leaving the bore, and to counteract the pressure of the air tending to turn the projectile over, or render it unsteady in flight. III. A given weight of projectile can be put into such a form as to oppose the least practicable cross-sectional area to the air, and thus to receive the least practicable retardation of velocity. Certain peculiar advantages follow from the rotation of the projectile, causing it to present the same part to the front throughout its flight. It becomes possible to make a much simpler percussion-fuse, because it is only necessary to provide for action in one direction in place of every possible direction. Shells required to act towards the front in any peculiar way have their bursting-charge and metal placed with a view to this object. So, again, the center of gravity may be brought to any desired part or the shell, and this is an important feature in the construction of projectiles. Rifling gives the power of altering the form of projectiles at will. The head may be made of any desired shape for penetration or flight. The projectile may be elongated so as to give a diminished surface for any resisting medium to act upon; thus in flight, velocity is kept up and the range extended, or on impact greater penetration is obtained. Weight for weight, the same effect may generally be produced with an elongated projectile by using a smaller charge of powder than with a spherical one. It follows from the flight of an elongated projectile meeting with less resistance from the air, and keeping up its velocity better, that at all but very short ranges the trajectory is flatter; hence the probability of hitting an ordinary object is greater. The power to vary the length of the elongated projectile enables all those for the same gun to be made of the same weight, and hence to require the same elevations with the same charge of powder. Or it is possible to make a projectile specially heavy if required. This obviously cannot be the case with spherical projectiles, which must be of the same size. The chief disadvantages are, bad ricochet, increased complication, and expense of manufacture, liability to injury arising from the necessity of soft studs, expanding rings, or a soft lead coat; increased strain on the gun, besides greater probability of jamming and injury to the bore, uncertainty of time-fuses.

RIFLED HOWITZERS. In consideration of the satisfactory results obtained with the 3.07-inch Moffatt breech-loading field-piece, and also of the evident advantages to be secured by the substitution of a breech-loading rifled howitzer for the 8-inch muzzle-loading smooth-bore howitzer, of at least equal power to the latter gun—for flank defense and siege purposes—a result believed to be attainable with this system by a 6-inch caliber, it was decided to construct such a howitzer on the Moffatt plan for experiments and tests, the slight changes in construction resulting either from some observed imperfection in the working of the mechanism in the field-piece or from the employment of a different nature of ammunition in the howitzer. A brief description here will therefore suffice. The howitzer consists of a steel body, to which is adapted the Moffatt breech-mechanism, a conical breech-plug closing the bottom of the bore through the agency of a strap or yoke, which locks into lugs on the sides of the breech for the support necessary to resist the shock of discharge, and which is attached to the trunnions as an axis of motion. The chamber is opened by tilting up the breech of the howitzer with a lever, whereby the block falls back upon the strap and uncovers the bore. In place of a leather strap to insure the opening of the breech, a heel is attached to the hinge of the breech-block, which, coming in contact with the strap as the breech is raised, throws down the block, and by the same movement turns with the hinge so as to clear the strap. The locking-bolt is bored through axially for the reception of a firing-pin, with which to explode the charge when primed metallic cartridges are employed. An ordinary vent is also provided by means of which the charge can be ignited by a friction-primer. The gun-body was made from a steel block furnished by Thomas Firth & Sons, of Sheffield, England. It was cast in an ingot, forged to dimensions, and bored by them to within one-quarter inch of its finished diameter. The steel contained about 0.64 of 1 per cent. of carbon. The breech-strap and block were made in Boston, and were of low steel, containing 0.44 of 1 per cent. of carbon.

The following are the principal dimensions of the gun:

Diameter of bore across lands.........	6 inches.
Diameter of bore through chamber...	6. 2 inches.
Diameter of breech-block cavity at seat of gas-check........................	6. 8 inches.
Diameter of breech-block cavity at outer edge................................	8. 5 inches.
Exterior diameter of piece at muzzle	12 inches.
Maximum diameter........................	16 inches.
Diameter of trunnions..................	5. 875 inches.
Diameter of rimbases.....................	8. 6 inches.
Distance between-rimbases.............	16 inches.
Diameter of loop (over trunnions) in breech-straps .... vertical	5. 875 inches.
Diameter of loop (over trunnions) in breech-straps .... horizontal.	6. 075 inches.
Length of gun body........................	78 inches.
Total length of gun.........................	88 inches.
Length of bore..............................	69. 625 inches.
Length of rifled portion of bore......	64. 625 inches.
Length of bevel joining lands to chamber..................................	1 inch.
Pitch of rifling, uniform, one turn in	30 feet.
Number of grooves and lands, each	17
Width of lands..........	0. 50 inch.
Width of grooves..........................	0. 6088 inch.
Depth of grooves...........................	0. 075 inch.
Length of trunnions......................	5. 875 inch.

The principal European Artilleries have produced rifled howitzers and mortars throwing shells of 80 kilos, with sufficient accuracy to render them formi-

Elements.	France.	England.	Prussia.	Austria.
	Howitzer of 22 c. m.	Howitzer ot 8 inch.	Mortar of 21 c. m.	Mortar of 8 po.
Nature of the metal of the piece	Cast iron. banded.	Wrought iron with steel tube	Bronze	Cast iron.
Method of loading....................................	Muzzle	Muzzle	Breech	Breech.
Caliber of the bore ....millimeters	223.3	203.2	209.3	209.3
Length of rifled portion (in calibers).........	9.8	4.4	5.5	4.1
Number of grooves	3	4	30	30
Twist (in calibers,) about	....	16	25	60
Inclination of the grooves to the generatrices of the bore	0° to 6°	1° 6′ 31″	7°	3° 1′ 16″
Weight of the piece ....kilos	3,700	2,350	3,025	4,655
Weight of the loaded shell........................	79.8	81.4	80.0	87.0
Weight of the interior charge of shell	4.0	5.9	5.0	4.0
Maximum firing-charge...........................	6.0	4.53	3.5	5.6
Ratio of the weight of the maximum charge to the weight of the projectile............	1 to 13	1 to 18	1 to 23	1 to 13
Ratio of the weight of the projectile to the weight of the piece........	1 to 46	1 to 29	1 to 38	1 to 53
Maximum initial velocity ....meters	257	....	215	
Maximnm range............................ do	5,220	4,480	4,000	4,500

dable to covered arches or blinds, such as exists at present.

On page 693 are some elements for a comparison of these different pieces.

It will be seen from this table that the French howitzer and the Austrian mortar of 8 po. permit of the attainment of the greatest ranges, but also that their weights are very considerable; the Austrian mortar, particularly, appears to have an exaggerated weight relatively to the effects attainable with it; it is possible by the system of banding to reduce this weight, say, at least 800 kilos., and to give the piece a greater length of bore, which would permit the use of larger charges and of a more progressive powder, by means of which ranges of 5,000 meters should be obtained.

In order to compare the accuracy of fire, we have calculated the ration of R and q of the mean deviations, longitudinal and lateral, to the ranges. The

Piece.	30°.		40°.		45°.		60°.	
	R	q	R	q	R	q	R	q
French howitzer of 22 c. m.	$\frac{1}{37}$ to $\frac{1}{67}$	$\frac{1}{325}$ to $\frac{1}{385}$	$\frac{1}{40}$ to $\frac{1}{66}$	$\frac{1}{450}$ to $\frac{1}{365}$				
English howitzer of 8 inches.*	$\frac{1}{90}$ to $\frac{1}{169}$	$\frac{1}{860}$ to $\frac{1}{1400}$	$\frac{1}{44}$ to $\frac{1}{330}$	$\frac{1}{194}$ to $\frac{1}{1436}$				
Prussian mortar of 21 c. m.	$\frac{1}{578}$ to $\frac{1}{294}$	$\frac{1}{578}$ to $\frac{1}{588}$	....	....	$\frac{1}{150}$ to $\frac{1}{321}$	$\frac{1}{1588}$ to $\frac{1}{443}$	$\frac{1}{256}$	$\frac{1}{432}$
Austrian mortar of 8 po.	$\frac{1}{118}$ to $\frac{1}{78}$	$\frac{1}{980}$ to $\frac{1}{1432}$	....	....	$\frac{1}{148}$ to $\frac{1}{78}$	$\frac{1}{780}$ to $\frac{1}{1432}$	$\frac{1}{81}$ to $\frac{1}{150}$	$\frac{1}{411}$ to $\frac{1}{788}$
Austrian mortar of 6½ po.	$\frac{1}{96}$ to $\frac{1}{116}$	$\frac{1}{770}$ to $\frac{1}{938}$	....	....	$\frac{1}{58}$ to $\frac{1}{140}$	$\frac{1}{400}$ to $\frac{1}{832}$	$\frac{1}{67}$ to $\frac{1}{144}$	$\frac{1}{789}$ to $\frac{1}{235}$

*A 20°, R$=\frac{1}{34}$ to $\frac{1}{261}$; $q=\frac{1}{330}$ to $\frac{1}{1700}$.

above table indicates the limits between which these ratios vary for the different angles of fire, in proportion as the range increases.

It will be seen, from a study of the figures in this table, that the French howitzer has above all a notable inferiority in point of accuracy of range. The Prussian mortar has a sensible superiority over the Austrian mortar in point of accuracy of range; but the accuracy in direction of the Austrian mortar is very much greater than the Prussian. This latter fact would tend to prove that the Prussians, notwithstanding the modifications successfully introduced in the plan of their shell, have not yet succeeded in giving to it a stability upon its trajectory comparable to that of the Austrian shell. In respect to this, however, it should be observed that the inclination of the rifling in the Prussian mortar is 7°, while in the Austrian mortar the inclination is only 3°; it is generally admitted in France that the inclination of the rifling for large pieces should but little exceed 4°.

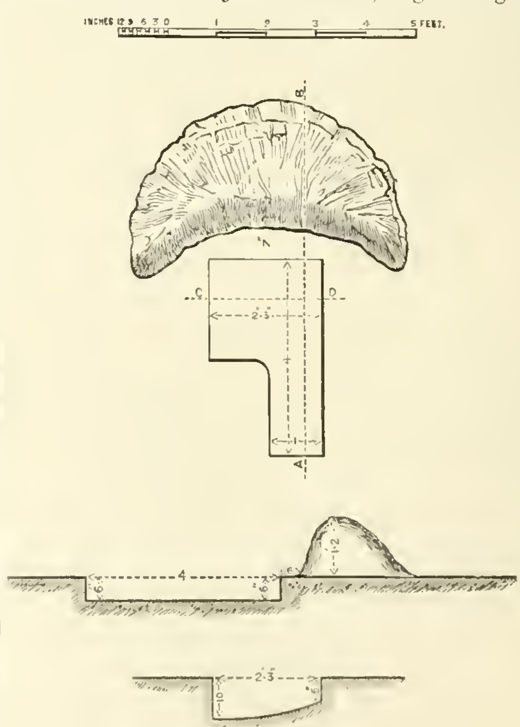
In respect to the effects of fire, the difference of weights of projectiles thrown by the pieces examined is too small to give rise to the supposition that there would be any appreciable difference in the effects of penetration for the same angles of fire and the same ranges; in point of the effects of explosion, the English shell, owing to its greater bursting charge, ought to be the most powerful.

From what precedes it is to be concluded that the French howitzer, which was remarkable enough at the time of its adoption, has not to-day a sufficiently accurate fire to warrant its introduction into siege-trains; for the armament of places, and the provisional armament of coast-batteries, it may possibly do good service, because, in these two cases, the effects of isolated shots may be very formidable, notwithstanding that, in order to obtain serious effects against the very solidly constructed shelters of a place, it is necessary to group the shots upon a small surface. See *Howitzer*, *Moffatt Gun*, and *Ordnance*.

RIFLED MUSKET.—A musket of which the bore is rifled. In 1855, Austria adopted for her infantry of the line, the *rifled musket*, with a barrel 37 inches long, and having four wide grooves equal to the land, making one turn in 83 inches. See *Rifle*.

RIFLEMEN.—Troops armed with rifles, and employed more or less as sharpshooters. The name has nearly lost all meaning, for the whole infantry are now riflemen; but as late as 1854, the riflemen were quite the exception, the army generally having the smooth-bore "Brown Bess." There were at that time only two English line regiments of Rifles, with two colonial regiments of infantry, and one Hottentot regiment of mounted infantry. The establishment of Rifle regiments was suggested to the British by the Americans and French, from the sharp-shooters of which nations the British armies suffered severely. During the French war, the 60th and 95th Regiments were armed as riflemen, taught light infantry drill, and clothed in dark green, to be as invisible as possible. The 95th became the Rifle brigade. Experiment has since shown that gray is less conspicuous than green as a uniform—hence it was at first adopted by many volunteer corps.

RIFLE-PIT.—A *hasty intrenchment*, large enough

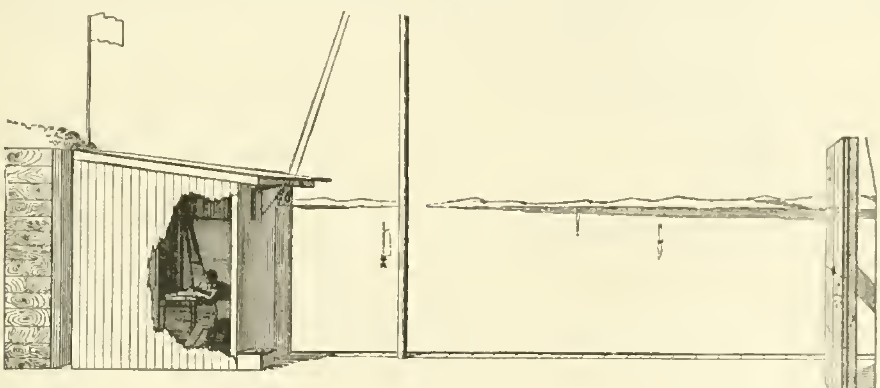


SHELTER-PIT FOR SKIRMISHERS.

to conceal a sharp-shooter or skirmisher, and by a small cover in front enable him to use his arms. A very slight earthen parapet is sufficient to protect men, in a great measure, from the effects of shrapnel and rifle bullets, besides screening them from view, which, in itself, is of great advantage. From recent experiments it has been ascertained that the penetration of rifle balls into newly excavated earth is about ten inches at 200 yards, and only twenty inches at a range of 10 yards. The diagram shows the dimensions of the pit and parapet that have proved in practice to be very desirable. After a little practice, each skirmisher will soon ascertain the exact form of pit that suits him. The depth need not be uniform, but should be about ten inches where the man's body will be, and about five or six inches in the other parts. In most instances the men will only have to improve natural cover. If time admits, the parapet may be made thicker and the trench deeper, and widened so as to give an abundance of room. The natural cover should always be taken advantage of when possible. See *Hasty Intrenchments* and *Shelter-trenches*.

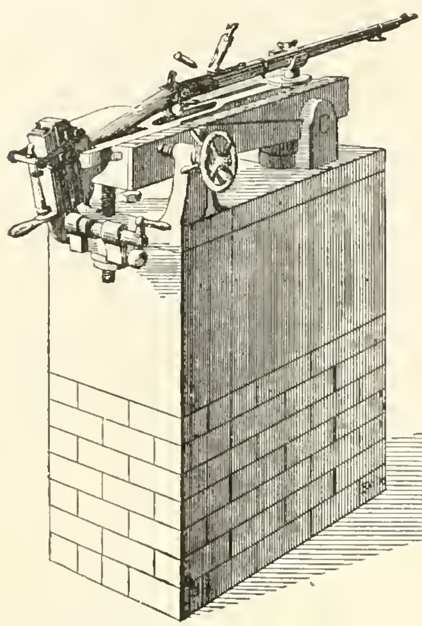
RIFLE PRACTICE.—While initial velocities and pressures are determined separately or conjointly by their special apparatus, nearly all other qualities of the ammunition are ascertained, directly or incidentally, from rifle practice at various ranges, with suitable rests and other appliances. The target ground and fixtures at the Frankford Arsenal possessing some peculiar features, a very brief description of their arrangement and use is appended.

The structures pertaining to the ground consist of one *firing house*, two *target houses* with their screens, and two cast-iron *targets* at distances of three hundred and five hundred yards from the firing house, and of dimensions 12′×12′ and 15′×15′ respectively. The firing house is provided with an improved *fixed rest* on brick pier, together with arrangements for firing from the shoulder and rest, recoil apparatus, etc. It is also supplied with armorers' bench and tools, desk, scales, clinometer, levels, telescope, etc., together with the usual instruments for determining the state of the atmosphere. The target houses with their screens are situated one in front of each target, at a distance from it of fifty feet and to the left of the plane of fire. They face their respective targets, and each has arrangements for a camera lens, which, by means of a mirror, throws an image of the target, reduced to one-twelfth, on the surface of the table, at which sits the target recorder. Lithographed target diagrams to scale, one of which, duly dated and numbered, is placed upon the table at the commencement of each series of twenty shots, enable the recorder to mark the position of each shot as it strikes, thus avoiding the delay and some degree of risk incident to the usual method of recording. These diagrams, moreover, duly signed and numbered, are filed as vouchers to their respective pages in the "Record Book of Experiments." A telegraph key and sounder placed at the side of the recorder place him in direct communication with the firing party. The targets are of the usual construction, the angle of depression of their centers being only seven feet for the five hundred yards, and twenty-one feet for the three hundred yard one, as viewed from the firing house. These arrangements have been in operation for some years, and the work of recording accomplished by their means is done accurately, safely, and with a rapidity limited only by outside considerations. The desiderata of a fixed rest are strength, solidity, capacity of adaptation to various models of small-arms, a facility in securing the arm firmly in position, without any undue strain upon any of its parts, an easy but steady recoil, and capacity for nice pointing and adjustment. The principal fixed rest at this Arsenal is a good attempt to embody these qualifications in the following manner: The support consists of a heavy freestone block resting upon a brick pier, and carrying the cast-iron bed plate of the rest as a cap covering its top and a portion of its sides. In this bed-plate is sunk the pintle which carries the trunnions upon which the *chassis as well as the top-carriage* move in a vertical plane. The chassis controls the recoiling top-carriage by accurately planed and scraped guides, whose surfaces have bearings upon its sides for a length of thirty-two inches; and, owing to the center of vertical motion being beneath, the recoil is always parallel to the axis of the piece at every elevation. The top-carriage contains the arrangements for directly supporting the piece, and these are so constructed as to dispense with direct screw pressure upon any portion



of it. The points of support, in addition to the butt-stop, are as usual two, one near the butt and the other at about thirty inches in front; at neither point, however, is any side screw clamp allowed to act directly upon the arm. At the rear the stock rests in a V while an inverted Λ descends upon its upper surface and secures it laterally as well as vertically by the pressure of a spring whose tension can be increased at pleasure. Meanwhile the thrust-block in rear of the butt plate—a solid brass segment moving vertically in a corresponding segmental bed—adjusts itself to the points of contact with the butt plate. The front support is also a V into which the barrel is pressed by the polished surface of a flat leaf spring above, which latter can, like the spring at the rear support, have its tension increased up to the limits of the strength of the rest.

The advantages of this arrangement are perfectly *symmetrical* character of the support afforded to the piece; the coincidence of the plane of sight with the plane of fire secured, without adjustment, as a mere consequence of the style of support; the absence of all distortion or buckling of the piece by local strains, or restraint of its longitudinal reaction, and the fact that the arm can be readily secured or released from the rest, since, when the tension of the restraining springs is once adjusted, the piece can be removed or returned and securely clamped, almost with a mere click, and will be found sighted upon precisely the point last aimed at. All bearing surfaces, journals, elevating and traversing screws, etc., about the machine are massive, far beyond the requirements of mere strength, and sufficiently highly finished to give great smoothness and steadiness to all adjustments; as is evidenced by the fact that alterations to the tenth of a minute can be made and read with ease and certainty in any direction by two independent means, the vernier and the micrometer screws. In adjusting



the lines for the sights of small arms, both means are always used, and a discrepancy of more than 0'.1 between them would demand a repetition of the trial. With the fixed rest and targets as described, all questions regarding accuracy and uniformity of flight of projectiles, can be determined by the usual method of co-ordinates and centers of impact. The subject of investigation may be the performance of a known arm with a new ammunition, or a known ammunition with a modified arm. A new arm with its own special ammunition may, too, be under trial as a whole system, but, in any case, the average trajectory, and the degree of closeness and uniformity with which the practice adheres to that average trajectory, can be determined.

Rifle practice constitutes a branch of military instruction peculiarly fitted for the National Guard, and in which they will always excel. The "*position*" and "*aiming drill*" which constitute the foundation of the system, can be acquired in their armories, and even at their homes, while the high state of intelligence existing among them enables them to soon apply upon the range the instruction they have received. Rifle practice is to a great extent a matter of judgment, particularly at the longer ranges, and the more intelligent men are, the better they will shoot. Thus both in England and Canada the volunteers have been found to shoot better than the regulars. In addition to the vast increase in military efficiency resulting from becoming good shots, it has been found that rifle practice has proved to be one of the most agreeable portions of military instruction. The honorable reputation of being a "crack shot," and the knowledge that the desired skill is solely dependent upon individual exertions, has done much to interest the National Guard in the subject, and has induced many to join its ranks.

While every inducement should be made to attract and develop good individual shots, so as to constitute a good regimental "team," and for this purpose individual emulation should be encouraged in every way, yet regimental commanders must bear in mind that the true object to be attained is to secure the *general efficiency* of the rank and file as riflemen. More credit should attach to an organization making high average shooting than to one having a champion team, and all influences possible should be exercised in that direction. Nor will this course interfere with the selection of a good team. Nothing has been more clearly demonstrated at Creedmoor than that shooting is a matter of education, and it will be found that a thorough course of instruction will not only make the regiment efficient as a whole, but invariably develop a number of "crack" shots from among those who supposed themselves to be without the qualifications requisite for a "Marksman," and the more "Marksmen" the better the chances for a strong "team."

Candle practice is specially to be recommended for the National Guard. It gives almost the same results as armory target practice, and, as it may be performed simultaneously by an entire company, the saving of time is a great desideratum. Calculating on a basis of one shot a minute, 5 shots by 30 men at a single target require two hours and a half, while at candles they could all be fired in ten minutes. In this practice, a gas pipe with small jets is preferable to candles. Some regiments place a miniature tin target in front of the lights aimed at, having the bull's-eye cut out, the flame appearing just behind its center, so that a "bull's-eye" extinguishes it. When candles are used, it is an advantage to insert them in a tube with a spiral spring, so as to always keep the flame in one position, as in a carriage lamp. Some regiments have a bench like a carpenter's horse to place the candles on, so as to admit of their being moved to different parts of the room to suit the light. In this practice the primer used on the regular cartridge does not contain sufficient fulminate to extinguish the flame at a distance of three feet with certainty. In order to meet this defect, special primers can and should be always obtained containing an extra quantity of fulminate Better effects are also found to result from enlarging the aperture into the cartridge. The shells made by the Union Metallic Cartridge Company are unsuited to this practice. The cone-shaped anvil used in them blows out, when used without powder, at the second discharge, spoiling the shell, and thus making the practice expensive. Neither the Remington shell nor that made by the United States Cartridge Company is liable to this objection, and in both, the opening for the fulminate can be enlarged. As a piece of the cap is frequently forced through the barrel by the explosion of the primer, care must be taken in this practice never to aim in any direction where injury could be caused by it. The main drill of the National Guard (in the cities at least) must take place at their armories, and practice at the range be but occasional, "not to learn, but to test what has been learned:" Officers should, therefore, devote all the available time to the sighting, position, and aiming drill, which form the foundation for the whole system. As these are apt to prove monotonous, candle practice should be frequently indulged in, this portion of the drill being always interesting to the men. It is, therefore, recommended that the men should be practiced in firing at candles at the conclusion of each aiming drill. With men of the intelligence of those composing the National Guard, the improvement that will be found to result from a little careful practice of this description will be found surprising; and a company that at the beginning could not extinguish more than two or three candles at a volley, in two or three months will put out nine out of ten; and it is frequently observed that those who have had the least previous practice as sportsmen will prove the best shots. This (candle) practice will also prove valuable as a substitute for ball practice in judging the efficiency of the men in those cases where the latter cannot be had; and none should be practiced in target firing who have not averaged extinguishing five out of ten candles at a previous drill.

There is no portion of rifle practice more important than understanding how to estimate distance, but the question of how such a knowledge shall be acquired and imparted, forms a very difficult problem for an officer of the National Guard. In the country, facilities for the purpose can be easily obtained; but in the cities, officers, in addition to requiring their men, when upon the range and not firing, to practice in this exercise must urge them to accustom themselves to judge distances the best way they can, impressing upon them that, no matter how accurate marksmen they may be at a fixed target, they are worthless if they cannot calculate the distance of an enemy. In estimating distances, the following suggestions may be valuable: At 50 yards the observer can name any one of his comrades readily, as the age, complexion, height, and figure can be determined at that distance. At 100 yards he should notice those parts which are clearly visible, and his attention drawn to the indistinctness of other portions. The lineaments of the face are no longer visible, the buttons down the front of the coat appears one continuous line. The movements of the men individually, and the form and color of the uniform, are, however, perfectly visible. At 225 yards, the colors of the uniform, cartridge-boxes, etc., are still visible; but the face now resembles a light-colored ball under the cap. At about 250 yards he can distinguish only the different parts of the body and the rifle. At about 450 yards, the direction of the line of march and the movement of the rifles can be detected, and in cavalry the helmet, cuirass, bright colors of the uniform, etc. At 600 yards the head looks like a small round ball, and the shoulders sloped off. At 700 or 800 yards the body has a dwindled appearance, but the legs of men in motion or extended arms are still distinguishable. At 900 and 1000 yards the separate files and direction of march are still apparent. At 1200 yards infantry can be distinguished from cavalry. At 2000 yards a man, or even a horse, looks like a mere speck or dot.

Individual practice should be encouraged by all officers and particularly in the case of the National Guard, to whom every inducement should be made to visit any available range for private practice. To prevent accidents and ensure the enforcement of the prescribed rules, every man should be required to enter his name on arriving at the range: those men who are the first to arrive should have the right to determine the distance at which they wish to fire. As the men arrive, they will form themselves into squads, each squad electing a Captain, who wil keep the score and enforce the rules of the range. All arriving subsequently are to obey his orders. If no markers or look-out men are employed, each Captain must make a detail from his squad for such purposes, and see that those detailed are properly relieved. The firing is to be conducted according to the principles above laid down, and every shot fired in rear of the firing point, whether accidentally or otherwise, unless fired into the pit provided for the purpose, shall be entered as a miss. The men last at the ground must see that the danger flag is hauled down, and the appurtenances belonging to the range replaced where they belong, or returned to the keeper. Practice upon the range is only intended to find out and apply what has been learned at drill, and acquire a practical knowledge of elevations and the allowances required for wind and weather. In all cases, therefore, extreme deliberation should be used. No advantage is gained by firing more than ten shots at a distance; and the habit beginners have of expending all the ammunition they can procure as fast as possible, is a positive detriment. Each shot should be fired with a definite purpose, and its results noted and remembered. The Captain of each squad, or of a team, should give special attention to this subject, as not only will the expense of the practice be greatly reduced, but the quality of the shooting greatly improved. There is nothing which prevents wild and hap-hazard shooting and develops those qualities of coolness, forethought, and judgment, which make a reliable shot, than to be kept on a short allowance of ammunition. See *Marksmanship*.

RIFLE RANGE. The first point to consider in regard to a range is its safety, and too much pains cannot be taken in the selection of the ground in order to protect the public from danger, as well as to prevent unnecessary expense in the erecting of butts, etc. While it is impossible to lay down precise rules for every feature of a country, the following suggestions will be found sufficient under ordinary circumstances: No ground is to be selected which does not afford a range of at least 300 yards, and it is most important that the ground behind the targets should be thoroughly commanded from certain points sufficiently clear of the line of fire to insure safety to the look-out men who are to be placed there in order that the fire may be easily stopped when necessary; hence a range down hill is generally to be preferred, as being more easily commanded to one uphill. The targets upon a range should, where the ground permits, be established by pairs, with an interval not less than ten yards between each target, and with a margin of at least 40 yards at the sides; the minimum breadth of ground for a pair of targets should be 90 yards, and all the targets should be on the same line. When, however, the number to be exercised in rifle practice is large, and the breadth of ground limited, a number of targets may be established, with an interval of ten yards between each, to be used as if for a pair, a margin being left at the sides of the outer targets of at least 40 yards. In these cases the number of each target should be conspicuously placed upon the butt in rear of it so as to be plainly seen from the firing-point, and the firing should be stopped at all the targets whenever the danger signal is shown at any target within 40 yards. The breadth of ground in rear of the target at each side of the outer ranges, should gradually increase from 40 to 80 yards, in those cases when the ranges are parallel; but when they converge towards the targets, the breadth may or may not be required, according to the degree to which the ranges are made to converge. The distances at the targets must never be less than ten yards between ranges in pairs, and eighty yards between pairs of ranges, whether they are laid out parallel to each other or converge towards the targets. If no butts are erected, and the ground is level, the space behind the targets should be about 1,500 yards. A less distance may, however, answer, if butts are erected, or if a steep hill rises in rear of the targets. Before steps are taken to procure grounds for ranges, it is essential to secure the right to fire over the land behind the targets to the extent required, should it not be desirable to purchase it. Generally this distance cannot be obtained, and a butt must be erected in rear of the targets, to arrest stray shots. The height of this must differ according to the nature of the background. If the range be on a plain, the regulation size of the butts is from 35 to 40 feet high, provided the distance behind the target is less than 1,500 yards. Under ordinary circum tances, however, the height of the butt need not be more than 20 feet, and when firing toward water a butt of 12 feet in height will be sufficient. On some ground there are found natural butts for the targets to rest against. To be of use in stopping stray bullets and thereby insure the safety of the public, the hill should incline 45 degrees, at least; if a smaller angle than this, it would, instead of acting as a stop, incur the chance of a ricochet, and therefore be unsafe. A few furrows from a plough will frequently lessen the chances of ricochets. The length of the butt for a pair of targets should not be less than 45 feet, measured along the top. They are far inferior to natural obstacles, and are expensive to erect and keep in repair. The number of each target should be placed on the butt directly over it in large figures, so as to be conspicuous from the firing-points. Where there are a number of targets these numbers should be painted red and black alternately. At long ranges Roman figures, made by laying rails on the butt, are more easily discerned than numerals. In crowded localities, where the range is short, and the danger of injury to the public great, a series of shields or screens may be thrown across the practice ground at different distances containing apertures of such a height and width as to permit the passage of all properly directed bullets, and to arrest random shots. These are sometimes high arches of cast-iron, and sometimes upright barriers of stout plank. Two or three sheds with plank roofs, made to slope *towards* the target, form a cheap and convenient screen, provided the ground between them is furrowed so as to prevent the ricocheting of the bullets which strike the sheds and glance downwards. In the longer ranges, these shields are objectionable, not only because the high trajectory of the bullet makes it difficult to place them properly, but because they confine the firing to a single distance, and render the appearance of the target as visible through the apertures so different from what it presents in the "open" as to deprive those using them of many of the advantages that should be derived from target practice, and particularly from acquiring a practical knowledge of distance. If care be taken that none be allowed to practice with ball who have not been through a course of "*position and aiming drill*," the danger of random firing will be reduced to a minimum, and the prescribed butt be found amply sufficient for all practical purposes. Every range is to be carefully and accurately measured, and the distances defined by a line of small pegs, at intervals of 50 yards, commencing at 100 yards from the target, and continuing to 900 yards, or to the extent of the ground, if under that distance. These pegs also serve as guides to prevent firing on a wrong target—a fruitful source of accidents. To avoid the sun, the targets must be placed at the northern end of the range; or if that is not practicable, at the eastern. In using the ranges the firing parties commence their practice close to the targets and gradually retire. Consequently, as there is not likely to be as much practice at the extremely long ranges as at the shorter ones, a piece of ground, of a triangular shape may be selected for an extensive range, the targets being placed at the broadest part, and the firing-points being reduced as the distance is increased. Several flag-staffs should be placed in such positions upon the range as to make the danger signal so conspicuous when hoisted upon them as to give notice to all passers-by that firing is going on. Smaller flag-staffs should also be provided at each lookout station. In addition to these flag-staffs, a suitable danger flag should also be provided for each firing-point, to be elevated in answer to the danger signal, as hereafter explained. Several flags should be erected above the top of the bank in rear of the targets during the practice, together with one amid way upon the range, to show the direction of the wind. A wooden socket should be set in the ground in front of each target, in which the marker should place the staff of his danger flag when obliged to leave his mantelet for any cause. This should be set at an angle so as to display the flag clearly.

The following is a list of the articles required for practice upon the range by a single regiment:

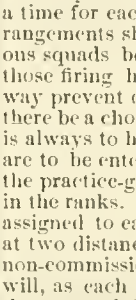
Iron targets, 6 feet by 2 feet, complete............ 8
Flags (when used), Red, 6 feet square (or flag-staff)............ 1
Flags (when used), Red, 3 feet by 4 feet (danger) 4
" " Red and white, $2\frac{1}{2}$ feet square 4
" " Dark blue, $2\frac{1}{2}$ feet square.... 4
" " White, $2\frac{1}{2}$ feet square......... 4
Poles—lance, 10 feet long............ 22
Discs (when used), Red flag, danger and for flag staff (as above............ 2
Discs (when used), Black and white disc, 18-inch diameter, 3d class, 9-inch............ 4
Discs (when used), Red disc, 2d class, 28-inch in diameter; 3d class, 8-inch............ 4
Discs (when used), White disc, 2d class, 18-inch in diameter; 3d class, 9 inch............ 4
Discs (when used), Black disc, 2d class, 18 inch in diameter, 3d class, 9 inch............ 4
Poles, $1\frac{1}{4}$-inch, for 2d class; for outer, 12 feet 6-inch; center, 10 feet 6-inch; bull's-eye, 8 feet 6-inch............ 22
Poles, 1-inch, for 3d class; for outer, 8 feet 6-inch; center, 7 feet 6-inch; bull's eye, 6 feet... 22
900 yards Gunter's chain or cord, labeled every 5 yards, and numbered from 1 to 900, divided into 18 equal parts............ 1
Pins of stout wire, 12 inches long............ 18
Stadometer complete, with 20 yards of chain, cross-staff and tripod for stand............ 1
Tripod rests............ 2
Sand-bags, bushel............ 2
Large brushes for coloring targets, 1 lb............ 4
Small brushes for coloring target (sash tools)... 4
Whiting, fine, without lumps (annually).... 1 cwt.
Lampblack............ 15 lbs.
Glue, to make size............ 42 lbs.

In practice at a range by military organizations it is indispensable that the regulations for practice should be carefully prepared and strictly enforced. Safety, accuracy in marking, and, above all, the avoidance of delays (a point to which particular attention must be paid) can alone be secured by having all officers thoroughly familiar with the prescribed regulations The regimental Inspector of Rifle Practice or (in default of such an officer) an officer specially detailed for the purpose, should be charged with the entire management of the targets, markers, and scorers, and should be held responsible for all delays or errors on the ground. He will also assist the squad commanders in instructing and correcting the practice of their men. Before the firing commences, the markers and look-out men should be posted, and a large red flag hoisted upon the flag-staff in the range. These men, when not attached to the range, should be detailed beforehand, and marched to their positions as soon as their party reaches the ground. If a guard is required, it should be posted in the same manner. Proper reliefs should also be provided from men who have completed their practice in time to allow those on duty to shoot. Printed orders should be furnished to both officers, markers, and look-out men, at the time they are detailed, in the following form, and care be taken that such orders are understood.

Orders for the Senior Officer at each firing-point—Not to allow any practice to take place until the large red flag is hoisted on the main signal staff, and the sentries or look-out men are posted, to prevent all persons whatever from attempting to cross the range and give notice of danger. To inspect the markers and register-keepers before they take their places, and see that they are provided with all requisites, and properly instructed. To see that the markers and sentries are properly instructed in time, and that they are afforded an opportunity of firing. To see that the men do not load except at the firing point, and then that they keep at a "*ready*" until they have fired. In all important competitions, to see that each man's trigger is tested at least once during the practice. To see that the squads firing are properly equalized. Not to allow a man to fire until the shot of the previous man (should it strike the target) has been signaled. To order the "*Cease firing*" to be sounded, and the "*danger*" flag to be hoisted at the firing-point, immediately the red flag is raised from the marker's butt, or any person or animal appearing in front of the firing party, and *on no account* to allow any firing to proceed so long as the danger flag is up at the marker's butt. When this flag is lowered, to order the "*Commence firing*" to be sounded, and the "*danger*" flag at the firing-point to be dropped. On the ranges situated in pairs, to see that the parties fire by classes at the same distances, and not one class in front of another. When the "*Cease firing*" sounds to see that the firing at all the targets which are within one hundred feet of the target at which the "*danger*" flag is displayed is discontinued until such "*danger*" flag is lowered, and the "*Commence firing*" is again sounded. To be most particular in cautioning his men that they will be almost certain to injure the marker if they should fire on a wrong target and the trap be open, and whenever a man fires on a target different from that to which he is assigned, to debar him from further practice and report him to the commanding officer. To see that all persons who desire to watch the practice stand to the rear and clear of the party, and on no account to allow any noise or talking among the men, whose attention should be fixed on the practice. To be most particular that the men keep their places in the ranks while the practice is proceeding, to allow no irregularity, and to be alert to prevent accidents. To see that the proper discs are used by the markers. To use his best endeavors to prevent delays, and forward the progress of the firing.

Orders for the Markers.—To see, on taking their places, that they are properly supplied with flags or discs, brushes, paint, etc., and when ready to wave their red flag and withdraw it. To see that the following flags or discs are raised to signal the position of the shots which strike the target, and the "*ricochet* and *danger*," or "*Cease fire.*" 1. Black disc or white flag—outer. 2. White disc with black cross, or similar flag—inner. 3. Red disc or dark blue flag—center. 4. White disc, or red and white flag—bull's-eye. 5. Red flag waved horizontally twice to and fro in front of the target—ricochet. 6. Red flag—danger, and cease firing. To see that the signal flags are invariably waved when the wind blows directly up or down the range; and (where flags only are used) whenever a shot strikes the target to the right of the center, that the flag denoting its value is inclined to the right, and *vice versa*; also, when a shot strikes the target high, that the flag is high as possible, and upright; and when low, that it is raised only high enough to be easily visible above the butt; and when using the disc that it is placed immediately in front of the hit on the target. To see that the "*danger*" flag is hoisted whenever it is necessary to cease firing, to re-color the target, or for any other purpose; and to allow no one *on any account whatever*, to leave the marker's butt until the "*Cease fire*" has been sounded, or the "*danger*" flag has been raised at the firing-points *in answer* to the "*danger*" signal; also to see that the red flag is kept up (and waved so as to attract attention) so long as the markers are out of the butt, or any person is in the line of range. To see that the "*danger*" flag is lowered directly the range is clear. To allow no person to enter the marker's butt, except those on duty, without an order from the senior officer on the range, nor to allow any one to enter or leave the butt except by the regular path. To check all talking or any disturbance in the marker's butt. To see that the "*danger*" flag is hoisted and shaken about immediately; any of the look-out men either hoists his flag or gives notice that persons or boats are within the line of fire, and that it is kept up until the range is clear, and the look-out man lowers his flag. When the firing is at long range, to see that all persons in the marker's butt stand as close as possible to the slope most distant from the target, to avoid the chance of being struck by the bullets when falling. At the first signal to "*Cease firing*" to put out the "*danger*" flag, but not leave the butt. At the second signal, to place their flags, etc., in the proper place, fall in, and return to their command. To report all damage done, or repairs necessary for firing discs, flags, etc.

Orders for Look-out Sentry.—To look out carefully, and the instant any person or animal appears at . . . . , going towards . . . . or along the shore (when firing seaward), coming from . . . . ., to hoist the red flag and call out to the non-commissioned officers in the marker's butt, in a loud voice, "DANGER," and to keep his flag flying until the said person has passed to the . . . . (according to the direction in which he is proceeding). The same precaution to be observed in respect to boats passing close in-shore in the line of range. To give notice to all persons who may be about to pass the range that they are in danger while the firing is going on, and to signal them back. In the performance of his duty (more particularly during the execution of the platoon and skirmishing practices), to keep as low as possible to avoid the risk of being hit by a ricochet shot. To return to his command at the second signal of "*Cease firing*," as prescribed for the markers. The marker in the butts, if not a marker belonging to the range, should invariably be a non-commissioned officer *of a different company from that engaged in firing*, and is responsible that the correct signals are given to the several shots which strike the target. The firing parties should not consist of more than twenty men each, and only one squad should be allowed to practice at a time for each target available. Such detailed arrangements should be made as will insure the various squads being at the firing-points by the time those firing have finished their practice, and in this way prevent delay. When exercising by classes, if there be a choice of time for practice, the senior class is always to have the advantage. The men's names are to be entered in a blank return before going to the practice-ground, in the order in which they stand in the ranks. One blank will answer for the squad assigned to each target to record the performances at two distances. During the practice, an officer or non-commissioned officer is to keep the register, and will, as each shot is signaled, call out its value and the name of the firer. Any objection to the marking must be made before the second shot is fired. All entries during competitions or practice for final classification should be made *in ink* on the practice-ground; should any alteration become necessary, a fine line is to be drawn through the figure or letter, and the correction made adjoining it, the initials of the company officer keeping the register being immediately attached to it (*thus*, 3 : A. L.), to verify the circumstances. Inattention to this regulation, or an erasure (which is prohibited), should invalidate the register. This rule should be adhered to in all cases to prevent complaints. See *Rifle Practice.*



Boxer Shrapnel.

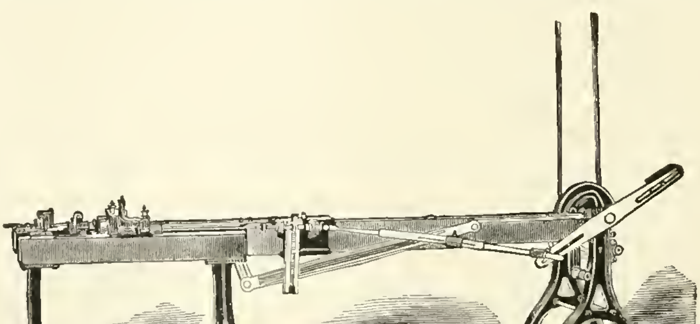
RIFLE SHRAPNEL.—The shrapnel for the 3-inch B. L., rifle, shown in the drawing, are filled in the same manner as the spherical shrapnel. The fuse-hole has a composition bouching by which it is distinguished from the shell of the same gun which has no bouching.

In the Boxer shrapnel for the rifled ordnance of the English service, the essential features of a shrapnel-shell are embodied. This shell has a cylindrical iron body, with a chamber at the bottom, and four longitudinal grooves inside to facilitate breaking up; it is cast without any head. A tin case for the bursting-charge fits into the chamber *on the shoulder* of which rests a wrought-iron disk. The shell is lined with paper, and filled with balls embedded in rosin. A wrought-iron tube passes down the middle of the shell and through a hole in the center of the iron disk, to lead the flame from the fuse to the bursting charge. A hard disk is placed over the top of the bullets. The wooden head is ogival in form, and made of elm covered with thin wrought-iron, which is riveted to the shell. This head contains a socket and bouching for the fuse. See *Case-shot*, *Projectiles*, and *Shrapnel*.

RIFLING.—This operation is performed by means of the rifling machine. The machine is horizontal, and the gun to be rifled is fixed in front of it and in line with the rifling bar, to which a stout head carrying the cutter is fixed. Only a single groove is cut at a time, and that as the cutter is coming down, the bore bringing the chips of metal before it. All the grooves in the gun are first cut out roughly in succession, and then finely. The distance between the grooves is regulated by a disk fixed to the breech of the gun, having its periphery equally divided by as many notches as there are to be grooves. The gun is fixed each time by a pawl, and when a new groove has to be cut is turned round to the next notch. The gun remains stationary while the head carrying the cutter works up and down the bore, so it is necessary to make the bar to which the head is attached turn round more or less at the same time that it advances and returns, otherwise we should merely have a straight groove cut along the bore, instead of the spiral we require to give rotation to the projectile. The gun-metal in which the cutter is fixed fits the bore accurately by means of burnishers. It is fastened to a stout hollow iron bar termed the rifling bar. This bar is fixed to a saddle capable of sliding backward and forward on an endless screw. Although the rifling bar is fixed to the saddle and moves with it, it can revolve independently of it; and toward the end farthest from the gun is fixed a pinion which gears into a rack sliding in the saddle at right angles to the bar itself. The outer end of this rack is fitted with two small rollers or friction wheels which run along a copying bar fixed to one side of the rifling machine. This copying bar is inclined at a certain angle to the side of the machine, and the greater this angle, the more the rack is pulled out by the friction rollers, and the greater the twist given to the rifling bar and so to the grooves in the gun. The angle can be altered if required; and we can also take away the straight copying bar and use a curved one, as is done when a gun is to be rifled with increasing twist. By thus changing the copying bars, or their position, we can use a single machine for any description of rifling. The cutting tool itself is of steel and works in and out of the head, being drawn in or forced out by means of a cam attached to one end of an iron rod passing through the hollow rifling bar.

The movement of the slide to which the outer end of the rod is attached (and consequently of the cutting tool) is regulated by another copying arrangement on the other side of the machine. This arrangement consists of two horizontal bars, one higher than the other, along which travels a weighted lever attached to a pinion which works the slide. When the rifling head is passing down the bore, this weighted lever travels along the upper bar; but when the machine is reversed, the lever is prevented by a small movable piece from returning on the same bar, so that the weight falls over on the lower one, and in doing so draws back the slide and spindle and forces the tool out. By varying the form of the upper surface of this lower bar the depth of the various parts of the groove can be regulated and altered as required.

The drawing shows a light machine used in armories for rifling gun-barrels with a uniform twist, from one turn in 20 inches to one in 36 inches. The cutter-rod carries from one to three cutters, as the rifling is four, five, or six to the circumference. An adjustable feed-stop gauges the depth of the rifling, and the racks, which are of steel, are double, to take up all back-lash, so that the cutters cannot ride on the lands. An oil-pump feeds automatically at each end of the stroke. The carriage is gibbed on the outside of the long slide, allowing free access to its working parts. Weight, 1,600 pounds. This machine rifles by the filing process, which is more correct than the planing process, and will turn out about one gun-barrel an hour. See *Grooves*, and *System of Rifling*.



RIGHT SHOULDER ARMS.—A position in the Manual of Arms, executed as follows: Being at a carry, the Instructor commands: 1. *Right shoulder*, 2. ARMS. Raise the piece vertically with the right hand; grasp it with the left at the lower band, and raise this hand till it is at the height of the chin; at the same time embrace the butt with the right hand, the toe between the first two fingers, the other fingers under the plate. (Two.) Raise the piece and place it on the right shoulder, the lock-plate up, the muzzle elevated and inclined to the left; so that, viewed from the front, the line of the stock from the toe to the guard, shall appear parallel to the row of buttons; slip the left hand down to the lock-plate. (THREE.) Drop the left hand by the side. 1. *Carry*, 2. ARMS. Carry the butt slightly to the left, and lower the piece with the right hand; grasp it with the left at the lower band, the hand at the height of the chin, the barrel to the rear, and vertical. (Two). Resume the carry with the right hand. (THREE). Drop the left hand by the side. Being at a support, to come to a right shoulder, the Instructor commands: 1. *Right shoulder*, 2. ARMS. Grasp the piece with the right hand at the small of the stock, and carry it in front of the center of the body, grasping it with the left hand at the lower band, the hand at the height of the chin. (Two). Carry and place the piece on the right shoulder, the lock-plate up, the right hand embracing the butt; slip the left hand to the lock-plate. (THREE). Drop the left hand by the side. See *Manual of Arms, Fig. 9.*

RIGID DYNAMICS.—That portion of theoretical dynamics which, based on the theory of the free and constrained motion of *points*, applies the principles thence deduced to a *system* of points rigidly connected, so as to bear throughout the whole continuance of their motion the same invariable position with relation to each other; in other words, as no body in nature can be considered as a point, but is truly a system of points, rigid dynamics has for its aim to apply the abstract theory of dynamics to the cases actually occurring in nature. For a long time problems of this sort were not resolved by any general and adequate method, but each class was worked out according to a method especially applicable to its particular circumstances. The great general principle discovered by the French geometer, commonly known as *D'Alembert's Principle*, which applies equally to all such problems, and removes the necessity for specially investigating each particular case, was an inestimable boon to mechanical science. It is thus stated in his *Traité de Dynamique*: In whatever manner a number of bodies change their motions, if we suppose that the motion which each body would have in the following moment, if it were perfectly free, is decomposed into two others, one of which is the motion which it *really* takes in consequence of their mutual actions, then the other component will be such, that if each body were impressed by a force which would produce it alone, the whole system would be in equilibrium. In this way every dynamical problem can be compelled to furnish an equation of equilibrium, and so be changed into a problem of *statics*; and thus the solution of a difficult and complex problem is effected by means of the resolution of a much easier one. D'Alembert applied his principle to various problems on the motions and actions of fluids, the precession of the equinoxes, etc.; and subsequently, in a modified form, the same general property was made the basis of a complete system of dynamics, by La Grange, in his *Mécanique Analytique*.

RIGODON.—Formerly a beat of drum while men who were shelled (a French punishment, the severest next to death) were paraded up and down the ranks previous to their being sent to their destination.

RIMBASE.—1. A short cylinder at the junction of a *trunnion* with the gun. The ends of the rimbases, or the *shoulders* of the trunnions, are planes perpendicular to the axis of the trunnions. Rimbases are for the purpose of strengthening the trunnions at their junction with the piece, and by forming shoulders, to prevent the piece from moving sideways in the trunnion-beds. 2. The shoulder on the stock of a musket against which the breech of the barrel rests.

RIMER.—An old name for a palisade in fortification.

RIM-FIRE CARTRIDGE.—A metallic cartridge in which the fulminate is placed in the *rim* surrounding the head. This rim being struck at any point, explodes the powder. Formerly much used in pistols and magazine-guns. These cartridges are not *reloaders*.

RIMPLER SYSTEM OF FORTIFICATION. In this system it is proposed to replace the curtain by a bastion that may flank the collateral works and be defended by them, to cover the garrison under casemates, and prepare an interior as well as exterior defense. This system contains excellent ideas. The besieger must carry two ravelins before reaching the counterscarp; then he must attack the fausse-braye, the bastion, its retrenchment, and furthermore drive the defenders from the casemates. The ditches and outworks are powerfully flanked, and the retrenchments of the bastions are excellent. This fortification is not practicable on account of the great space it occupies, of the large garrison it requires, and the immense outlay it would necessitate.

RINGED ARMOR. Armor of the Middle Ages, composed of flat rings sewed side by side on quilted linen or leather. See *Armor*.

RING GAGE.—A circular steel gage used in inspecting shot and shells. They are made of two sizes for each caliber, the larger being a trifle more and the smaller a trifle less in diameter than the true caliber of the projectile. All shot received must pass through the larger gage, but are rejected if they pass through the smaller.

RING WADS.—Wads consisting of a ring of rope-yarn, with two pieces of strong twine tied across it at right angles to each other. See *Grommet Wads*.

RIOT.—The legal name of an offense which consists in the assembling of three or more persons for an illegal purpose, or for the carrying out of a legal purpose in an illegal manner. Riots often commence in some supposed private wrong. Some degree of violence is incidental to a riot, and a degree of intimidation to the neighborhood. A riot cannot take place unless at least three persons act in concert. When a riot becomes formidable, it is usual for the authorities to take active measures to disperse it. Thus, in England, any Justice of the Peace may command the persons assembled to disperse peaceably by a form of words called Reading the Riot Act, which is as follows: "Our Sovereign Lady the Queen chargeth and commandeth all persons being assembled immediately to disperse themselves, and peaceably to depart to their habitations, or to their lawful business, upon the pains contained in an Act of King George for preventing tumults and riotous assemblies. God save the Queen." If the rioters, after this formal proclamation, remain more than one hour afterward, they are guilty of felony, and may be seized and carried before a Justice. Sometimes it is difficult to distinguish between an illegal assembly and one which is legal, though noisy and tumultuous, and the opinion of the Justice of the Peace is not conclusive as to its illegality. Sometimes the Riot Act is read more than once during the disturbance, in which case the second or third reading does not supersede the first.

The great and overwhelming interest exhibited by the people of the United States in the late terrible railroad and labor riots in various parts of the country will cause us to extend the limits of this article. At a period of profound quiet and repose, the entire country was startled by the simultaneous seizure by lawless men of the four great trunk lines between the Atlantic Seabord and the Western States. In a single day the whole internal trade of the Union was suspended. Millions of dollars of capital were paralyzed, thousands of enterprises were confronted with ruin, and the whole of this great country was threatened with a crisis such as it had never experienced before. Instantly the whole military power of the general government and the great States immediately involved in the trouble was called upon to give protection to the endangered commerce of the land. The peaceful country resounded with the tramp of armed men hastening to assert the majesty of the law, on the one side; and with the rush of infuriated mobs, on the other side, gathering to resist the execution of the statutes of the land, and to overturn the very foundations of society. Almost without warning the American people were brought face to face with a conflict which for a while threatened their very existence as a nation. The excitement grew steadily, and for a time mob law was supreme. From all points came reports of lawless violence, of pillage, arson and murder. The worst elements of the Old World, that had been driven out of Europe, suddenly appeared, and proclaiming their terrible doctrines of destruction and rapine, endeavored to revive in this prosperous and peaceful land the horrors of the Parisian Commune. The danger was terrible and real, and for a moment the American people stood appalled, not knowing how far the revolt might extend, or what character it might assume. Never since the days of the Civil War had the nation been so profoundly moved, or so painfully apprehensive. On all sides the determination was made plain that the outbreak must be put down; the laws must resume their sway; and the future of this great country must not be perilled by mob violence. No man could tell how soon his home would be the mark of the rioter's torch, or his dear ones be at the mercy of an infuriated mob, and this thought brought hundreds of thousands to the support of the representatives of law and order. At the call of the civil authorities armed men came from all quarters, and it was soon apparent even to the most desperate rioters that the people were determined to preserve their institutions and property from violence at any cost. This formidable uprising of the people had the happiest effect, and the revolt succumbed before it. The disturbers of the peace slunk away, or were arrested, and the supremacy of the law re-established. The very originators of the strikes, horrified at the capture and distortion of their movement by the mob of lawless ruffians, in many instances, gave their assistance to the authorities in restoring order. The New York riots will be here noticed at length, as also the action of the general government. We are endebted to the *History of the Great Riots*, by Edward Winslow Martin, for the substance of this account.

Late on the evening of the 19th of July, 1877, a meeting of firemen and brakemen employed on the Erie Railroad was held at Hornellsville, New York, at the close of which a message was sent to the Superintendent of the Erie Railroad, giving him notice that the men of the Western, Susquehanna, and Buffalo divisions had resolved to quit work at one o'clock the next morning. The Superintendent proceeded at once to Hornellsville, where he found that the strikers had stopped work, and had taken measures to prevent all passenger and freight trains from leaving or passing through that place, east or west. Simultaneously, the firemen, brakemen, and switchmen at Salamanca, on the Western division, quit work, and when the Superintendent of that division, who had started out from Dunkirk for Hornellsville by a special train, arrived at Salamanca, his engine was cut loose from the train and put into the engine-house, and the strikers informed him that no engine or train would be permitted to pass Salamanca. At Andover station, on the Western division, one of the striking firemen took engine No. 22, and went out on the road without orders or permission from the Company, and on the time of trains, intending, he said, to go to Hornellsville. Up to four o'clock in the afternoon of the 20th the strikers had given the Company no reasons for their strike. At that hour their Committee handed Superintendent Wright a document containing the following demands, on behalf of the firemen, brakemen, switchmen and truckmen: That all of the men discharged for taking part in any meeting or going as a Committee to New York shall be reinstated. The brakemen to receive $2 a day, the switchmen $2, the head switchmen $2.25, truckmen in yard $1.50, truckmen on section $1.40, and pay no rentals on Company's grounds except as by agreement. The firemen to have same pay, or rates of pay, as they received prior to July 1st, 1877, and monthly passes to be continued as before, and passes to be issued to brakemen and switchmen. These demands were at once communicated to the Receiver at New York. By their action in seizing the Erie Railroad and stopping its business by force, the strikers not only violated the laws of the State of New York, but were guilty of resistance to the orders of the Supreme Court of the State, the Erie Railroad at this time being managed by a Receiver appointed by the Court. The officials of the Erie Railroad promptly made arrangements to have through passengers and baggage transported by the New York Central Railroad, and at the same time reported the seizure of their road to the Governor of New York, and asked the protection of the State. The Governor thereupon issued the following proclamation:

Whereas, the Receiver appointed by the Supreme Court of this State to take all care of the management of the Erie Railway and its properties has made known to me that a conspiracy has been formed to prevent his discharging his duty as such Receiver under the orders of the said Court: that the business of said road and the running of trains have been interrupted by violence which the civil authorities are unable to suppress; and, whereas, the honor and good faith of the State require that it should protect the said Court and its officers in the execution of its order: Now, therefore, I, Lucius Robinson, Governor of the State of New York, by virtue of the authority imposed upon me by the constitution and the laws, command all persons engaged in such unlawful acts to desist therefrom; and I call upon all good citizens and upon all the authorities, civil and military, to aid in suppressing the same and in preventing breaches of the peace. The law recognizes and protects the right of all men to refuse to work except upon terms satisfactory to themselves, but it does not permit them to prevent other men from working who desire to do so. Unless the State is to be given up to anarchy, and its Courts and laws are to be defied with impunity, its whole power must be exerted to suppress violence, maintain order and protect its citizens in their right to work, and the business of the country from lawless interruption within our borders. It is no longer a question of wages, but of the supremacy of the law, which protects alike the lives, the liberty, the property and the rights of all classes of citizens. To the maintenance of that supremacy the whole power of the State will be invoked if necessary.

Orders were despatched from Albany to the 23d (of Brooklyn) and the 74th (of Buffalo) Regiments of the National Guard of the State of New York to proceed at once to Hornellsville to sustain the authorities. Later on the 54th Regiment, from Rochester, was ordered to the same place. The companies of the 54th were the first to reach Hornellsville. They arrived at that place on the evening of the 21st, about four or five hundred strong. The crowd of railroad men surrounding the trains upon their arrival immediately began shaking hands with acquaintances and gave the soldiers a warm welcome, carrying pails of water along the train. By nine o'clock the Company's grounds surrounding the depot and railroad shops were in full possession of the military authorities. Two pieces of artillery were put in position at the rear of the Company's shops, and guards were stationed around the northern half of the yard, on which the shops and depot are located. As the Company did not attempt to start out a train, there was no demonstration made by the men engaged in the strike, and good order and quiet prevailed throughout the town. The Committee representing the men at the beginning of the strike served a notice on all the liquor dealers forbidding them to sell liquor to railroad men. The President of the village also issued a proclamation to the same effect. This, together with the fact that a large number of railroad men signed the Murphy temperance pledge in the preceding spring, is believed to account for the quiet existing under such exciting circumstances. No marked demonstration was made by the men until twenty minutes past nine on the morning of the 22d. The strikers had informed the railroad officials that they would not interfere with the mails, but that no passenger or freight trains should pass over the road. On the morning of the 22d, the railroad officials, nearly all of whom had gathered at Hornellsville, determined to attempt to run a passenger train westward from Hornellsville. An engine with a postal car attached was coupled to two passenger coaches. The latter were occupied by the Superintendent of the Western division, a squad of soldiers and two or three passengers. Soldiers were stationed on the platform of each car, two were also posted on the engineer's cab. The train then started from the yard guarded for some distance by soldiers stationed on both sides of the track. At Cass street crossing, a short distance beyond, a man attempted to board one of the cars, but he was driven back by the soldiers. From this post, for a distance of about fifty rods, to West street crossing, the track was covered with soft soap. The driving wheels began to slip, and the engineer threw sand on the track, but this was insufficient to give a headway of over five miles an hour. When the train reached West street crossing, about two hundred of the men were assembled. Here railroad torpedoes were thrown under the driving wheels of the engine, but still the train moved on. Men seemed to be reaching the ground from all quarters and by hundreds ran alongside the train. Suddenly it parted between the baggage car and passenger coach, and as the men saw the victory was theirs, with a shout, they took possession of two of the coaches as they came to a standstill and rendered the brakes useless. The soldiers and passengers were ordered out of the cars and obeyed, while the men, with cheers, shoved the cars back into the yard, and the soldiers marched back to the depot. The engine and postal car went on toward Dunkirk. Half an hour later the company started out train No. 7 on the Buffalo division, also guarded by soldiers. As the engine and tender switched off on the Buffalo track, the engine was boarded by the men. Some pushed the soldiers' guns aside and climbed up to the tender; others jumped on the pilot and went over the top of the engine to the cab, when they ordered the fireman, who was an extra man, to get off. After a short parley he was taken from the engine, and the Engineer ran the train back into the yard, the men cheering as before. The crowd of seven or eight hundred men suddenly melted away, and during the remainder of the day there was no disturbance, as the Railroad Company made no further efforts to run their trains. The strikers were very determined, and were prepared for a desperate resistance to the civil and military forces. They had a camp in the woods near Hornellsville, and were well supplied with small-arms and ammunition, besides having two pieces of cannon. They were well organized, and their movements were well directed.

The first detachment of the 23d regiment, nearly 400 strong, reached Hornellsville on the 23d. This brought the military force at that place to a strength of about 1,200 men. The rioters numbered about 2,000 men. About noon on the 23d, a Committee of strikers waited on the railway officials to state their grievances. The Chairman of the Committee made a general statement of the causes which forced the men to strike, and said they had received orders not to commit depredation. They proposed to stop the trains, but not to do violence. He then submitted the following, as the terms which he thought the men would accept and go to work. The wages demanded are just about the same as the Company now pay under the ten per cent. reduction. The brakemen are willing to go to work at the ten per cent. reduction, provided the train men are paid for any overtime that they may make in being ordered out and being abandoned; also any overtime which they may make while being delayed upon the road, to be paid for at the same rate per day; overrate per day to be $1.80. The trackmen in the Hornellsville yard to receive $1.50 per day, and be paid for overtime at the same rate; the trackmen on sections outside of the yard to receive $1.40 per day, and to pay no rentals for their houses, except as they may agree with the Company. The switchmen to accept the ten per cent. reduction, on consideration that ten hours shall constitute a day's work, and all overtime to be paid for at the same rate per hour—$1.80 and $2.05 per day. The firemen to accept the ten per cent. reduction on consideration that their several pay shall be $1.60, $1.92, $2.03 and $2.14, and that all firemen shall be promoted according to age. Coal-passers to be paid the same as before. The Superintendent said he was glad to see them make an effort for peace, but assured them that the Receiver would not go to work upon other terms than he had announced; that the Company could not accede to the demands presented. The Committee then asked if the Committeemen, who had been discharged, would be restored to their former places if the men went to work. The Assistant Receiver replied that they would not. The Committee then retired, being escorted through the lines. Later in the day the following notice was received and promptly published:

The Receiver fully appreciates the fidelity of his officers, agents, and men who have remained true to their duty in the present emergency, and such fidelity will not fail to be properly recognized. No compromise will be made with, and no concession will be made to, those misguided men who are, have been, or may be false to their trust, and violaters of the law. And all persons are warned that no one has the right to represent or speak for the Receiver, except his regular officers. Any other person pretending to do so is an impostor. The Receiver is induced to believe that the large majority of the employés now neglecting their duty are acting under the coercion and terror of lawless and desperate men, most of whom are strangers, and have never been in his service. All well-disposed employés will be protected.

From Hornellsville the disturbance spread rapidly along the line of the Erie Railway. Port Jervis, Corning, Painted Post, Buffalo, and other points were affected, and the Erie brakemen and firemen at all these places joined the strike and stopped the running of the trains. At Buffalo the strikers were exceedingly violent. Early in the afternoon of the 23d, an assault was made by nearly two thousand rioters on about two hundred soldiers who were guarding the Lake Shore round house. The military were obliged to leave the building, which was now barricaded by the mob, who had placed cars in position as defence against an attack. The Colonel of the 65th Regiment, with about thirty men and three officers, proceeded to the round house to retake it from the mob. They were met with yells of derision from the crowd, and, under a shower of stones, were obliged to retreat at the double-quick, and force their way through the yelling crowd at the point of the bayonet, some of the soldiers being badly cut on the hands with knives, and also clubbed. Four of the soldiers lost their muskets, which, however, were afterward recovered. The Colonel was badly clubbed, twice knocked down, forced across the canal, and obliged to take refuge in the Lake Shore paint shop. The Erie strikers did not confine their lawlessness to their own road, but invaded the shops of the Lake Shore and New York Central roads, and forced the men to stop work, and prevented the movements of all freight and stock trains in the depot yard. The Lake Shore men joined in the strike, as we shall see, but the men of the New York Central road showed no disposition to do so. A meeting of citizens was duly summoned by the Mayor of Buffalo, but it was slimly attended, and was captured by the strikers, whereupon it was adjourned by the Mayor. In the meantime the second detachment of the 23d Regiment left Brooklyn on the afternoon of the 23d of July, and reached Elmira shortly after seven o'clock on the morning of the 24th. At this point the Commander was warned that the strikers along the road would endeavor to stop the progress of the train, and accordingly stationed guards on the engine and tender, and on the platforms of the cars. These men were ordered not to fire without cause, but to see that the train was not interfered with. The train left Elmira at 9 o'clock, and reached Corning at 10..22 A. M. Several rioters attempted to board the train, but were quickly forced off by the guards. About one hundred of them gathered around the train, gesticulating and hooting, but making no further demonstration of violence. As the train moved past the depot, the rioters rushed ahead, and turned the switch. The engine was moving so slowly, however, that the train was at once stopped. The mob now hastened up the track and blockaded it by overturning a baggage car upon it. Several locomotives were also injured. The fireman of the troop train now deserted his engine and joined the mob. The track was torn up for a short distance by the rioters, and the advance of the troop train was effectually stopped. At several points higher up the road the track was torn up, and cars were overturned. A construction party was at once organized, and, under the protection of the troops, the track was relaid and the overturned cars righted. The train moved on slowly, at the rate of about one mile per hour, in order to protect the working parties, and reached Painted Post about four o'clock in the afternoon. The strikers were at this time about two miles ahead of the train, and were damaging the road as fast as was possible. Every effort was made to repair the track and enable the troops to come up with the rioters. So successful were these efforts, that at half-past four the troops were within half a mile of the rioters. A strong detachment was immediately thrown out, which, moving rapidly ahead of the train, soon came up with the rioters as they were engaged in tearing up the rails. At the sight of the troops the strikers fled to the woods. The damage to the track was at once repaired, and the train passed on to Addison. From this place no farther trouble was experienced until a point half a mile below Hornellsville was reached. Here the engine, tender and baggage car were thrown from the track by a loosened rail. In consequence of the presence of so strong a military force at Hornellsville, there was no disturbance at that place on the 24th. The leader of the strikers, was arrested and held by the civil authorities. No effort was made to rescue him. All through the 24th there was great excitement at Buffalo, but there was no outbreak. About 600 militia and two batteries of artillery, besides 300 policemen, were held in readiness to move upon the mob at any moment. On the night of the 24th an attempt was made to fire the bridge of the Erie Railroad over the Neversink river, at Port Jervis. Precautionary measures were taken by the Company at the commencement of the disturbances, an increased number of watchmen being stationed at this bridge. This fact undoubtedly saved it from destruction, as the next morning a five gallon can of kerosene oil was discovered under the bridge, placed in such a position that its ignition would have carried the flames to the woodwork of the bridge. It is supposed that the incendiaries became alarmed before the completion of their arrangements, and thinking that they were discovered, fled, leaving the oil behind them. The guards at that point were increased to prevent further trouble.

The Governor issued the following proclamation: "I deem it my duty to invite the special attention of all the citizens of this State, and especially of such persons as are now attempting to interfere by unlawful means with the running of railway trains, to the following act passed by the Legislature at its last session: Chapter 261. An act to Punish Trespassing on Railroads, passed May 10th, 1877: The people of the State of New York represented in Senate and Assembly do enact as follows: Section 1.—Any person who shall wilfully place any obstruction upon any railroad, or loosen, tear up or remove any part of a railroad, or displace, tamper or in any way interfere with any switches, frogs, rail, track, or other part of any railroad, so as to endanger the safety of any train, or who shall wilfully throw any stone or other missile at any train or any railroad, shall, upon conviction thereof, be punished by imprisonment in a State prison, not exceeding ten years, or be liable to a fine not exceeding $1,000, or by both such fine and imprisonment. Sec. 2.—This act shall take effect immediately. I warn all persons engaged in the violation of the above law to desist therefrom, and I call upon all sheriffs, magistrates, district attorneys and other civil officers, and upon all good officers to aid in the enforcement of the said law, and of the punishment of all who are guilty of its violation, and I hereby offer a reward of $500, to be paid upon the arrest and conviction of each and every person who shall be guilty of a violation of the said act. The failure or omission of any sheriff, district attorney, or other civil officer to take the most active steps in his power to enforce the provisions of this act will be considered sufficient cause for his removal." This proclamation had a happy effect in all parts of the State, and especially upon the line of the Erie Railroad. The offer of a reward was certain to sow discord in the ranks of the rioters, and convert some of them into informers.

Feeling themselves strong enough to enforce the law, the civil authorities at Hornellsville now determined to open the Erie Railroad to traffic, and to arrest the more prominent of the rioters. It was decided to enforce the law, even should a conflict with the rioters be necessary; and the 26th of July was fixed as the day on which the effort was to be made. In the meantime several prominent gentlemen of the place exerted themselves to bring about a settlement and avert the necessity of using force. Warrants were issued for the arrest of over one hundred of the rioters, and the 23d Regiment was assigned the duty of supporting the civil officers in making these arrests. Orders were issued for the regiment to be ready to move at six o'clock A. M. on the 26th. The Gatling guns were prepared for immediate use, and the regiment fully counted upon a sharp conflict with the mob. The railroad officials had a number of detectives among the rioters, and every movement of the strikers was known, as well as the location of their various camps. Few of the rioters were seen in Hornellsville, or in the immediate vicinity of their camps, but at a given signal they could have assembled at least 900 men. On a hillside overlooking the military and railroad head-quarters their outposts could be distinctly seen by day, and at night scores of moving lanterns gave evidence of their vigilance and activity. In different portions of the woods, and not remote from the line of the road, they had over half a dozen camps, which had been provisioned by plundering the freight cars in the depot yard at the beginning of the strike. The strikers' camps would have been surrounded early on the morning of the 26th, but during the night of the 25th a settlement was effected between the railroad officials and the rioters.

An effort was made by the strikers on the Erie Railroad to bring on a strike on the Lake Shore Railroad, which extends from Buffalo to Toledo, and forms a part of the New York Central's line to Chicago. The disturbance began at Buffalo, where the Lake Shore men struck on the 22d, and prevented the passage of freight trains. At Erie, Pennsylvania, and other points along the road, the train men joined the strike, and stopped the trains, but no further violence was attempted. No trains were allowed to run on the line between Buffalo and Erie, it having been determined not to undertake to run any trains until the strikers ceased their interference with the road. The Atlantic express from Chicago reached Erie at eleven o'clock on the morning of the 24th of July. It consisted of four fast mail cars, with heavy mails, two baggage cars, and four well-filled passenger cars. In accordance with orders from the President the train was run upon a side track and declared abandoned. The passengers were much incensed, and tried to urge the strikers to run the train through to Buffalo. The strikers partially consented, fired up an engine and attached it to the train. The Superintendent of the Buffalo division telegraphed to prevent the strikers from taking out the train. A meeting of the strikers was held at the depot at three o'clock in the afternoon. The mayor, sheriff, and a posse of police were on hand to preserve order. The mayor advised the men to let the train alone and not to interfere with the Company's orders. The chief of the strikers also advised the same course. The engine was then taken off, run into the round house, and the train was left on the siding. It contained about one hundred through passengers for New York, and the cars for the time were converted into a hotel. About half-past six o'clock the Chicago and St. Louis express came in from Chicago, and, like its predecessor was run upon a side track and abandoned. The trains were held at Erie until the morning of the 26th, when, it being certain that the strike was at an end, they were ordered to proceed to Buffalo. From this time the trains were run regularly over the Lake Shore road. It was believed that the strike would certainly extend to New York city. That city is the eastern terminus of the New York Central & Hudson River Railroad, and there the Company have vast interests at stake and give employment to several thousand men. The city of New York is peculiarly circumstanced. It contains a large class of professional criminals, and a larger multitude of idle and reckless men. In addition to these, there are many men of foreign birth, who, while pursuing some means of support, are thoroughly imbued with communistic ideas, and are ready at any time to make war upon the existing state of society. These classes make up a formidable section of the population of New York. It was feared that should the strike extend to New York, these classes would make it a pretext for riot and violence. New York being the wealthiest city of the Union, and one of the great financial centers of the world, always offers inducements to a mob of desperate characters to engage in an outbreak in the hope of plunder. The hard times from which the whole country was suffering had pressed very heavily upon the workingmen of New York. Many were out of work, and all were more or less discontented. In case of an outbreak it was certain that the rioters would be largely reinforced from this class.

The leaders of the communistic societies of New York, which associations are made up almost entirely of foreigners who have in many cases been members of similar organizations in Europe, regarded the exciting period as a fitting time to test the strength of the popular sympathy with them. They determined to hold a public meeting ostensibly for the purpose of expressing sympathy with the workingmen engaged in the strikes, but really to test their strength in New York, and see if they could command sufficient outside aid to enable them to bring on an outbreak. The permission of the authorities being necessary to enable them to hold such a meeting, they applied to the Police Commission for leave to hold their meeting in Tompkins Square. Their request was promptly granted, and a call was issued for a mass-meeting of the Trades Unions at Tompkins Square on the night of Wednesday, 25th of July, to express sympathy with the men engaged in the strikes in other parts of the country. The true character of the proposed meeting was well understood throughout the Union, and considerable surprise was manifested at the course of the New York authorities in allowing the meeting to be held. The Police Commissioners were convinced, however, that to prevent the meeting would be to increase whatever excitement and discontent might exist among the laboring classes, and that the best way to deprive the Communists of their influence was to permit them to hold their meeting and show their designs. They felt confident that the great mass of the workmen of New York were not in sympathy with any communistic schemes, and that they would be alienated from them to a still greater extent by their public proclamation. They, therefore, decided to allow the meeting at Tompkins Square. At the same time it was resolved to have a strong, well-armed force of police at hand to put down any attempt at an outbreak, and to be ready to support such action with the entire police force and the military. The commissioners felt fully confident of their ability to deal with the mob, and meant to show them that the city authorities were not afraid of them.

The meeting was held at the appointed time, and was watched with the keenest anxiety by the whole country. All felt that it would decide whether there would be a general communistic revolt, with its accompaniments of bloodshed, pillage, and arson, or whether the authorities were strong enough to enforce the laws. If the mob got the upper hand in New York, it was generally said, the terrible results would spread to the whole country; if the authorities could prevent an outbreak, the insurrection would receive its death blow.

The following resolutions were read to the meeting:

Resolved, That the workingmen's party of the city and county of New York tender their heartfelt sympathies to the railroad men now on strike in different localities in the country.

Resolved, That we consider all legalized chartered corporations, such as railroad, banking, mining, manufacturing, gas, etc., under the present system of operation, as the most despotic and heartless enemies of the working classes.

Resolved, That their acts of tyranny and oppression have been the cause of demoralizing thousands of honest workingmen, thereby driving them to acts of madness; desperation and crime that they would not otherwise have been guilty of had they been justly dealt by.

Resolved, That as these chartered companies have been the primal cause of their employés' miseries and of their consequences, we hold them morally responsible for all acts of violence that proceed from and are the legitimate results of their tyranny and oppression.

Resolved, That we view with alarm the growing influence and power of these corporations over the legislation of the State and nation, and believe if that influence continues, the executive, judicial, and legislative branches of the government will become totally demoralized, the rights of the masses destroyed, and, instead of the voice of the people, the power of the almighty dollar will become absolute and supreme.

Resolved, That we do earnestly request and advise all the working classes throughout the country to unite as speedily as possible for the purpose of forming a political party, based on the natural rights of labor. Let us make common cause against a common enemy.

Resolved, That nothing short of a political revolution through the ballot box on the part of the working classes will remedy the evils under which they suffer.

Resolved, That it is the purpose of the workingmen's party to confiscate through legislation, the unjustly gotten wealth of these legalized and chartered corporation thieves that are backed by the Shylocks and moneyed syndicates of Europe and of this country.

Resolved, That we love law and order, peace and tranquility, justice and righteousness above all else, and deprecate anything and everything that will pervert them, and that we are ever ready to give our lives in defense of the inherent rights of man.

The following address was made to the President of the United States: We, the workingmen of the city of New-York, in mass-meeting assembled, acting from a sense of duty, and prompted by true feelings of humanity and a sincere desire for peace and harmony in society, do earnestly and respectfully call your attention to the serious condition of affairs now existing, and which have existed for some time past between the operatives and the officials of the mining and railroad corporations in several States of the Union. The crimson tide of the life-blood of citizens, soldiers, and hardy workmen have already mingled in sanguinary strife. The heavens have been lit up with the lurid glare of incendiary fires that have reduced to ashes millions of property. Men have fallen beneath deadly blows dealt by unseen and unknown hands, until it seems as if evil days had fallen upon us as a nation. Three millions of the bone and sinew of the country converted into wandering vagabonds, and a large portion of those employed on the verge of starvation. Do these evils that have assumed such magnitude and proportions as to necessitate the issuance of a proclamation on your part to preserve the peace, come within the scope or jurisdiction of national legislation? Whatever may be the cause of these evils, the only remedy applied so far as been the hangman's rope and the soldier's bullet. Think you, Mr. President, these are effectual and permanent remedies that will insure henceforth peace and good order in society? We think not. Whatever cause produces these antagonistic relations between employer and employé must be sought out and removed. We address you, Mr. President, because you are one having great power and authority conferred upon you by the Constitution. You are Commander-in Chief of the armed forces of these United States, and during the recess of Congress they are at your absolute disposition. Need we suggest to you the wisdom of extreme caution in the exercise of your national military power, lest the breach of the peace be widened, class feeling intensified, and public safety more endangered? We think, Mr. President, that the situation of affairs is of such an important and alarming character that they justify on your part the immediate calling of an extra session of Congress. These terrible occurrences and disturbances between the employers and employés of mining and railroad companies that have startled and shocked the community of late involve, as you well know, what is termed the relations between labor and capital. Many are of the opinion that any interference or action on the part of the government to adjust these relations are contrary and inimical to the genius and spirit of modern civilization and republican institutions; that the function of the government is simply to prevent any violent collisions in society resulting from the antagonistic relations of these two elements performing such important functions in the affairs of human society, and that throughout the history of the world so far have been eternally at sword's points with each other. Those who take this view of the matter seem to overlook the great fact that legislation has always dealt with at least one of these factors—namely, capital; and has almost entirely ignored the other—namely, labor; which is, in our opinion, the primal cause of the present difficulties. Had legislation afforded the same opportunities and guaranteed the same rights and privileges to labor that it has to capital these evil days would not have befallen us. When railroad kings can build palaces to live in, costing millions, and others die bequeathing hundreds of millions to their children, and boast while living that they never troubled themselves about the election of representatives, but bought them up after they were elected, and used them as a means to enrich themselves at the expense of their employés and the general public, it seems about time to consider whether or not legislation cannot confer some justice and rights upon labor as well as privileges to capital. We have always considered that law should be the synonym of justice. Has not Congress the power under the Constitution to govern and control, for the benefit of the whole people, the highways and water-courses of the nations and regulate its internal commerce and trade? Is there any constitutional law that prohibits the State or general government from controlling or supervising the mineral resources of the nation? Should not, also, the telegraph system be connected with our postal department? and last, but not least, a governmental monetary system established that would supersede the present individual corporate banking institutions that are nothing more nor less than parasites on the body politic. All of these chartered institutions exist by a system of dividends or profits that proceed directly from the laboring classes. In their efforts to make those dividends the blood and marrow are extracted from labor, until finally, maddened and desperate by the exacting tyranny of capital, rendered ignorant and brutish by poverty, it resorts to brute force and violence to redress its wrongs. It cannot be expected that men acting under the impetus of starvation should act wisely or well, or adhere to moral principle. The very individuals who are most loud in their denunciation of the acts of the strikers, placed in their situation, might do, possibly, if they had the courage, far worse. We, as a class, view with alarm the growth and power of these gigantic corporations. Wielding thousands of millions of dollars' capital as a power they are fast demoralizing and corrupting the executive, judicial and legislative branches of the governments of both State and nation; and the rights of labor and the liberties of the common people, if we continue on in this course, will soon be swept away (and here let us state that a member of your Cabinet, has recommended as a measure of political reform in this State the restriction of suffrage on the basis of a moneyed qualification, thereby offering a direct insult to every workingman in this State); and when they are gone the revolution commences and the emancipation of the white wages slaves of the North will cost the Republic more blood and treasure than ever the emancipation of the black chattel slaves of the South did, and God knows that cost enough. We look to you, Mr. President, to be vigilant in respect of our interests and welfare, for the prosperity and perpetuity of this nation rests upon the principle of justice to labor. Class legislation is the ruin and eventual downfall of any nation.

After reading these resolutions and the address the following speech was made in support of the same: We are here to-night to propose a remedy for strikes and hard times. Our remedy is that government shall become the superintendent of education, property and trade, and the employer of the people on the basis of equal rights, opportunities and equitable compensation. Our motto is, "No Rich, No Poor." The age in which we live is pregnant with great political and social problems which are forcing themselves upon us for solution, and as we are more favorably circumstanced than other nations the duty rests with us of experimenting in the science of sociology until the hallowed object of perfecting human government is accomplished. Though thus far our efforts have not been crowned with the degree of success that was anticipated and formidable obstacles still remain to be overcome, let us not relax but rather redouble our efforts to stay the swelling tide of corruption and strife and to inaugurate an era of virtue and peace. The gigantic proportions of peculation and fraud developing in political circles and the increase of crime and inequality throughout the land are mortifying to us as a people, and, as the scheming speculators and legalized monopolists are growing richer and the useful classes poor, a crisis will soon be reached most fearful to contemplate, unless measures are speedily devised to arrest the evil.

We live upon a land flowing with the milk and honey of human subsistence, yet gaunt poverty sweeps over society, spreading distress, crime and premature death. Mammoth storehouses are filled to repletion with the products of industry, while thousands of producers famish for want of bread. Dense forests and rank grass cover millions of fertile acres, while houseless, homeless, anxious laborers loiter in the market begging for the privilege to toil. The development of labor-saving machinery marvellously increases the power to produce wealth, which should lighten the burden of the workmen and advance the prosperity of society; whereas it is swerved from a true and healthy course and enters into harmful competition with those whose living depends upon a demand for their labor. Though the earth teems with annual harvests and the hands of labor produce an abundance of every convenience and luxury of life, yet, under the baneful influence of a defective system of government, which fails to protect its citizens in the enjoyment of their equal and natural right to the soil, and under an Ishmaelitish system of commerce and industry, which regards land, as well as products, as an article of traffic and monopoly, society is divided into landlords and tenants, capitalists and laborers, rich and poor, and conditions of anxiety and antagonism are engendered which poison every sphere of social life. After a careful investigation of the causes of political and social evils we are constrained to believe that they are the legitimate effects of an anti-democratic feature in our government and of an antagonistic system of industry and commerce. Therefore, to expect a prosperous condition of affairs by a mere change of officers, the exposure of fraud or the denunciation of crime, while the present system remains unchanged, is to expect results contrary to the nature of things, for the opportunities open to our public officers to acquire wealth by an abuse of the power reposed in them and the fabulous fortunes often realized through legalized methods of fraud prove too great a temptation for frail human nature to resist. Therefore, when a reform has to be undertaken (to be successful) it must be supported by the whole people that feel oppressed; and as they are largely in the majority, they have the power to speedily and peacefully change the form of government under which we live. The necessity of a thorough change is manifest, and numerous are the plans proposed and the efforts made to mitigate the evils complained of; but mitigation is not enough. We believe the time has passed for fragmentary propositions of reform to awaken any considerable degree of enthusiasm in the people or to be of any permanent value to society if accomplished. Though the efforts to extend the right of suffrage, the formation of trade societies, protective unions, strikes for more equitable terms of time and wages, etc., are praiseworthy manifestations of the right spirit, and have been and still are valuable as a means of education; yet to arrest the further growth of fraud and remove the giant evils there is need of a more comprehensive scheme than any hitherto proposed, one that shall conserve the best interests of every useful class and calling, and unite their scattered forces in one consolidated army of progress. To realize the necessary reform and place the future developments of society upon a harmonizing upward grade, the government and industry of the country should be reconstructed upon the principles of natural right, political equality and mutual protection, and there are two methods by which this may be accomplished. The most speedy one is by political action, and the other is by the organization of labor on the basis of mutual interest. We live under governments that may be peacefully so amended by political action as to secure the sovereignty of the people, and the subordination of their legislative and executive officers, making them just in principle, wise in policy, and honest in administration. But the present constitutions exclude a majority of citizens from a voice at the polls, and set aside the cardinal principle of popular sovereignty by clothing the legislators with authority to enact laws, grant privileges, and appropriate public property without submitting their acts to the people for ratification (technically the referendum). Further, acting under their authority, the officers to whom their administration has been committed have issued depreciated currency, have chartered banks and legalized interest on money, and thereby imposed upon society the most oppressive system of aristocracy (except that of the land) that ever afflicted the civilized world. Therefore the governments are unjust in principle, unwise, partial and oppressive in legislation, and complex, extravagant, and subject to fraud in execution. Therefore, we present the following propositions of reform for the consideration of the people of this country, believing them to be true, and their adoption necessary for our prosperity as a nation:

First. All members of the human family are entitled by nature to use sufficient of the common elements (land, water, air and light) to maintain their existence and properly develop their being.

Second. Land being an inalienable natural right (to which all men are alike entitled), and not property, should be supervised by government for the use of its citizens upon the basis of equality.

Third. The unconsumed property and other advantages resulting from the experience of the past should be a common inheritance to the living generation.

Fourth. The currency of a nation should be issued by government only, be a legal tender and bear no interest, thereby protecting the people from the snares and frauds of gambling money-changers.

Fifth. As all just governments derive their powers from the consent of the governed, the right of suffrage should be secured to every citizen of mature age, without regard to sex or condition.

Sixth. To sweep away the present multitudinous and vexatious laws, and to introduce a more simple code, more easy to understand and observe; also to protect society against usurpation and peculation by public officials, and help to educate the people in political science, the government should be democratic. Though legislation may be done by representatives, the people should reserve the sovereign right to ratify or reject the acts of their public servants, and to protect the personal rights of the individual against any undue legislation in respect to freedom of speech, religious belief, habits of dress and diet, and the like.

Seventh. So long as the existence of an army or navy may be deemed necessary, they should be remodelled to correspond with the principles of equal pay and rations; and opportunities should be afforded to rise from the ranks to the command, and from the forecastle to the quarter deck.

Eighth. To avoid the evil consequences of official patronage and party bias, all officers should receive their commissions direct from the people, while clerks, mechanics and other operatives should be taken from the list of competent applicants, as their names stand recorded, or be drawn, as the names of jurors are drawn, from the wheel.

Ninth. To secure the greatest advantages of economy and convenience resulting from the improvements of the age, and to guard against the cupidity of contractors, the fraudulent principle of interest on money, the impositions of the banking system, and the extortions practiced by railroads, gas companies and other organized monopolies, the system of contracting public work should be abolished, and all public improvements, such as post roads, railroads, gas works, water works, mining operations, canals, post offices, telegraphs, expresses, etc., should be public property and be conducted by government, at reasonable rates, for the interest of society.

Tenth. To advance material science, develop the resources of the country, and protect the useful classes against the avarice of capitalists or the derangements of trade, the various branches of useful industry should be instituted by the government upon equitable principles, as to time and compensation, and thereby furnish employment to those who might otherwise be idle and suffer the pangs of poverty, or be tempted to crime.

Eleventh. To provide for the proper education of the people, schools, colleges and institutions of science should be supported by the government, and be free to all; and to enable the people to convene frequently to consider subjects of public interest, and review the acts and propositions of their public servants, the primary or public school houses should be open at least two evenings in each week for the use of the people.

Twelfth. The greatest degree of benefit to be realized from combined effort will flow from the most comprehensive union of interests, upon the principle of equality; to attain which, government must ultimately absorb and direct every department of use, extending to the citizens equal opportunities, equal compensation for services performed, and equal protection in seasons of sickness, disability and old age. Accordingly, let us hasten the realization of a just and wise system of government, established upon the principles above stated.

Fairly computed, there were probably less than ten thousand persons on the ground. Nearest the stand were the internationalists and society men; next to them a row three or four deep of mere listeners; and on the rim an ever-moving congregation of idlers, who only served the purpose of deluding one into the belief that it was a great throng. The crowd was generally tame and apparently aimless. It lacked enthusiasm. The speakers themselves seemed to feel the want of sympathy that is ordinarily expressed in hearty cheers, and were content with the mild hurrahs of the few malcontents who surrounded the platforms. The railway men did not put in an appearance, or if so, in such small numbers that their presence was not notable, while of societies the representation was small and without organization. In fact, judging from the comments of the more intelligent, the occasion was regarded as one which had been created for the benefit of a few demagogues and ward politicians, rather than for the illustration of any broad principle. From the beginning to the end of the meeting there was not the slightest exhibition of a dangerous purpose on the part of the gathering, and incendiary remarks, whether in English or German, fell upon the ear still-born. The orators had apparently lost heart. The stands were thronged with noisy boys, and there was an utter want of the vim and snap that characterizes an ordinary political meeting. Perhaps all this result was due to the fact known to every person on the ground, that while not a policeman showed his uniform in the crowd, or invited the slightest antagonism, five hundred sturdy men, armed to the teeth, were within earshot, ready to sweep down on the instant at any point where a disturbance might occur, and nearly a thousand more were in reserve, waiting with ready hands to preserve peace and maintain the fair name of the metropolis. Certain it is, that the so-called "dangerous class" of New York, if they were present, never in their history witnessed such a masterly preparation to punish, and, if necessary, crush them, as was then shown. The action of the police force was simply superb. The men seemed to rise out of the ground, and when the meeting dissolved, and the four calcium burners that had been used to light the square were extinguished, the long blue line that reached across the square, and steadily pressed before it those who loitered, told the story in five minutes that communism in New York was a fiasco and a fraud. The utmost good nature prevailed, the sidewalks of the square rang with the cries of hucksters, women and children lined the steps of the adjacent houses, or innocently elbowed their way among the multitude, and faces generally wore anything but the expression of excitement or anxiety which might be expected to attach to the occasion. Of the eight or ten thousand thus assembled, probably not more than three thousand were actively identified with the trades unions and international societies, and many of the former openly expressed their condemnation of the attempt of a few men to create further trouble and distress at this time. The bulk of the crowd was composed of people who curiously desired to see what was going on, and took good care to be sufficiently near the highways to make an early exit in case of a demonstration by police or military.

The intervention of the military power of the Federal government in behalf of the endangered railroad property of the country was a phase of the great outbreak which was certainly not contemplated by the strikers in commencing their movement. When the Governor of West Virginia called upon the President for assistance, there was a feeling of general surprise throughout the country: and when it was learned that the force sent in answer to his call numbered but a few hundred men, it was feared by many that it was not in the power of the general government to deal with such a movement as vigorously as it demanded, inasmuch as the army was too small and was scattered over so wide an extent of country. In addition to this, the use of the Federal army in the affairs of the States under the previous administration had so shocked the best sentiment of the country that many persons feared the employment of the army in the present instance would lead to results equally deplorable. The course of the President and his advisers proved in the main entirely satisfactory to the country, and demonstrated that the constitutional use of the army is in no way dangerous to the independence or reserved rights of any of the States; and the firmness and moderation which marked the action of the government called forth praise from all parties. The task before the President was a very delicate one; he was to fulfill his constitutional duty of protecting the States against internal disorders which they could not suppress, and he was at the same time to treat the disturbance as a matter strictly within the jurisdiction of the State, or in other words he was not to take the enforcement of the laws out of the hands of the State authorities, but was merely to sustain them in their efforts to suppress the disorder; and to do this he must place the Federal troops under the orders of the Governor of the State into which they were sent, and must still retain the general direction of them. In other words, the Federal troops were to be so many policemen loaned to the States to enable them to execute their laws. Happily for the whole country, the President was fully imbued with this view of his duty in the matter, and his course was in accordance with it.

The presence of the United States troops had every where the happiest effect. Though the detachments sent to the various points of danger were small, they were everywhere respected, and feared by the rioters. Their discipline and steadiness made it certain that they would obey orders literally and promptly, and the character and experience of the officers were a guarantee that while they would deal with the disturbance with forbearance and moderation, they would also put down resistance to them promptly and with vigor if called upon to act. Wherever the regulars appeared, the rioters slunk away; not a hand was raised against them; and their service was confined entirely to guard duty. The force at the disposal of the government was, as has been said, small and was scattered over the whole country. It became necessary to concentrate as strong a force as possible in the States of West Virginia, Maryland and Pennsylvania, and at the earliest moment. For this purpose detachments were brought from the Atlantic coast ports, and the troops that had been stationed in the Southern States by President Grant for political purposes were moved northward to the scene of danger. The policy of the government was to act with caution, but also with vigor and promptness. This line of conduct was strictly adhered to. The troops behaved with admirable firmness, paying no attention to the jeers and insults of the rioters, and avoiding in every way giving provocation to the mob. During the whole disturbance, the Signal Corps of the army rendered important service, in forwarding to the war department news of the events at their respective posts. The despatches of the signal officers were regularly laid before the Cabinet, and were always found free from exaggeration and thoroughly reliable. The government came to depend upon them as its most accurate source of information.

The *North American Review* for September to October, 1877, contained two articles relating to the strike, which are of so much interest to those interested in the question that we give the substance of them here: The first is from the pen of Colonel Thomas A. Scott, the President of the Pennsylvania Railroad. Colonel Scott, after reciting the history of the troubles, and stating the necessities of the rail road companies, makes the following deductions: This insurrection, which extended through fourteen States, and in many cases successfully defied the local authorities, presents a state of facts almost as serious as that which prevailed at the outbreak of the Civil War. Unless our own experience is to differ entirely from other countries—and it is not easy to see why it should, with the increasing population of our large cities and business centers, and the inevitable assemblage at such points of the vicious and evil-disposed—the late troubles may be but a prelude to other manifestations of mob violence, with this added peril, that now, for the first time in American history, has an organized mob learned its power to terrorize the law abiding citizens of great communities. With our recent experience before us, it is believed that no thoughtful man can argue in favor of delay by the proper authorities in dealing with lawless and riotous assemblages. Delay simply leads to destruction of property, and may lead in the end to the destruction of life. The force used to repress such assemblages should be as prompt in its manifestation as the evil with which it deals. The interests concerned are too grave to admit of delay. The raising of the black flag and the stoppage of all vessels on the Great Lakes and on the Mississippi and Ohio rivers would not produce one tithe of the damage to the whole country that has resulted from the recent stoppage of the great trunk lines. The burning of the vessels and their cargoes on these waters would raise a storm of wrath which no mob would dare to face, and would be visited by the United States government, under existing laws with most exemplary punishment. But what distinction can be established between such a crime and the hideous destruction at Pittsburgh of over one thousand eight hundred cars laden with the products of the various States, together with the engines ready to move them to their destination, and the station buildings and machine shops that were absolutely essential to their proper care and movement, and which, with other like doings, resulted in the stoppage of all commerce and business relations between the States not only on one highway, but on many important lines, through the concerted action of the mob and its leaders? In the city of Pittsburgh much human life and many private dwellings and other property were sacrificed as the result of mob violence; indeed, it is almost a marvel that a large portion of that city was not destroyed by fire. Only the prevailing direction of the wind averted greater and more general disaster.

The authority of the United States, now potent to protect commerce moving upon the waters, should be equally potent when the same commerce is exposed to greater peril upon land. This brings us then, to the practical question: In what shape can this protection be put so as to be extended most efficiently and with the least delay? The present regulations all favor, unintentionally, the rioters and the mob. In the first place the Mayor of a city must exhaust his power, the Sheriff of the county must essay his strength; then, while precious time is expending—for a mob constantly attracts dangerous elements and grows with impunity and success—the Governor of the State must be called upon by the Sheriff of a county. If the State happens to have an effective military organization, which at the present time is the case in perhaps not more than five out of thirty-seven States of the Union, the Governor can call out the military forces and suppress the riot. If the State has no such organization, or if the military forces of the State prove inadequate to the emergency, the Governor is paralyzed, and must call upon the United States for assistance. If the authorities of any State should, for any cause, fail to refuse to call upon the United States government, what possible remedy or protection is left to life and property within the limits of that commonwealth?

It can readily be seen what frightful possibilities of mischief are afforded by the necessarily long interval which must elapse in the present state of laws before the Federal authority can intervene in cases where its intervention is most imperative. In fact, as our recent experience has shown, the only roads which could procure prompt protection and immunity from interference were those whose misfortunes had made them bankrupt, and placed them in the direct custody of receivers appointed by the United States Courts. To the aid of these roads the United States Marshal could call the United States troops, and no rioter dared to resist the power represented by the small but admirably disciplined detachments quartered near the scenes of recent troubles. It will hardly be contended that the railway companies must become bankrupt in order to make secure the uninterrupted movement of traffic over their lines, or to entitle them to the efficient protection of the United States government. If a bondholder or other creditor is entitled to the protection of the Federal courts to prevent the threatened impairment of the value of a property through legal proceedings, he certainly should not be left without remedy against lawless violence which has actually destroyed the security for his investment, and has, as at Pittsburgh, converted millions of dollars into scrap iron and ashes. The laws which give the Federal courts the summary process of injunction to restrain so comparatively trifling a wrong as an infringement of a patent-right, certainly must have been intended or ought to give the United States authority to prevent a wrong doing, which not only destroys a particular road, but also paralyzes the entire commerce of the country and wastes the national wealth. It is demonstrable that during the recent disturbances the government of the United States was itself a direct loser, and through the government the tax-payers of the whole country to a very large amount, by the diminution of the national revenues arising from the interruption of business and the interference with many of the operations on which the internal taxes of the country are levied, as well as by the diminution of the customs revenues as all the imports during this period, instead of being forwarded to their destinations, were necessarily placed in store, of course without payment of any duty to the government for the time being. Suppose that this state of things had continued for sixty days, would not the United States government have been deprived of nearly all the revenues on which it relies to meet its current obligations?

Certainly it cannot have been contemplated in the formation of our government that the United States authorities should submit to see the transportation of the mails, covering the enormous financial and business transactions of the whole country, and the movement of supplies required for its own various departments, made dependent upon the grace and favor of rioters, whose misconduct in almost any other form would have secured their immediate arrest and condign punishment. During the recent riots the movement of United States troops was impeded at several points, and large quantities of ammunition and other Federal stores on their way to the Pacific coast were forcibly detained for days. The operations of the national government in some parts of the country were as completely blocked as in the early days of the Civil War. There certainly should be a protection against such dangers, and a remedy for such wrongs. If the government of the United States is to exercise its power of protection or of remedy, it perhaps can do so only through an adequate exhibition of the military force that may be given it for such purposes by Congress. The important question is to ascertain in what way the government can so exhibit its military force as to secure the utmost possible efficiency in the enforcement of law and order, without jarring or disturbing the general framework of our institutions and our laws. It seems to be indispensable, in the light of recent events, that whatever force is to be used by the government in such emergencies should be so distributed and controlled that it may be concentrated upon any point or points that may be threatened within a few hours of any outbreak. Several companies of regular troops that were quartered at Baltimore, Philadelphia, Pittsburgh, Reading, Scranton, Louisville, Chicago, and other places, during the recent riots, had to be transported for such distances that, if they had been compelled to march instead of moving by rail, they would have been powerless to avert mischief. It was only by the fear or favor of the rioters that the United States were able to concentrate their forces where they did. In some cases formal resolutions were passed by the strikers that no troops should be allowed to pass over the lines. In Jersey City a mob endeavored to prevent the departure of a United States battery and the troops connected therewith. On the Erie Railway, between Cornell and Hornellsville, a few lawless men, by tearing up tracks, destroying bridges, and tampering with switches, were able seriously to retard the military forces of the State, which were there under the orders of the Governor to re-establish law and order. What is needed, therefore, would clearly seem to be that proper forces should be so disposed at prominent points—large cities and other great business centers, in many of which the government has arsenals, custom-houses, mints, navy yards, and other property of its own to protect—that their movements can be combined rapidly and they be directed against points of danger, so as to be able to act effectively and with decision before violence can become triumphant.

With the experience of other countries to warn and guide us, and especially with the experience of England, where the rights of the people have for ages been guarded and asserted as jealously as they always have been and should be among ourselves, we shall have only ourselves to blame if, through apathy, demagogism, or weakness we leave ourselves unprepared to meet an issue which, from all the evidences of the times, is only too likely again to be forced upon us. With the approach of winter, and the loss of out-door employment which severe weather, even in the most prosperous times, entails, the country will have to deal not only with the deserving among the unemployed, who can be reached and helped through local organizations, but with vast numbers of idle, dangerous and, in many cases, desperate men, who have been allowed unfortunately to catch a glimpse of their possible power for mischief. Such men, unless confronted by a thorough organization in the cities States and other communities, backed by the power of the Federal government and an unmistakable public opinion, will need but little urging to renew the scenes which have already brought such disgrace upon the American name. It surely may be hoped that at the approaching session of Congress the earnest, unprejudiced and patriotic men of both houses will discuss this grave subject independently of party lines, and with the united resolve to secure equity to all interests, and to take all necessary measures to secure protection to life and property and impartial enforcement of the laws, including the guarantee to every man of the right to work for such compensation as he may agree upon with other men, free from interference or intimidation. The able lawyers of the Senate and House will perhaps frame a law which will give to the owners of every highway carrying inter-State commerce, whether by land or water, in which citizens of different States are interested, or carrying the United States mails or other government property, the right to appear by petition properly verified before the tribunal of the United States, in order to show that the movement of such traffic has been interfered with by unlawful combinations, by threats or by violence, and which, upon such showing, will give these tribunals the right, when necessary to call upon the United States, in the form now authorized by law to enforce their process by arresting the rioters and the suppression of all such unlawful combinations.

The magnitude of the evil to be met and dealt with can hardly be overstated. The remedy to be provided should be equally prompt and effective. It must be discussed and adopted in the interest of the whole country, and not of any particular class; for the interests of all classes of our citizens are the same in the maintenance of domestic peace and civil order. But to no one class in the community is an absolute assurance of peace so important as to the men who have no capital but their labor. When the accumulations of labor are put in peril by lawlessness, capital may always protect itself by suspending the enterprises which give labor its value and insure its reward. Anarchy not only deprives the laboring man of his present subsistence, but puts in jeopardy all his hopes of improvement for his own future and the future of his family.

The second article referred to is entitled "Fair Wages," and is signed "A Striker," and contends that the rights and value of labor, which were acknowledged here forty years ago because the country wanted hands, now turns the laboring men's earnings against them, and the country's prosperity becomes their disaster. The writer concludes as follows:

Let us put this matter in a plain way, as we understand it, and use round numbers, instead of fractions, as we have to deal with hundreds of millions, dividing the subject into sections.

"*First.* In the United States the amount of capital invested in railway property last year was $4,470,000,000, made up of $2,250,000,000 capital stock, and $2,220,000,000 bonded debt. The gross earnings were $500,000,000, or about eight and a half per cent on the capital. The running expenses (of which the bulk was for labor) were $310,000,000, leaving $185,000,000 as interest to the capitalist, or barely four per cent. on his investment. Labor is admitted into this enterprise as a preferential creditor, to be paid out of the gross earnings before the most preferred mortgagee or bondholder receives a dollar. For, as capital could not build the roads nor equip them without labor, so the enterprise, when complete, cannot be run without labor. Capital, therefore, takes a back seat when it comes to the push, and acknowledges not only that labor has the largest interest in the concern, but takes the first fruits. I take the railroad as a sample out of all enterprises, and if we could get at figures, there is no doubt it is a fair sample of the crowd. If, then, labor is the more important and essential factor in the result, when it comes to the question which of the two shall suffer in moments of general distress—the capitalist in his pocket or the laborer in his belly—we think the answer has been already settled by the rights assumed by one and acknowledged by the other.

Second. It is manifestly unjust that the workingman should be subjected to under wages in bad times, if he has not the equivalent of over wages in good times. If railroad companies in concert with the laboring class had established a tariff of labor, and paid a bonus on wages at every distribution of dividends, that bonus being in proportion to the profits of the road, so that each man becomes a shareholder in his very small way, then he would have submitted to bear his share of distress when all were called on to share trouble, but to share it equally and alike.

Third. When folks say that labor and capital must find, by the laws of demand and supply, their natural relations to each other in all commercial enterprises, and neither one has any rights it can enforce on the other, they take for granted that the labor 'market' is like the produce market—liable to natural fluctuations. If that were so, we should not complain. But it is not. The labor market has got to be like the stock and share market—a few large capitalists control it and make what prices they please. This sort of game may ruin the gamblers in stocks and injure those who invest, but the trouble is confined mostly to those who can afford it. But not so when the same practice operates in the labor market. The capitalist must not gamble with the bread of the workingman, or if he does, let him regard where that speculation led France one hundred years ago, when the financiers made a corner in flour, and the people broke the ring with the axe of the guillotine.

Fourth. When the railway companies obtained privileges and rights over private property, and became, by force of law, the great landowners of the State, holding its movable property as well, and controlling every avenue and department of business, public and private, they became powerful monopolies. The State endowed them with powers to frame laws of their own, and deprived citizens of their property, means, facilities of transport, to vest it all in their corporations. Thus endowed, they cannot pretend they are no more than ordinary commercial enterprises. They are responsible to the State for the result of their operations if they disturb fatally the order of our concerns. They are not independent. The State has claims upon them it has not on private concerns. They may not accept liabilities and then decline responsibility. It behooves the State to decide what the people are entitled to in return for all they have conceded to these companies, and to enforce such claims.

Fifth. The English Parliament legislated on the question of the number of hours a workingman should labor. It limits them to so many. It legislates for his health and supply of light and water. In all these matters the capitalist has an interest. (He does as much for his horse.) But when it comes to the question of a proper amount of food and clothing, of warmth and shelter, the government declines to interfere. It leaves the question of fair wages to be adjusted between employer and employed."

Commenting upon these articles, *The Philadelphia Times* pertinently said: "The chief importance of these two articles lies in the fact that they are written by men who represent what are supposed to be the two most opposite views of the labor question. One is the leading railroad man of the country, the head of the great corporation which had to stand the brunt of the recent outbreak of violence. The other, though unknown to fame, is evidently a fair representative of the restless, discontented spirit that actuated that outbreak, and though he cautiously deprecates a resort to violence he leaves no doubt as to where his sympathies were. And yet neither of these representative men really discusses the questions involved with any thoroughness. Mr. Scott, indeed, makes no pretence of doing so. He merely presents, at the editor's request, some practical thoughts suggested by his own observation and experience during the recent troubles, and these very naturally relate to the preservation of order and the prevention of riotous outbreaks, rather than to the causes of remedies of any existing trouble. The 'striker,' on the other hand, has nothing to say or to suggest except that men are entitled to 'fair wages,' and if the capitalist attempt to 'gamble with the bread of the workingman,' he must 'regard where that speculation led France one hundred years ago.' Unfortunately the capitalist, as the railroad man for example, has had too much reason lately to 'regard' this piece of history, which he has seen repeating itself under his own eyes, and it is a little disappointing to find that our representative striker has no very definite suggestions to offer as to how 'fair wages' are to be secured at a time when capital is making no profit at all."

Mr. Scott's reflections upon the strikes are such as would be natural to any man who had been compelled to sit still and see the property under his charge destroyed in the absence of any adequate power to protect it; who had witnessed the failure of the local and even of the State authorities, and the fatal delays of a system that was never designed for such an emergency, and who felt the interests intrusted to him secure only when the strong arm of the Federal government was at last stretched out to protect them. Naturally and justifiably, Mr. Scott would strengthen those defences of law and order which his own experience has found most trustworthy. He would rely upon the Federal power to protect the commerce between the States, and would provide for the prompt and speedy exercise of this power in every great emergency. We doubt if the country will follow him in this, or be willing to relieve the local authorities from the responsibility for the protection of property and the preservation of order within their jurisdiction.

There is one thing, however, in Mr. Scott's paper which all classes will readily recognize, and that is the entire confidence which he displays in the honor and intelligence of American workingmen and his practical belief in the community of interest between employers and employed. A railroad president represents both the owners and operators of the road, and it concerns the one class quite as much as the other that the business of the road shall be safely carried on. It is probable that he would not even dissent from the 'striker's' proposition, that when it comes to a question of which shall suffer in moments of general distress the demands of labor come first, since this has been practically acknowledged by everybody, and countless capitalists have done without their earnings within the last year that laborers might have bread. So, too, with the only practical suggestion which the *North American's* 'striker' has to make, that workingmen, if they are to be subject to under wages in bad times, should have the equivalent of over wages in good times, since that is also generally acknowledged and in a limited sense has been generally acted on. If any system of dividing a proportion of the profits among employés would secure contentment and universal happiness, there is little doubt that employers would gladly adopt it and would find it profitable; only such a system is much more easily suggested than fully elaborated and carried into effect. The first thing that we need is to learn to discuss these subjects temperately, and in a spirit of mutual trust, and it is a good sign that the most conservative and eminently respectable periodical in the country has undertaken to direct the discussion into a profitable channel. It may be only an accident that the representative employer approaches the subject in a more catholic spirit than the representative striker, but it shows at least that the leading men of the country are willing to meet the issues of the day and anxious to solve them for the good of all alike."

While the troubles we have detailed were in progress in the State of New York, many other States and localities throughout the United States were already or rapidly becoming involved in disturbances in many cases more violent and deplorable. About the middle of July, 1877, the Baltimore & Ohio Railroad Company made a reduction of ten per cent. in the pay of its employés. The pay of all the employed, of whatever grade, was equally diminished, no invidious distinctions being made. All accepted the change quietly except the firemen and the men who run the freight trains. The first-class firemen on this road had been receiving $1.75 per day; the reduction brought their wages to $1.58. The firemen of the second class were reduced from $1.50 to $1.35 per day. These men refused to accept the reduction, and stopped work. As soon as this became known, numerous applications were made to the company, by men out of work, for employment in the places of the men who had "struck." The company, having the large unemployed class along its line to choose from, had no difficulty in filling the places of the strikers, generally with experienced firemen who were eagerly seeking employment. Here the matter might have rested had the sober good sense of the strikers come to their aid. They had refused to work for the wages offered by the Baltimore & Ohio Company, and had abandoned their post. In so doing they had exercised an undisputed right. Having left the service of the company, they should have recognised the fact that they had no longer any interest in its action, and should have sought employment elsewhere. Unfortunately for themselves and for the whole country they chose a different line of conduct, and one which changed the sympathy which the country had felt for them in their privations to the sternest condemnation of their lawlessness. The leaders of the strikers now resolved to compel the railroad company to recall the order for the reduction of wages. They believed that they could accomplish this by taking forcible possession of the road at certain points, and preventing the passage of all freight trains until the company should be driven, by the loss of its business, into an acceptance of their demand for a return to the old wages. They did not seem to be aware that by seizing the property of their late employers, and stopping the business of the road, they were assuming the character of criminals and committing offenses against the laws of the land of so grave a nature that the authorities would be compelled to crush them by force.

On the morning of the 16th of July, about forty firemen and brakemen of freight trains on the Baltimore & Ohio Railroad, in Baltimore, refused to accept the reduction in their wages, which was to go into effect that day, and stopped work. The strikers assembled at Camden Junction, about three miles from Baltimore, and stopped a freight train, persuading the fireman to leave his engine, and refusing to allow another to take his place. At the request of the railroad officials, the city authorities sent a police force to the spot and dispersed the strikers. The trains were then run during the day without further delay. This, however, was but the beginning of the trouble. The news spread rapidly along the road, and the disaffection soon reached Martinsburg, in West Virginia, Cumberland, in Maryland, and Keyser, Grafton, and Wheeling, in West Virginia, the most important points on the line of the road, the last named place being its western terminus. At Martinsburg the Baltimore & Ohio Company have large shops, and there is always a large concentration of the rolling stock and employés of the road there. As soon as the news was received from Baltimore the firemen and the brakemen stopped work and took part in the strike. They numbered about one hundred men. They assembled about the depot, seized the road and the engines, and compelled the men who were willing to work to leave their places. No freight trains were allowed by the strikers to move either way, and all arriving at Martinsburg were compelled to halt; the engines were uncoupled and run on to the side tracks, and the firemen and train hands joined the strikers. The railroad officials, finding themselves powerless, applied to the Mayor and city authorities for protection. The strikers were ordered by the Mayor to disperse and cease their unlawful interference with the property of the railroad company, but refused to obey the command, which the officials were unable to enforce.

The Governor of West Virginia called for assistance, and the President directed the Secretary of War to send a sufficient force at once to Martinsburg. At the same time he issued the following proclamation to the rioters: *Whereas*, It is provided in the Constitution of the United States that the United States shall protect every State in this Union on application of the Legislature, or of the Executive when the Legislature cannot be convened, against domestic violence; and *Whereas*, The Governor of the State of West Virginia has represented that domestic violence exists in said State at Martinsburg, and at various other points along the line of the Baltimore & Ohio Railroad, in said State, which the authorities of said State are unable to suppress; and, *Whereas*, By laws in pursuance of the above it is provided (in the laws of the United States) that in all cases of insurrection in any State, or of obstruction to the laws thereof, it shall be lawful for the President of the United States, on application of the Legislature of such State, or of the Executive when the Legislature cannot be convened, to call forth the militia of any other State or States or to employ such part of the land and naval force as may be necessary for the purpose of suppressing such insurrection or causing the laws to be duly executed; and, *Whereas*, The Legislature of said State is not now in session and cannot be convened in time to meet the present emergency; and the Executive of said State, under section 4 of Article IV. of the Constitution of the United States and the laws passed in pursuance thereof, has made application to me in the premises for such part of the military force of the United States as may be necessary and adequate to protect said State and the citizens thereof against domestic violence, and to enforce the due execution of the laws; and, *Whereas*, It is required that whenever it may be necessary in the judgment of the President to use the military force for the purpose aforesaid, he shall forthwith, by proclamation, command such insurgents to disperse and retire peaceably to their respective homes within a limited time: Now, therefore, I, Rutherford B. Hayes, President of the United States, do hereby make proclamation and command all persons engaged in said unlawful and insurrectionary proceedings to disperse and retire peaceably to their respective abodes on or before twelve o'clock noon on the 19th day of July instant, and hereafter abandon said combinations and submit themselves to the laws and constituted authorities of said State, and I invoke the aid and co-operation of all good citizens thereof to uphold the laws and preserve the public peace. In witness whereof, I have hereunto set my hand and caused the seal of the United States to be affixed.

Disaffection continued to spread along the road. The passenger and mail trains had not been interfered with thus far, but the strikers at Cumberland, Keyser, Grafton, and other points, were firm in their determination that no freight trains should be run. At Keyser, on the night of the 19th, a meeting of workmen was held, at which the following resolutions were adopted: *Resolved*, That we, the men of the Third Division, will abide by the decision of our brother divisions in regard to wages in the future, and that we will stay by them in the present trouble until such decision is arrived at, as we have been oppressed by our superior officers beyond endurance. *Resolved*, That we, the men of the Third Division, have soberly and calmly considered the step we have taken, and declare that at the present state of wages which the company have imposed upon us, we cannot live and provide our wives and children with the necessaries of life, and that we only ask for wages that will enable us to provide such necessaries. *Resolved*, That we uphold the other divisions in the step they have taken in regard to the present trouble.

At Cumberland matters were especially bad. There, as at the other points on the line, the original strikers had been joined by large numbers of idle and disreputable persons, who were attracted by the hope of plunder. The mob, thus constituted, held the depot and yards and set the city authorities at defiance. As the trains sent out from Martinsburg reached Cumberland, they were stopped by the rioters, and the engineers and firemen were forced to abandon their posts. Thus the blockade, which had been broken at Martinsburg by the Federal troops, was established with equal rigor at Cumberland. At Wheeling, the western terminus of the main line of the Baltimore & Ohio Railroad, the excitement was very great. The men employed there stopped work, and joined in the strike, but attempted no violence. The company attempted to fill the places of the strikers with a party of men from Steubenville, Ohio, but the new comers were warned off by the strikers, who threatened them with assassination if they went to work. The state of affairs along the line of the Baltimore & Ohio Railroad had now become so threatening that the force of regulars was largely augmented. The troubles continued to increase, and brought on the Baltimore riots.

One of the Baltimore papers, commenting upon the character of the mob in that city, said: "The number of railroad employés engaged in the rioting here has from the first not exceeded 150; but at the outset of the affair they were joined by thousands of laborers and mechanics out of employment, and by the entire criminal masses of the city, eager for an occasion to plunder. A large number of men besides these, in various occupations, who have suffered a reduction of wages of late, are in a sullen temper with their employers and with capitalists generally. They imagine that they have been wronged, and welcome what they think is an attempt of the railroad men to right a similar wrong. Some have actively aided the rioters, and nearly all have fermented the movement by reckless and inflammatory talk. The communistic character of the riots is shown by every incident. The mob which assailed the 6th Regiment, Friday night, was not composed of railroad men, but was a miscellaneous assemblage of laborers. The crowd that stoned the United States troops to-day probably had not a single striker in its midst. So of the gangs gathered up by the police in the numerous combats around Camden station last night. Some were thieves and rowdies, and others were workingmen, usually well-behaved, but now crazed by the excitement of the outbreak. It is a notable fact that most of the men who yelled "bread" in the crowd that surged against the lines of the police and the soldiers last night had evidently money enough to buy whiskey, for they were half-drunk. Some of the strikers affirm that they and their friends were taking no part in the lawless acts, and that the movement has passed altogether out of their hands. The prejudice against the Baltimore & Ohio railroad among the working classes, and to some extent among people in the higher walks of life, furnished at the beginning a strong fund of sympathy to sustain the strike. It was currently believed that the policy of the company has been to starve its men in order to keep up its ten per cent. dividends. There is no doubt that this prejudice was the real basis of the outbreak. Desperate men took advantage of it to defy the law, relying upon popular support."

The troubles were not to be confined to the States of Maryland and West Virginia. About this time the Governor of Pennsylvania caused the following telegram to be forwarded from Harrisburg to the President of the United States:

Domestic violence exists within the State of Pennsylvania in the City of Pittsburgh and along the line of the Pennsylvania Railroad, and other railroads in said State, which the authorities are unable to suppress, and the Legislature of Pennsylvania cannot be convened in time to meet the emergency. I have, therefore, to request that in conformity to the Constitution the government of the United States shall furnish me with military force sufficient to suppress disorder, and to protect persons and property against domestic violence.

The President at once complied with this demand, and issued the following proclamation:

Whereas, It is provided in the Constitution of the United States that the United States shall protect every State in this Union on application of the Legislature, or of the Executive when the Legislature cannot be convened against domestic violence; and, *Whereas*, The Governor of the State of Pennsylvania has represented that domestic violence exists in said State which the authorities of said State are unable to suppress; and, *Whereas*, the laws of the United States require that in all cases of insurrection in any State, or of obstruction to the laws thereof, whenever in the judgment of the President it becomes necessary to use the military forces to suppress such insurrection or obstruction to the laws he shall forthwith by proclamation command such insurgents to disperse and retire peaceably to their respective abodes within a limited time: Now, therefore, I, Rutherford B. Hayes, President of the United States, do hereby admonish all good citizens of the United States and all persons within the territory and jurisdiction of the United States against aiding, countenancing, abetting, or taking part in such unlawful proceedings, and I do hereby warn all persons engaged in or connected with the said domestic violence and obstruction of the laws to disperse and retire peaceably to their respective abodes on or before twelve o'clock noon on the 24th day of July instant. In testimony whereof, I have hereunto set my hand and caused the seal of the United States to be affixed.

At the same time President Hayes ordered General Hancock to proceed to Philadelphia with such troops as could be spared from Baltimore, and orders were despatched to the Eastern posts to reinforce General Hancock at Philadelphia with every available man. On the same day orders were issued by the Governor of Pennsylvania placing the entire militia force of the State under arms. In the meantime the strike spread rapidly along the line of the Pennsylvania Railroad, from Pittsburgh eastward. At eleven o'clock on Saturday, July 21st, the train men of the Pennsylvania Railroad at Altoona struck, and taking possession of the road and shops at that point, refused to allow the passage of freight trains. They were joined by a large number of tramps and loafers from the city, and towards nightfall numbered several thousand men. No disturbance was attempted on Saturday. On Sunday the 22d, the news from Pittsburgh was received and created great excitement. The rioters declared that no more troops should pass Altoona on their way to Pittsburgh; and when it was announced, early on Sunday morning, that a detachment of 250 men under Generals Beaver and Lyle, were nearing the city, the strikers prepared to stop them

The train bearing the troops entered Altoona slowly and cautiously. As it reached the depot the engine was taken off, in order that a heavier engine might be connected with the train for the purpose of taking it over the mountain west of Altoona. The mountain engine was backed out of the round house, but as it appeared, the rioters, who had surrounded the depot to the number of at least 3,000 men, and who were terribly excited, took possession of the engine and returned it to the round house. General

Beaver then ordered his men to march down and bring the engine out again, but upon reaching the round house they were surrounded by the mob, and finally surrendered their arms. Practically, then, General Beaver was left without any command, except the men under General Lyle and Colonel Snowden, about 160 all told, and all Philadelphians. These troops remained at the depot in a broiling sun for an hour and a half, and were then ordered down the track to break into the round house in order to get the motive power to take the train over the mountains. The mob had increased by this time to fully 5,000 excited and violent men. This round house is situated on the side of a cut, and between two bridges which cross the road. The troops passed under the western bridge, eastward from the round house, the hillside on the right being dense with rioters, the houses on the left being occupied by strikers, and a mob filling the two bridges. The men were armed, some with the muskets surrendered by the Clearfield militia. About twenty of the strikers were guarding the gate of the round house, and when the troops had been marched up prepared to force the gate, the mob showered upon them every vile epithet, threat, and insult that could be invented, and gave them every reason to apprehend that any attempt to open the gate by them would be the signal for an instantaneous and terrible assault.

The rioters crowded up against the troops, standing shoulder to shoulder with them, shaking their fists in the faces of the men, and throwing stones, some of which wounded a number of the Weccacoe Legion. The rioters—those who were armed—stood with vindictive looks, their right hands resting upon their hips or thrust in their breasts, as if prepared to shoot at the slightest provocation. Having received information that the piston-rod of the locomotive had been removed, and the fires drawn from the furnace, it was concluded not to essay the effort of taking out an engine; that was useless, and to incur a foolish sacrifice of life. The troops would have been at a great disadvantage, and had a conflict taken place, would have been severely handled. They withdrew from the vicinity of the round house when the condition of the locomotive was ascertained.

A body of strikers then offered the troops a special train to the east, if they would promise to leave. This was declined, however. Colonel Snowden finding, upon inquiry, that it was impossible to go west on account of obstructions to the road and inability to secure an engine, determined upon a feint, by going east, as if to Philadelphia, and upon reaching Huntingdon to go south and endeavor to make Pittsburgh from that direction, or await the arrival of reinforcements. Upon nearing Huntingdon, Colonel Snowden received a dispatch stating that the rioters had assembled there in force, and that the train on the road to Bedford had been overturned and the road completely blockaded.

Colonel Snowden then telegraphed to the superintendent of the Harrisburg division whether the troop could get to that city, and the reply came that transportation could not be furnished to that point on account of the condition of the mob assembled in the depot, and determined not to allow the troop to return. This mob, he was assured, numbered 3,000 strong, and was vowing revenge against the troops, because, as was reported, they believed them all pecuniarily interested in the Pennsylvania Railroad. In order to avoid any destruction to railroad property, which the superintendent thought would surely ensue if the troops came to the city, he refused to give them transportation. The command then traveled east, and dropped off at Bailey's Station, about twenty-three miles west of the State capital, and waited there for the 7.30 accommodation train (Monday morning) to proceed to Rockville. On the train they were joined by a number of General Lyle's men, who had returned from Altoona, the General remaining at that place, where he was ordered to await further orders. It would have been perfect folly for the troops to remain at that place a moment later than they did, owing to the inflamed condition of the strikers. It was upon a calm review of the situation that Colonel Snowden took the responsibility of coming eastward, after all his efforts to get to Pittsburgh had failed.

At Bailey's Station the men had no breakfast, and were in poor condition when they got to Rockville. Here the Philadelphia troops separated from the other soldiers on the train, and marching down the track, apparently making for the Harrisburg depot, but after tramping for a mile or so, they took the road to Englestown. It was necessary to keep the purpose of this movement a secret, even from the other soldiers who had determined to go direct to town. Some of the rioters soon learned that these troops had left the track, and it was surmised they had taken the Northern Central road, and were going by the city in that direction, and endeavored to intercept them.

The other troops took the track, and were captured, as we shall see farther on. In the meantime, however, Colonel Snowden, with all his men, and all their accoutrements and clothing, even to their heavy overcoats, took the Englestown road, and made a long circuit of about twelve miles to Progress, a village about two miles northeast of Harrisburg, and thence in a direct line marched to the State arsenal, thus completely deceiving the rioters, who had formed their plans with great care to capture the troops, who executed their movement without the loss of a single article belonging to the command, and reached the arsenal about five o'clock on Monday afternoon. From this time until the arrival of the Governor and the State forces, on their way to Pittsburgh, the situation at Altoona remained unchanged. The rioters held possession of the road, allowing no freight trains to pass, but making no effort to interfere with the passenger trains. The strikers at Harrisburg began their operations on the morning of Sunday, July 23d. About ten o'clock several railroaders, encouraged by a large number of persons, went to the locomotives of several freight trains, and demanded that the engineers and firemen should leave their engines. The demand was readily complied with, and as the railroad men descended from their engines they were greeted with loud cheers from their friends. There had been indications on Saturday night of a strike along the middle division, but the railroad authorities were unwilling to believe that trouble would take place. The interference with a freight train and the hooting and stoning out of soldiers who passed through for Pittsburgh from Philadelphia were attributed to irresponsible outsiders by them, but all their hopes were dispelled on Sunday morning at ten o'clock, when, at the command of several apparent strangers, the engineers and firemen of several freight trains descended from their locomotives after having housed them. All the freight trains were deserted. The round houses in the upper portion of the city contained about forty locomotives, and over twelve hundred cars were standing on the sidings in the same vicinity. The strike was general on the middle division, between twelve and fifteen hundred being affected by it. Of these four or five hundred were employed in Harrisburg, most of them in the Pennsylvania round houses. A crowd collected at the Pennsylvania depot early on Sunday morning, and by two o'clock in the afternoon it had swollen to several thousands. Many of them congregated out of idle curiosity, but a considerable number were attracted by a determination to interfere with the passage through the city of several hundred Philadelphia soldiers destined for Pittsburgh. It was also believed that among the military would be several companies of negroes, and against them numerous dire threats were made. The ammunition for the expected white troops had been got in readiness at the State arsenal, but it was deemed prudent, considering the excitement at Altoona and in the city, to countermand the order, and the ammunition was returned to the arsenal. Had any of the military arrived, it is highly probable they would have encountered considerable difficulty in passing through the city, the ringleaders in the strike having expressed determination to throw all possible obstacles in their way.

A meeting of three or four thousand people, many of them railroaders, was addressed on a common, a few hundred yards above the depot, by a man named Torbett, who justified the strikers in their course and predicted their triumphant success. He counselled them not to destroy railroad or other property. He intimated that if attacked by troops they had a perfect right, in self-defence, to strike back, as their brethren had done in the affray at Pittsburgh. Torbett spoke from the top of a box-car, and when he referred to the military he was loudly cheered. After the meeting the crowd surged toward the depot. About eight o'clock the day express east, detained nearly five hours by the car fire at Pittsburgh, arrived.

The crowd gathered about the train, and several persons detached the engine several times, when the railroad officials ordered the engine to be taken to the round house. The passengers were compelled to lie over at Harrisburg. On the train were about a dozen soldiers, who had grown tired of the service which they had rendered at Altoona. Quite a number of them were sick; and one of them, named Ballenger, a perfumer, of Philadelphia, who had been sunstruck, was taken to the Harrisburg hospital for treatment.

The principal arsenal of the State of Pennsylvania, containing a large supply of arms and ammunition of all kinds, is located at Harrisburg. The ammunition for the troops called into service by the Governor was being prepared there. In view of the threatening condition of affairs, it was deemed best to station a guard of city troops at the arsenal. This was done on Sunday, and the force was increased during the next day or two as rapidly as possible. By direction of the State authorities seven cannon, occupying a position in the Capitol grounds, were spiked, on Sunday afternoon, as a precautionary measure

During the day the Mayor of Harrisburg issued a proclamation, calling upon the people to desist from gathering in crowds on the streets, and to remain quiet until an amicable settlement of the troubles could be had; and requested the saloon-keepers to close their houses during the excitement. The proclamation was unheeded, and the Mayor attempted to address the mob later in the day, at the depot, he was rudely hustled aside. During Sunday and Monday the rioters had everything their own way at Harrisburg. The police force of that city numbered twenty men, and was too small to offer the slightest resistance to the mob. No violence was done by the strikers to property, because no resistance was offered to the will of the mob. The railroad officials promptly withdrew their trains where opposition to their running was displayed by the mob, and no effort was made to risk the company's property. The workmen in several of the large industrial establishments in the city stopped work and joined the strikers, who were also reinforced largely by the roughs and disreputable classes of the town. During the night an attempt was made to throw a train from the track as it was coming into Harrisburg by the Reading Railroad, with several companies of State troops, but the effort very fortunately failed.

On the 22d, the train men at Columbia, 103 miles west of Philadelphia, and an important point on the eastern division of the Pennsylvania road, joined the strike. All engines were housed, and no freight trains were permitted to move either way. During the day several attempts were made to get engines out of the round house, of which the strikers held possession, but the rioters boarded the engines, ordered the engineers and firemen off, and ran the locomotives back into the house. The excitement was very great and increased daily, the strikers, as usual, being joined by all the disreputable and dangerous characters of the place. On the afternoon of the 24th the rioters compelled a force of track men to suspend work, taking their picks and shovels from them, and marching them into the town like prisoners. They declared that if they were interfered with, or if troops were sent to Columbia, they would fire the railroad buildings and trains. The authorities were powerless to deal with the trouble, and no effort was made to disperse the rioters, who remained in possession of the company's property until the appearance of the Governor backed by a strong military force, induced them to cease their violence and return to their duty. Philadelphia, as has been said, is one of the most important points on the Pennsylvania Railroad. It is also the second city of the Union, with respect to population, and the chief manufacturing city of the new world. Several lines of railroad center there, and thousands of workingmen find employment in the various industrial establishments. Like all large cities Philadelphia contains a large class of vagrants and criminals, who would be exceedingly troublesome to manage in case of a riot of any degree of importance. It was certain that the strike on the Pennsylvania Railroad would extend to Philadelphia, and by no means sure that the employés of the other roads entering the city would not follow the example of the Pennsylvania men. It was therefore of the highest importance that measures should be taken at once to prevent the strike from assuming the character of a riot. As has been related, the President of the Pennsylvania Railroad, promptly called upon the city authorities for protection for the company's property in the city of Philadelphia, and the Mayor responded to this request by detailing a force of 150 policemen, for duty in the vicinity of the depot and yards of the Pennsylvania Company at West Philadelphia. The city military companies were sent to Pittsburgh on Friday, the 20th, and from that time the duty of protecting all the vast interests at stake in Philadelphia devolved upon the Mayor and police force.

Philadelphia was profoundly excited by the news from Pittsburg on the 22d. Until a late hour of the night, the streets were thronged with persons eager to learn the news from the scene of trouble. For the first time since the close of the civil war, the afternoon papers issued Sunday editions, which were quickly bought up, and read with the most painful interest. It was understood that the train men at the West Philadelphia yards would join in the strike, and there was a very general fear on the part of the citizens that the strikers would be thrown aside, as they had been at Pittsburgh, by the mob, and that Philadelphia might be the scene of a terrible outbreak. Such, indeed, would have been the case but for the admirable conduct of the Mayor and his subordinates, and the gallantry of the police force.

Upon the receipt of the news of the fighting and conflagration at Pittsburgh, the Mayor, who had established his head-quarters at the West Philadelphia depot, issued the following proclamation to the people of Philadelphia:

Whereas, Violence, tumult, and riot exist in various portions of this Commonwealth, to the great injury of domestic industry and trade, and to the discredit of the fair name and fame of American institutions and her form of government, the perfection of which we last year celebrated in this the city of the Republic's birth; and, *Whereas*, It is of the highest importance that the great name which Philadelphia has made for herself among the nations of the earth during the Centennial year shall be preserved, and that she shall be spared the horrible scenes enacted in our sister cities: Now, therefore, I, William S. Stokley, in the name of the Commonwealth of Pennsylvania, and by virtue of the authority vested in me by law, do appeal to all citizens, of every occupation and calling, to render it unnecessary that, in the performance of my duty, I should be called upon to suppress outbreak and violence, which I assuredly will do if the occasion requires it, and hand over the offenders to condign punishment. And I make this appeal in the firm belief that the citizens of Philadelphia appreciate, as I do, the importance of maintaining peace and good-will among all classes of society, and I hereby pledge myself to give a patient hearing, and to do impartial justice, as I best know how, to all persons who desire it. Let all the people resume and continue their lawful occupations, and avoid assembling and organizing together for discussion or otherwise at the present time. This is the surest and best means of preserving the honor and fair name of the City of Brotherly Love.

The Pennsylvania Railroad was not the only sufferer from the strike in Pennsylvania. The roads extending through the coal regions soon became involved in it. The first outbreak in this section of the State occurred on the night of the 22d of July. The militia had begun to assemble in obedience to the orders of the Governor, and some companies had started for Harrisburg, at which place they were ordered to report. To prevent them from reaching their destination a party of rioters, on the night of the 22d, set fire to the Lebanon Valley Railroad bridge over the Schuylkill at Reading. The bridge was entirely consumed and the direct communication between Reading and Harrisburg broken. The loss to the Reading Railroad Company by the destruction of this bridge was $150,000. On the 23d there was great excitement at Reading, and during the day the city was in a state of riot and disorder. The railroad men formed but a part of the disorderly throngs; the greater part of these crowds consisted of loafers, disreputable characters, and tramps.

The General Manager of the Reading Railroad appealed to the Sheriff to call out his posse to protect the railroad and the company's property. This the Sheriff declined to do. Little or nothing was done by the city authorities to check the disorder, and during the day the rioters had their own way. About nightfall a detachment of the 4th Regiment from Allentown arrived at Reading. The tracks being torn up, the soldiers were obliged to leave the cars and march to the depot. The main line of the Philadelphia & Reading road passes through Reading on Seventh Street. Penn Street is the main highway, running in an opposite direction from, and crossing Seventh Street at right angles. From Penn Street northward, for two squares, two lines of track are laid leading to the new depot. These are laid through a deep cut with a heavy stone wall twenty feet high on each side. From the moment of leaving the cars, the troops had been threatened by a furious mob. The officer in command, in view of the threatening demonstrations of the mob, decided that it would be better to march to the depot through the deep cut, the steep sides of which would afford better protection to his flanks than could be had in the open street. He therefore directed his march towards the cut, but the soldiers had scarcely entered it before they were greeted with a terrible volley of stones from the sides of the cut, where the greatest crowds had assembled.

Pistol shots were also fired at the troops. Upon reaching Penn Street the regiment was attacked by another mob and lost patience. One of the men, without orders, discharged his piece, and immediately the regiment fired a volley into the mob. By this discharge ten persons were killed and forty wounded. Many of these were innocent bystanders, as is generally the case. The mob scattered and fled in terror, and the troops marched into the depot, in which they took up their quarters. Guards were stationed about the building, and citizens were not permitted to enter it. The firing upon the mob by the 4th Regiment produced the greatest excitement in Reading, and the death and injury of so large a number of innocent persons intensified this feeling. The troops were severely denounced by the citizens, many of whom joined the mob, and were loud in their threats of vengeance, committing in their unreasoning anger the mistake for which the people of Pittsburgh paid so terribly. Still, as it was necessary to take prompt measures to check the mob, the city authorities, who were joined by a detachment of armed citizens and a number of the Reading Railroad Coal and Iron Police, commenced on the 24th to assert the authority of the law, and to put down the outbreak. During the afternoon the police officials were informed where the strikers had stored a portion of their ammunition, and the Chief of Police with a small detail of officers, proceeded to an unfrequented basement in a quiet part of the city, forced an entrance, and succeeded in capturing two large boxes of old-fashioned muskets that the strikers had procured from the relics of an old military company. The young man who had informed the police of the whereabouts of the muskets narrowly escaped death at the hands of an infuriated mob. The strikers admitted that they had plenty of arms, and the officials were ready to believe the boast. It was decided by the authorities, in consideration of the threats of the mob against the troops who had taken part in the firing of the previous night, to send them away from Reading, as the best means of avoiding further trouble. It was hoped that their places could be filled by several companies of the 16th Regiment from Conshohocken and Norristown, which reached Reading about ten o'clock on Tuesday morning. These troops left the cars about five miles below Reading, and marched into the city, taking up their quarters at the depot where they joined the 4th Regiment.

These new soldiers, having heard of the killing of the ten citizens, conferred with the representatives of the strikers, and it was not long before many of the Conshohocken military freely expressed themselves as being ready and willing to throw down their arms or give them to the rioters. One soldier remarked, "We are workingmen and we don't fight against workingmen. We want bread at home, but we don't want to rob our fellow-workingmen for it. No, sir; we came up here to protect property, but not to murder the poor men of Reading." Shortly after this many of these soldiers, arm-in-arm with the railroaders, were going about the back streets in a jolly state of intoxication. As they staggered along they made many threats of violence, and the citizens became intensely alarmed at the situation. People coming in from the country reported several of the roads lined with the soldiers, without their guns, walking home, in the absence of suitable railroad transportation. In other words, they were deserting. All these things helped to fan the flame of prejudice and excitement against the military that first arrived and then fired into the crowd. By half-past three o'clock in the afternoon the rioters had won over so many of the Conshohocken troops, and these were so open in their expressions of hostility to the 4th Regiment and of sympathy with the mob, that there was danger of a conflict between the two divisions of troops. To avert this danger, the authorities determined to send both divisions out of the city at once. Accordingly, at four o'clock, they vacated their quarters at the depot, and marched out of Reading by different routes to their homes. Reading was now entirely dependent upon the efforts of the local authorities. About nightfall a force of about 300 regular troops, with four pieces of artillery, who had been disembarked on the outskirts of the city, marched into Reading. Four companies proceeded to the depot, where they were quartered, and a battery of artillery occupied a commanding eminence on the southern section of the city and went into camp. The mob looked on in silence, not daring to utter a word of insult. On the 25th, the authorities feeling strong enough, determined to begin the work of repairing the railroad tracks and arresting the leaders of the riot. The police officials were astir at early dawn, and a platoon of thirty men, each of them armed with a Spencer rifle, accompanied them. This detachment formed a guard for at least a thousand men who were early at work in repairing the tracks torn up by the mob. This was successfully accomplished, and by ten o'clock all through trains from tidewater to the coal fields were running without molestation. Before twelve o'clock information was sworn to, implicating about one hundred and fifty men as being concerned in acts of incendiarism, intimidation, and riot. Arrests were steadily being made, and as fast as the officials brought their prisoners in, they were either taken to jail at once or admitted to bail. But one of the accused was able to furnish security. It was generally conceded that some one well-informed as to the plans and personality of the rioters had given the information upon which these arrests were made. The prisoners were pale, nervous and trembling when brought to the station. They were arrested in various saloons and on street corners, and in other haunts of disreputable people. They were placed in a closely covered van and hurrried off to jail in default of bail, followed by a large crowd. These arrests were made very quietly, for the purpose of maintaining peace and order, and preventing excitement.

For some days Reading was uneasy and excited, and arrests continued to be made by the police; but no further outbreak occurred, and the city gradually settled down into its accustomed quiet. On the 7th of August, the Coroner's jury, which had been summoned a day or two after the conflict with the mob to consider the cause of the death of the killed on that occasion, rendered the following verdict, in which substantial justice is done to the troops:

First. The said persons came to their death by a firing of the military upon the rioters.

Second. That the soldiers composing a portion of the 4th Regiment, Pa. N. G., numbering about two hundred men, while marching through the railroad cut along Seventh Street, were continually assailed with stones and brickbats from the time they entered the cut at Walnut Street bridge until they approached Penn Street, a distance of two squares, the assault becoming severer the further they moved, and being accompanied with pistol shots after they had reached Washington Street bridge; that during said march many of the soldiers were badly wounded by the missiles, some of them being knocked down two or three times. Notwithstanding an order from the commanding officer not to fire, a single shot from one of the military was a signal for others to fire, which soon became general. It would be expecting too much of human nature, especially on the part of untrained soldiers, to expect them not to fire under the fearful peril in which they were placed, and when once the firing commenced, the volleys of stone and pistol shots continuing, and being especially directed against their ranks, the inquest cannot censure them for the manner in which they acted.

Third. That the military were here as the representatives of public order, under directions of Major-General Bolton, who was doubtless acting under the State civil authority, said orders having been duly communicated to General Reeder, commanding the 4th Regiment, who was instructed to report to the Sheriff, Mayor or railroad officials. Having been met before reaching Reading by several officers of the railroad company, who informed him that the railroad depot was in possession of the mob, he left the cars, with command, at a short distance above the depot, and marched down the railroad to the depot. Upon reaching the depot and finding it in possession of the Coal and Iron police, but meeting neither the Sheriff nor the Mayor (the latter official being out of the city), he was requested by an official of the railroad company to move in the direction of Penn Street to release a passenger train then in the hands of the mob, and while complying with this request the firing of the military took place. It thus appears that under the evidence, so far as it has been laid before the inquest, that General Reeder, with his command, was acting within his instructions, and if any blame is to be attached to the action of the military, it must be borne by the superior officer in command.

Fourth. That while the deaths were immediately owing to the firing of the soldiers, who were at the proper place, under proper authority, where the disorder was raging, yet the responsibility for the terrible tragedy of Monday night is directly attributable to those who composed the lawless body assembled near the corner of Seventh and Penn Streets, who were instigating the riotous proceedings. While many were present not as inciting to riot, but out of idle curiosity, they, nevertheless, by their presence gave aid and confidence to the mob spirit who initiated the disturbance. The latter are the persons primarily responsible for all the subsequent trouble and bloodshed, and, if detected and arrested, should be held to the severest accountability.

Fifth. The absence of the Mayor from the city may be a sufficient excuse for the inactivity of the city authorities at the time.

Sixth. While on the one hand the testimony clearly shows that the Chief of Police was faithful in the discharge of his official duty, it is a matter of regret to the inquest that the testimony does not equally commend the Sheriff in the discharge of his duty; on the contrary, though telegraphed for early on Monday morning, 23d July, and having reached the city by special train, provided by the railroad company, at five o'clock A. M., he nevertheless made no attempt to provide for the preservation of the public peace, although earnestly appealed to and urged to organize a posse by a number of citizens during the day. It is well known that during the whole of Monday the city was under the power and in the control of the mob, whose progress was hourly gathering strength, and that therefore at noon Messrs. Wootten and Miller offered to furnish a sufficient number of men, with arms and ammunition, to constitute a posse comitatus, and suppress the riot if the Sheriff would give the authority for so doing. This offer was declined by the Sheriff, who significantly remarked that the mob also had arms. All that the Sheriff of Berks county did in this fearful emergency, after wasting the whole day in his office doing nothing at all, was to issue his proclamation, after five o'clock in the evening, calling upon citizens to remain at home. In conclusion thereof, or in accorddance with evidence presented, the inquest believes that the Sheriff, having neglected and refused to perform what was his obvious duty, is in a measure responsible for the events which followed.

From Reading the strike spread rapidly into the mining regions of Pennsylvania. Attempts were made by the miners at Pottsville and Shamokin, in the Schuylkill district, to bring on riots on the 24th and 25th, but were failures. At Shamokin the rioters were fired upon by the burgess and his posse, and dispersed. The citizens gave an unswerving support to the authorities, and the danger was averted. At Mauch Chunk an effort was made to induce the firemen and brakemen on the Lehigh & Susquehanna Railroad to join in the strike, but the majority of the men refused to leave their work. The Lehigh Valley Railroad men joined the strike on the 25th, and there was considerable excitement at Bethlehem. The trains were stopped, and the engineers and firemen forced to abandon their locomotives. On the same day the brakemen and firemen on the eastern division of this road, extending from Easton to Mauch Chunk, struck.

and blockaded the road. The Lehigh Valley men at Easton joined the strike during the night, and those at Wilkesbarre took similar action about the same time. This placed the entire line of the Lehigh Valley Railroad in the hands of strikers. All freight trains were stopped, and the strikers announced that while they would allow the company to carry the mails over its line, no passenger trains would be permitted to run. The railroad officials then gave orders to stop all trains, and to make no attempt to carry the mails. Bethlehem and Wilkesbarre were the centers of the trouble. The principal excitement was at the latter place. On the night of the 25th all the passenger trains were stopped at Wilkesbarre, but on the morning of the 26th some of them were permitted to depart, in order that the men employed on them might reach their homes. The strikers continued to hold the road until the last of July. The company then determined to run their trains in spite of the strikers, and on the 31st succeeded in getting a train through from Bethlehem to Mauch Chunk. They announced to their employés that their abandonment of their posts was virtually a withdrawal from the service of the company, and that their places would be supplied with new men. This was done in a great measure. Application was made to the Governor for assistance, and a force of State militia and regulars was ordered to protect the road. The strikers declared their intention to stop the trains, and on the 1st of August, the day appointed for the resumption of traffic, a large crowd assembled at the depot at Wilkesbarre, resolved that no trains should pass that point.

Scranton, the most important point in the coal region, was profoundly agitated from the first of the troubles. On the afternoon of the 24th the strike was begun by the employés of the Lackawanna Iron and Coal Company. As soon as the gong sounded at noon, the men, to the number of about 1,500, stopped work and struck, and all operations ceased in the rolling-mills, foundries and steel works. The strike was first declared in the old rolling-mill, at a given signal, and the men retired from the building, leaving the red-hot bars in the rolls, and the fires glowing in the furnaces. They then proceeded in procession to the company's steel works, where work was immediately suspended, and the employés joining the strikers, the entire party marched to the foundries and shops, where similar scenes were enacted. The men said that it was impossible for them to live on the wages they had been receiving, and on the 15th of the month their pay was cut down ten per cent. more. A meeting was held in the afternoon, and it was resolved to demand a restoration of the last ten per cent. reduction. On the night of the 23d, the men employed at the Meadow Brook Mines in the suburb of Scranton, struck for higher pay, about 300 of them turning out. At six o'clock on the evening of the 24th the firemen in the employ of the Delaware, Lackawanna & Western and the Delaware & Hudson Companies struck work. As soon as the bell in the round house denoted the hour of six, the men conveyed their engines into the yard, drew the fires from them, and left them in good order. A coal train which left Scranton at five o'clock was returned, and placed side by side with about twenty other trains laden with black diamonds in the yard. The firemen retired from their work peaceably, and in the course of conversations held with several of them, they declared that they would protect life and property with their lives if need be. Superintendent Manville answered the men in the employ of the Delaware & Hudson Company in the afternoon to the effect that the company would make no concession, and the firemen on that line struck simultaneously with those on the Delaware, Lackawanna & Western road. The men took all the passenger trains to their destinations, and as soon as they arrived at the depot the fires were drawn and the engines placed in the yards. It was announced by the railroad officials that no freight, coal or passenger train would run until the difficulty was settled. The strike was solely on the part of the firemen, and the engineers, conductors and brakemen were not concerned in it. The effect of the strike on the road was to prevent all shipments of coal, and to make the mines throughout the Lackawanna valley idle.

In view of the excitement prevailing in the city, the Mayor of Scranton, on the 24th, issued the following proclamation:

In view of the excitement throughout the country occasioned by the labor troubles and the lamentable loss of life and property in our own and other States, it becomes the duty of all good citizens to use their best efforts to preserve peace and uphold the law. Recognising, as every one must the unfortunate condition of the business, and financial interests of all classes of the community, and especially the hardship and suffering of the laboring men, we must yet unite in maintaining to the fullest extent the majesty of the law and the protection of life and property. I therefore earnestly urge all good citizens, and especially the workingmen themselves, to abstain from all excited discussion of the prominent question of the day. The laboring men of our city are vitally interested in the preservation of peace and good order and the prevention of any possible destruction of property. I trust the leading men among the workingmen fully realize that the interests of the whole city are their interests, and that any riot or destruction of life or property can work only injury to all classes and to the good name of our city. Every taxpayer will realize that any destruction of property will have to be paid for by the city, and would by so much increase the burden of taxation. In one day Pittsburgh has put upon herself a load that her taxpayers will struggle under for years. In conclusion, I again earnestly urge upon men of all classes in our city the necessity of sober, careful thought and the criminal folly of any precipitate action.

The excitement continued to increase, and, on the 25th thousands of miners flocked into Scranton, swelling the crowds about the depot, and adding to the danger. The strikers declared that they would allow the mails to pass unmolested, but would suffer no passenger cars to go through. The excitement increased to fever heat when the morning mail train from Binghampton, for New York, arrived at 9.50. The strikers were indignant to find that an express car and three passenger coaches were attached, together with the mail car. Exciting demonstrations were made at the various stations along the line, and at Great Bend, forty miles north of Scranton, a crowd of five hundred sought to detach the passenger cars, but were deterred by the engineers. On arriving at the suburbs of Scranton, the train was boarded by a number of the strikers, who, as soon as it reached within a few yards of the depot, cut off the passenger and express cars, and permitted the mail to pass. At the depot an excited crowd boarded the train, and the postmaster was about to put on the mails when informed by the railroad officials that the train would go no further unless the passenger cars were allowed to run. This decision caused much indignation among the strikers, and several uttered loud threats of seizing the engine and running the mail to New York, but wiser counsels prevailed, and a meeting was forthwith held on the platform, when it was resolved to telegraph the Governor and Postmaster-General, apprising them of the state of affairs, and disclaiming all responsibility on the part of the men for the detention of the mails, which were carried back to the post-office. The reply was awaited with anxiety, and the telegraph office and depot were crowded till noon, when a flag was flung from a window of the head-quarters of the strikers. It was a call for a meeting, and there was a rush for the hall at once, none but firemen and brakemen being admitted. A despatch from the Governor was read amid cheers, stating that he had instructed the Superintendent to allow the mails to run through. The men then prepared a statement for publication in the local papers, setting forth their grievances and the cause for their present action. They also adopted a petition, asking the saloon-keepers to close their places of business. On the same day the brakemen joined the firemen in the strike. The excitement was increased during the day by the action of the miners, who represented no less than forty thousand men in the Scranton district, asking an increase of twenty-five per cent. on their wages. A committee of six waited on the General Coal Superintendent, and presented a series of resolutions, setting forth the fact that the men had endured repeated reductions until their wages had reached a starvation standard, and that they did not propose to endure it any longer. They further stated that if the men on the railroad returned to work, they would hold out until such time as their wages were advanced. The Superintendent informed them that he would forward their petition to the company, and would have an answer for them on Friday. The men then called a mass-meeting in the woods, in the suburbs, for the afternoon of the 26th.

The strike of the miners introduced a new and dangerous element into the troubles. The miners, not satisfied with quitting work, refused to allow the pumps of the mines to be worked. The men who attempted to run the pumps, the work of which was necessary to keep the mines from flooding, were driven away by the strikers, and the engines were "shut down." The water was thus allowed to gain steadily upon the mines, flooding them, and injuring them to the extent of many thousand dollars. This wilful destruction of the property of their employers by the miners was simply suicidal. A despatch from Scranton, on the 29th of July, thus summed up the state of affairs: "The entire Lackawanna region is idle. Week before last this region sent nearly 150,000 tons of coal to market. Last week it did not send a tithe of that quantity, and next week it will not send any. The miners of the Delaware & Hudson Canal Company quit work yesterday morning, and those of the Pennsylvania Coal Company are in enforced idleness on account of the destruction of a head-house and bridge on their gravity railroad. The head-house, which was situated in the woods east of this city, was burned down at three o'clock this morning by a mob which surprised the watchman, and tied him with ropes to a neighboring tree. They saturated the wood-work of the head-house, and then set it off with a match. It made a fierce blaze, which was plainly visible here. Destruction of the head-house causes a complete stoppage from Hawley to Pittston. It was not the work of the company's employés, but of outside persons, who took that mode of forcing the strike upon them. The Pennsylvania Coal Company have recently been working on full time at their mines, and the best of feeling exists between themselves and their workmen. The latter are indignant at the dastardly act, and the prospects are that the burned property will not be replaced until the dispute between labor and capital is finally settled.

The watchman who was driven from the head-house states that the place was set on fire by no fewer than a hundred men, who danced about the blaze like demons, and shouted in fiendish exultation while the work of destruction was going on. Superintendent Smith states that the act will make the company's mines idle for an indefinite period. They were working on full time, and shipping 30,000 tons a week. The men in the company's employ had made no demand for an increase of wages, and the burning of the head-house is the work of outsiders, who wanted to force them into a strike. Not a mine in the valley is at work, and the most of them are filling fast with water. An idea of the importance of flooding a mine can be obtained from the fact that in 1868 the Diamond Colliery was idle three days for the repair of its machinery, and it took eight months, and cost $30,000, to pump out the water that accumulated in that time. The Mayor and company's officials will make an effort to-morrow to set the mine pumps to work. The situation here is absolutely painful, and there is no knowing what moment an outbreak will occur.

The Mayor was very active in his efforts to bring about an adjustment of the troubles, and succeeded at length in inducing the miners in the neighborhood of Scranton to allow the pumps to be run by the bosses, clerks, and civil engineers in the employ of the coal companies. This concession gave great offense to the strikers in the lower part of the county, and delegations were sent to the Scranton miners to put a stop to the practise. Efforts were made to settle the strike on the Delaware, Lackawanna & Western Railroad, and with success. On the 30th of July the men gave up the struggle, and returned to work at the old wages. This surrender was brought about by the action of the Mayor, who sent for the executive committee, whom he informed that travel would have to be resumed over the road the next morning, even if the presence of the troops were necessary to such a result. Accordingly the men called a meeting at one o'clock, when a decision was had in favor of returning to work by a vote of 82 to 9. The committee then proceeded to inform the Superintendent of the decision arrived at, the only terms asked being that no one taking an active part in the strike should be prosecuted. This he consented to, and in half an hour later a passenger train started from this city for Northumberland. It was greeted by crowds at every station along the line, but no demonstrations were made. A despatch was forwarded to Binghampton to start No. 4 train from there to New York, and it passed through Scranton uninterrupted at six o'clock. Passenger and freight traffic was now fairly established all along the line, and the bubble of the Delaware, Lackawanna & Western Railroad strike had burst. The railroad men were bitterly denounced for their surrender by the miners, who numbered between 20,000 and 30,000 men in the Lackawanna valley. The miners avowed their intention to continue the strike until their terms were accepted by the coal companies. They became more and more turbulent every day, and it at last became evident to the Mayor of Scranton that the presence of troops at that city was necessary. The Governor was informed of the state of affairs, and decided to go to the assistance of Scranton with a force of State militia and regulars.

Scranton continued to be troubled with the excitement arising from the miners' riot. In spite of the powerful protection afforded by the troops, the workmen returned to their duties in the various industrial establishments slowly, being rendered afraid to go to work by the threats of the miners who still remained idle. A letter from Scranton, written August 7th, said: The miners of this region manifest a most determined attitude, and from present prospects, it is safe to say, will prolong the strike in the Lackawanna and Wyoming valleys for six months, if no settlement is made. An important meeting of delegates from every mine in Luzerne County will be held here to-morrow to appoint a general Executive Committee, and adopt a programme for the purpose of securing perfect unity of action, so that the men at all the mines will resume work simultaneously whenever the time for resumption has come. A mammoth store was opened here to-day by the Miner's Executive Committee to relieve the immediate necessities of their number who are in distress, and it was speedily filled with provisions. Business men placed a dozen teams at their disposal, free of charge, for the purpose of receiving and distributing supplies, and the scene about the store was animated in the extreme. Farmers in the surrounding country have made them donations of potato patches, and many of the miners have gone off in gangs to do work in the country and receive pay in provisions.

The disaffection in the coal regions continued to increase, and assumed its most formidable proportions after the railroad troubles had been satisfactorily adjusted. By the middle of August nearly all the mines in the Lehigh, Schuylkill, Lackawanna, and other mining districts were idle, and more than sixty thousand men were out of work. The miners presented a general grievance, declaring that their wages were too low to enable them to live, and demanded an increase of from ten to twenty per cent. Though there were many isolated acts of violence committed in the coal regions, there was no general outbreak.

The New York Division of the Pennsylvania Railroad, the Central Railroad of New Jersey, the Erie Railroad, the Lehigh Valley Railroad, and the Morris and Essex Division of the Delaware, Lackawanna and Western Railroad, terminate at Jersey City and Hoboken, opposite New York. As the strike had affected all these roads to a greater or less degree, it was feared that it would break out in Jersey City. Tha tplace contains a large population of railroad men, and a much larger number of persons in the lowest walks of life who are always ripe for an outbreak. Lying just across the river from New York, a mob in Jersey City would be rapidly reinforced by the dangerous element of the metropolis. The authorities were resolved to be ready for the danger if it should come, and to meet it promptly and firmly. The strike on the western lines and the outbreak in Pittsburgh produced great uneasiness and excitement on the New Jersey roads, and the Governor was informed by many of the railroad officials that it might be necessary for them to ask the protection of the State for their property. The officers of the Pennsylvania road were especially apprehensive, as the trouble on their main line had been so great. Trouble from employés was not dreaded so much as from the turbulent populace. An influx of ruffians from New York was feared, and the character of such reinforcements to the mob justified the gravest apprehensions. During the night of the 22d, and the small hours of Monday morning, the Governor was in receipt of despatches from various points along the company's line, indicating approaching trouble at Trenton or Newark. These were afterwards learned to be premature, but they induced the Governor to issue orders to the various military commands of the State to assemble at their armories ready for service. By daylight the 4th Regiment had gathered, fully equipped, at their armory, adjoining the City Hall, Newark Avenue, Jersey City, and in halls close by. The 7th, 300 men, was at Trenton; the 9th, 350 men, at Hoboken. The 1st and 5th of Newark, 800 men, were at Newark. Forty rounds of ammunition were supplied to each man. General Mott, in charge of the brigade, had his headquarters at Trenton, and was in constant communication with Jersey City. When morning had fully come, it was felt that although the militia had possibly been called out rather hastily, yet it was not to be regretted. Jersey City's element of "roughs" seemed to have increased during the night. The men, who had come from unknown quarters, lounged near saloons and talked constantly about the strike. No threat was made, but citizens generally grew uneasy as the day advanced.

The first shadow of actual trouble was at nine o'clock, when one of the employés called upon the Superintendent, and said he was authorized to inform him that the firemen would strike about noon. The Superintendent expressed a wish that a committee of the men should wait upon him, an l a committee of six did so. He argued with them that enough had already occurred to settle whatever questions had caused the strike, and that any further action of employés was not needed in that direction. If they left their engines, the mob in New York and Jersey City would avail themselves of the opportunity to enact here the terrible scenes of Pittsburgh and Baltimore; for all of which they would be primarily responsible. His talk had great influence. The men resolved not to strike, but to continue work unless assailed by the populace. A meeting that had been called for eleven o'clock was not held, and the Superintendent, congratulating himself upon having such sensible men, felt assured that if he could prevent any demonstration from outsiders, he had attained his end. Towards noon and later the arrival of regular troops on their way to Philadelphia became known. A battery of light artillery with four field-pieces arrived from Fort Hamilton and passed down the freight-yard to be loaded upon the flats. This display made the loungers on the corners and in the vicinity of the yards imagine that precautionary measures on a gigantic scale were taking place. They began to feel their unimportance and grew more excited. There were perhaps 700 or 800 of these unpleasant persons at different railway crossings and at open places. The liquor, that the times are never hard enough to prevent them from obtaining, began to take effect, and they cursed the troops right bravely. And then they retired to the saloons for reinforcements. It had been the intention of the Chief of Police to close the rum-shops, but the order did not appear to be put into effect. About four P. M. everybody was very nervous, not excepting the authorities at police head-quarters. There they fell to work drafting a proclamation. While that literary business was in progress, the light artillery was made rea ly to start They occupied four flats with their guns, five cattle-cars with the necessary number of horses, and two or three passenger coaches with the men. To these cars were added another coach, and a baggage car contained forty-seven of the regular troops that had arrived between one and two from New London, Connecticut. They landed at the Adams Express dock, which is retired and not withiñ the ken of persons in the freight-yard. The engine that was to take the train stood in the yard, and some rough men gathered around threatening to shoot the engineer and conductors if they moved the train of troops. These officials naturally were frightened, and when it became generally known that threats had been made, all sorts of fears were expressed. A posse of seventy-five police were immediately brought out, and they pushed from the track a crowd, possibly of 1,500 men and boys. The men who had threatened the engineer disappeared. The train of troops was finally ready, and the Superintendent said it should go. The engineer still hesitated. No other engineer would consent to take his place. The others said they were not called upon to do any man's work except their own. At length the engineer consented to take charge of his engine if the Superintendent would accompany him. The Superintendent did not hesitate a moment. The Millstone way passenger train was also just ready to start. Two tracks were cleared, and with this passenger train between it and the mob, the military train left the station. The engineer was in his place. The two trains moved slowly down the track, side by side, faster and faster. Finally, while every one was expecting trouble, the military train shot quickly ahead, and the danger was over. The Superintendent came back to his post and arranged for the further transportation of troops. At six o'clock twenty-seven sailors from the United States steamer Colorado embarked for the Navy Yard at Philadelphia. They started on an hour and a half's notice. Their departure excited no demonstration. More troops arrived at half-past six from Newport. They comprised ten officers and 147 men of Batteries K, B, E, and F. They filled four coaches, and started at half past eight with a protection train on their exposed side. The train accompanied them only a short distance. At nine o'clock three batteries from Boston, numbering about as many men as the Newport detachment, arrived and departed without the least disturbance. At six o'clock in the afternoon the Governor issued the following proclamation: To the people of the State of New Jersey: In the present state of the public mind I warn all citizens to keep at their homes and places of business, avoiding all gatherings in the street, so as to give no encouragement by their presence to evil-disposed persons. Let every good citizen now, by word, act and sentiment, aid the authorities in securing perfect peace. Sheriffs and officers of cities are particularly requested to exert all their powers in a calm, judicious, but effectual way to protect life and property from all lawlessness, and thereby save the counties and cities from any liability under the statute for destruction of property by mobs. The whole power of the State will be used for the maintenance of the laws. I caution every person disposed to distub the peace to desist at once, and thereby prevent any necessity for the use of the State force. Given under my hand, at the City of Trenton, on this 23d day of July, A. D. 1877.

Meanwhile all schedule trains had started on time, with many through passengers. The incoming trains were somewhat late, having been detained at Philadelphia. All evening trains were shifted and shunted in the company's yards, the police keeping up their line from the station to Railroad Avenue. About nine o'clock some freight cars and way passenger trains were stoned while passing through the heavy cut, two miles from the station. A squad of police went out to the gap, and remained on guard until relieved by militia. Detachments of State troops were brought from Trenton during the afternoon, and posted at the bridge over the Raritan, at New Brunswick, and the bridge over the Hackensack, between Newark and Jersey City. These important bridges were strongly guarded throughout the period of the disturbance. During the night the shops of the Pennsylvania Railroad in the Hackensack meadows were guarded by fifty men. The next day this guard was relieved by the 5th Veteran Regiment of Newark. At Newark, New Brunswick and Trenton there was considerable excitement, but no effort was made to bring on a strike. The passenger trains were run as usual, and the freight trains which were discontinued in consequence of the troubles at Philadelphia, and other points on the main line of the road, were resumed as soon as the route beyond Philadelphia was clear. By the night of the 24th, the danger on the Pennsylvania road was over; there had been no strike of the employés, and the mob had found the civil and military forces so strong that they wisely decided not to attempt an outbreak. On the evening of the 25th, the firemen and brakemen of the Morris & Essex division of the Delaware, Lackawanna & Western Railroad joined the strike, which, as we have related elsewhere, had already begun on the main line of this road in Pennsylvania. The men were quiet and orderly, and attempted no violence. There was not much life in the strike, and on the 17th the men at the eastern end of the line agreed to resume work at their former wages, trusting to the company to increase their pay as the times improved. This offer was accepted, and the strike finally came to an end. The trainmen of this road at Phillipsburg, opposite Easton, Pennsylvania, did not unite in this settlement until some days later. The next road to join in the strike was the New Jersey Central. The trainmen on this road struck on the 25th, and stopped the running of the freight trains. The principal disturbance was at Phillipsburg, opposite Easton. The New Jersey Central men there united with the employés of the Morris & Essex road, and with them put a stop to the business of both roads. On both roads the strikers refused to allow the running of passenger trains. They stated that the mails might be carried over the lines in the postal cars, but no other cars should be run. The authorities of both roads thereupon refused to send out any trains until their roads were freed from the interference of the rioters. Though all the strikers refrained from any further violence than the stopping of the trains, and announced their intention of protecting the property of their roads, it was uncertain how long this state of affairs would continue, and was of the highest importance that the railroad blockade should be ended at the earliest practicable moment. Accordingly a strong force of troops, under Brigadier General Sewell, was sent to Phillipsburg. This force consisted of the 1st, 5th, 6th, and 7th New Jersey Regiments and the Hoboken Battery. The troops reached Phillipsburg on the 28th of July, and at once took possession of the railroad property there. A feeble effort was made to prevent the railroad officials from resuming the running of the trains, but was promptly put down. The presence of the troops, and the determined attitude of the authorities convinced the strikers that their efforts at resistance to the laws would be in vain. On the night of the 28th the Morris & Essex men ceased their interference with their road, and early the next week returned to work. The strikers on the eastern end of the New Jersey Central Railroad returned to duty about the 28th of July. They had little sympathy with the outbreak at Phillipsburg. Being thus isolated, and overawed by the military, the strikers at Phillipsburg returned to duty about the 1st of August. The troops were kept on duty for some days longer as a matter of precaution, but no further trouble was experienced in New Jersey.

The excitement spread rapidly westward, and following the line of the Baltimore & Ohio Railroad, soon reached the State of Ohio. At Newark, about thirty miles from Columbus, the Baltimore & Ohio Railroad crosses the Pittsburgh, Cincinnati & St. Louis, or, as it is more commonly called, the Pan Handle Railroad. Newark is a city of considerable importance, and one of the principal railroad centers of the State. On the 18th of July the brakemen and firemen of the Baltimore & Ohio Railroad at Newark struck work, and refused to allow the freight trains of the road to pass the point. All arriving trains were stopped, the engines uncoupled from the cars, the fires put out, and the engineers and firemen forced to abandon their posts. The strikers were quiet and orderly at first, the only violence being the throwing of a man from a camel-back engine for attempting to start the fires. The Sheriff of Licking county repaired to the depot, and, after reading the Riot Act, ordered the strikers to disperse. They refused to comply with his demand, and he reported the disturbance to the Governor of Ohio, and asked for a military force to enable him to preserve order. The Governor directed a regiment to repair to Newark to assist the Sheriff, and issued a proclamation commanding the strikers to desist from personal intimidation and interference with property. The troops reached Newark during the night of the 21st, and by the next morning were on duty at the railway depot and yards. The militia soon made it evident that they were in sympathy with the railroad strikers, so that it was by no means certain that they could be depended upon in case of emergency. The men of the Pan Handle road now joined in the strike, that road having become involved at Pittsburgh and at its western end; and during the 22d a large number of them reached Newark from Dennison. The miners from the coal and iron regions near Newark were in active sympathy with the strikers, and assured them of assistance whenever called upon. For the time the strikers attempted no violence at Newark, but contented themselves with blockading the railroads. A Committee was sent by the Newark strikers to Columbus, to induce the railroad men at that point to join in the strike. Meetings of the brakemen and firemen of the Baltimore & Ohio and Pan Handle roads were held on the night of the 22d at Columbus, and resolutions were adopted demanding a restoration of the old rates of pay. The strikers at once left their work to await the answers of their respective companies. Their demands were refused, and on the morning of the 23d a meeting was held at the Union depot for the purpose of enforcing the strike. A large gang of men gathered about the depot and yards early in the day, but it was observed that but few railroad men were among the crowd. The main body was made up of idlers, curiosity seekers, and a set of roughs and non-railroaders, who seemed to have suddenly come to the front. From the depot the mob hastened into the city, resolved to force the employés in the private establishments of Columbus to quit work. The rioters numbered between two hundred and three hundred men. The first place visited was a rolling-mill on the banks of the Olentangy. The employés were ordered to cease work. As there was a general disposition among the mill men to join the strikers, they easily obtained a promise that the mill would shut down as soon as the heat on hand was finished, which was done. The mob then went to the Smith Pipe Works, farther north, and commanded an immediate suspension. Some were in favor even of letting the metal in heating out of the cupola. There was a charge of five tons nearly ready to pour out, and had the threat been carried out, the hot metal would have fired the building and destroyed the fine property. The Superintendent sensibly told the mob he would shut down as soon as the heat was off. The crowd then left. Before night every establishment containing an engine, on the west side of the river, had been closed up.

The officials of most of the roads voluntarily closed the railway shops for the time, thus depriving the mob of the opportunity of compelling them to close. The through lines declined to receive freight, and freight houses were generally closed up. Brakemen and switchmen declared that they had nothing to do with the raids on private establishments, and did not approve them; but few railroad men were seen in the mob. The Mayor of Columbus, on the afternoon of the 23d, issued a proclamation calling on the rioters to disperse and cease their interference with private property. Several hundred special policemen were sworn in. The railroad authorities decided to make no efforts to run their trains until the strike had been put down by the civil authorities, and thus to give no provocation to the mob. The promptness with which the citizens enrolled themselves in the special police force and the determination exhibited by the State and city authorities to put down mob violence at any cost, greatly demoralized the rioters. On the morning of the 24th nearly all the manufacturing establishments that were forcibly closed on the previous day were reopened, the operatives returning to work on being assured of protection. Columbus was excited, but quiet throughout the day. On the 25th, the Governor issued the following proclamation: Owing to trouble existing between railroad companies and their employés great excitement exists throughout the State. Of this unfortunate state of affairs lawless and disreputable persons are taking advantage and endangering life and property. The civil authorities, State, county and municipal, as well as military, must and will everywhere exert their power to enforce the law in every respect. The good name of our people demands that this shall be done, and in no other way can the order which is absolutely necessary to public and private safety be maintained to avert all danger, and in order to successfully meet all resistance to the thorough execution of law I hereby call on law-abiding men of all our cities, towns and villages to tender their services to their respective civil authorities, and, under their direction and control, organize themselves into a volunteer police force sufficiently strong to overawe the lawless elements. I confidently expect all good men will respond promptly and cheerfully to this call.

Every effort was made to place the military force of the state in a condition for service, and the determination of the people of Columbus to allow no more mob violence was too plain to be mistaken by the rioters. No further disturbance occurred, and for days matters remained unchanged. The failure of the strikes at other points disheartened the strikers, and they made no resistance to the running of the trains on their roads. By the 2nd of August both the Baltimore & Ohio and Pan Handle roads had resumed their freight traffic. When it was certain that the strike was dead, the troops were withdrawn from Newark, and the Columbus companies were dismissed. Other parts of the State were affected by the outbreak. Zanesville, on the line of the Baltimore & Ohio Railroad, was one of the first to be plunged into the excitement. The train hands took part in the strike about the time it was begun at Newark; and on the morning of the 23d a mob of about two thousand men assembled in front of a new hotel in process of erection, and ordered the men at work on the building to stop. The demand was at once complied with, and the mob then visited in succession the various manufacturing establishments of the town, and compelled the workmen to abandon their posts, thus forcing over fifty establishments into idleness. The rioters also compelled the street railway company to discontinue the running of their cars. No greater violence was attempted, but the proceedings of the rioters thoroughly alarmed the citizens, and a vigilance committee, composed of about one thousand of the most reliable citizens of Zanesville, was organized and armed. They were placed on duty on the afternoon of the 23d, and at once began the arrest of such rioters as could be secured. Under their protection the street cars resumed their trips about three o'clock in the afternoon, and the mob slunk away. From this time Zanesville was quiet. The strike on the railroad was adjusted between the Baltimore & Ohio Company and its employés, and the mob did not venture again to raise its head.

Cleveland, on Lake Erie, is an important railroad point. The Lake Shore & Michigan Southern Division of the New York Central Railroad passes through it. This road engaged in the strike at an early period, the troubles along its line beginning at Buffalo. The strike quickly spread to Cleveland. On the morning of the 23d of July the men in the Lake Shore & Michigan Southern shops, to the number of 250 or 300, quit work, held a meeting, and addressed a communication to the Superintendent, embodying the following demands:

First.—An increase of twenty per cent. on wages received July 1st, and that such advance date from July 1st.

Second.—That assurances be given by the company that no employé shall suffer on account of his participation in the strike.

A Committee waited on the Superintendent, and were informed that he could give no answer until the matter was laid before President Vanderbilt, and that he would forward it immediately. Before leaving, the Committee assured him that no property should be destroyed, but that the men were determined that no work should be done in the shops until the demand was acceded to. These men had been receiving from nineteen to twenty-one cents per hour, according to skill, and were running on ten hours time.

The next move was by the hands in the freight depot of the Lake Shore road to the number of 225. Their demand was that the company should pay them $1.50 a day for ten hours work and $2 for the same amount of work on Sunday; that they be paid in proportion for overwork; that they be paid for the time lost by the strike, and that they receive their pay by the 15th of each month. These propositions were also forwarded to New York by the Superintendent. During the afternoon a meeting was held by the shop and freight men for the purpose of concerting action among themselves and with the train men already out at Collinwood. A Committee of ten was selected to confer with the brakemen and firemen and with others who might be on a strike. The meeting was orderly throughout, and when a political speaker of greenback and labor reform tendencies was noticed in the room, the President arose and said that they wanted nothing from the politicians, as the men were perfectly able to attend to their own business. Collinwood, a short distance from Cleveland, was the point where the Lake Shore trains were held. All was quiet there on the 23d, only an occasional pony engine being allowed to move along the track. The strikers preserved order and obliged others to do so. They compelled all the saloons to close, and permitted none of their men to indulge in liquor. The side tracks were crowded with freight cars and the round house was full of engines. A large number of stock cars had been unloaded, the sheep being driven into the country. The hogs were hauled to the yards near by, where a hundred died from lack of water. Cattle were driven on to Painesville, where the company could care for them. The men in the machine shops, with the train men of the Cleveland, Columbus, Cincinnati & Indianapolis Railroad, went out on strike on the 23d, as they were refused the increase of twenty per cent. which they demanded on Saturday. At noon the shop men held a meeting at their shops to receive any communication from the company in response to their demand and the establishment of a regular pay-day. None coming, they decided to strike, and when leaving were met by their President, who addressed them. He expressed regret at having been so long delayed at his office, and then explained that, as President of the company, he owed a mutual obligation to stockholders and employés, and that embarrassment must necessarily arise in adjusting matters so as to fulfil his duties to both. He blamed the difficulty on too much cutting of rates, and said that no one had done more toward a pooling of rates than he. A consultation was then held at which a compromise was made, the men receiving an advance of ten per cent. on and after August 1st, and working ten hours instead of eight hours; they, on their part, agreed to go back to work the next morning. The advance was to be general, benefitting the train men also. An effort was made by the Lake Shore men to induce the employés of the Atlantic & Great Western road to join in the strike, but the latter had the independence to refuse, stating that their relations with their company were satisfactory.

A letter from Collinwood, on the 24th, thus describes the state of affairs there: "Everything presents the appearance of a Sunday in a New England village at Collinwood, the little station where the Lake Shore round house and shops are located. There are no crowds, no threats—simply the men sitting around in small groups, arrayed in their holiday attire, talking over the situation. The men have been anxious of late to have the remaining cattle cars unloaded, but the yard-master of the Erie division has seemed to be very slow in doing this. They say that it is cruel to let the animals suffer. About five hundred and fifty cattle have already been driven to Painesville, and others will probably follow. A very large number of the animals have died. One car containing 1,500 fowls gives forth an almost intolerable stench. The dead hogs are being carted away to the soap factories, and many of them buried to avoid the plague that must soon follow if the dead animal matter is not removed. Great trouble arises from insufficient means of watering the cattle, and scores of them are constantly dying of thirst. There is, of course, much feeling against some of the officials of the road, the men saying that if the officers had treated them properly they would not have complained of the reduction. At the first meeting, held at ten A. M., the prospects of their propositions being acceded to were fully discussed. The sum of what was expressed was that President Vanderbilt cannot exercise his power here as he could in a monarchy. This is a republic, and the poor man shall have his rights and his family must be supported. Furthermore, there will be no trouble at Collinwood, no fights or arson if the militia is kept back; but the moment the militia is used in the support of monopoly then the laborer will no longer keep quiet. There is much feeling among the men over the question of passes. One man said: "Suppose I am ordered to run my train down to Cleveland; I get for this sixteen cents; but I must return here to report to my superior, and for that I must pay my fare of twenty-five cents." He felt that this was an unbearable outrage. Another grave complaint lies in the fact that the men are only paid while in actual service. For instance, if a man runs from Collinwood to Toledo, which would take a little more than a day, he would be paid for that; but he is liable to lie off there for three days without pay, although required to be ready to report for duty at any moment. In this way the small pay earned is entirely absorbed." Matters continued in this state until the last of July, when the strikes on the other roads having been settled, and it having become plain to the men that they could not carry their point, they ceased their interference with the movements of the road, and signified to the General Superintendent their willingness to return to work at the reduced wages. The Superintendent agreed to correct some local abuses in regard to extra pay and the granting of passes, and repeated to the Lake Shore men the promise to increase wages when the business of the road should justify such a step. By the 3d of August, business was entirely resumed by the Lake Shore road.

There was considerable excitement also at Cincinnati. On the 23d of July the trainmen on the Ohio & Mississippi Railroad joined in the strike, and prevented the passage of trains. The employes of the Cincinnati, Hamilton & Dayton Railroad having been informed that their wages would be reduced ten per cent. on the 23d, protested against the proposed reduction, and announced their intention to strike if it should be enforced. The authorities of this road thereupon reconsidered their decision, and the wages remained unchanged. This determination was announced to the men on the night of the 22d, and consequently they took no part in the strike. Cincinnati was greatly aroused. Mass-meetings were held in the market places on the afternoon of the 22d, and were generally attended by men who had no interests in the railroads entering Cincinnati. They were addressed by speakers of the communist stamp and the excitement was fanned to a high pitch. Cincinnati contains a large population of idle and vicious persons, who are always ready to join in an outbreak. A large part of the militia force of the city had been sent to Newark to hold the rioters there in check, and the preservation of order depended mainly upon the police and the better class of citizens. The morning of the 23d of July found Cincinnati in a feverish and dangerous state. The rioters, who comprised the worst elements of the place, had taken courage from the fact that they had not been interfered with, and had increased so rapidly that they now comprised a large and formidable force. By the afternoon they had become threatening, and had completely wrested the strike from the hands of the railroad men. Early in the afternoon a crowd of perhaps fifteen hundred, composed mostly of boys from thirteen to twenty-one years of age, and backed up by sullen, vicious-looking men, with their hands behind their backs, surrounded the Cincinnati, Hamilton & Dayton Depot. As the half-past two train was about to leave, a boy of not more than eighteen sprang upon the engine, which had not yet been coupled to the train, and pulled the throttle. The engineer, who was near by, jumped on the engine in time to save it from destruction. The crowd then demanded that he should come down, but he stood by his post until an order came from the President to run the engine into the round house and abandon all trains for the day. The mob headed by two or three villainous-looking men, then started for the machine and repair shops of the company to force the employés to quit work. At the rail shop they were met by an officer of the road, who asked them if they were railroad men or strikers. They answered, "No," but they wanted those shops closed up. The workmen at last yielded, against their will, and left the shop. The crowd then went through the yard, taking each shop in succession, and compelling the men to quit work. This was the nature of the strike on the Cincinnati, Hamilton & Dayton road. The company's employés declared that if they had been permitted they would themselves have driven back the mob and started the trains. A letter from Cincinnati said: "Loud condemnation is heard on all hands of the inactivity of the police, who have, so far stood by and watched the progress of the rioters without lifting a hand. The entire militia force of the city is two hundred miles away, and it is beginning to be felt that the only protection of life and property is to be found in vigilance committees and individual efforts by citizens. The demand for muskets and revolvers has been so great as to completely exhaust the stock of the gun stores. It is noticed that these arms are bought by the respectable part of the community. Bankers are beginning to fear raids upon their vaults, and anxiety is felt by the officials of the United States sub-treasury, where several millions in currency are locked up in old safes. Threats have been made by the communists that they will burn the great manufacturing establishments, and no one would be surprised if they were carried into execution. There are men in this city who were engaged in the pillage and arson at Pittsburgh, and they do not hesitate to say that they came here on the same mission. This afternoon the Mayor delivered a speech to the thieves and rapscallions at the Cincinnati, Hamilton & Dayton depot, entreating them not to burn and destroy. "What good would it do you," he asked, "to set fire to buildings?" "It would show that we are men," answered a voice in the crowd.

The early evening trains on the Indianapolis, Cincinnati & Lafayette road were stopped by uncoupling the cars as fast as the engineers attempted to pull them out. Thousands of men doing business in the city and living in the distant suburbs have no means of getting home to their families to-night. If the present condition of affairs continues, the old stage-coach will be brought into requisition for transporting mails and passengers. Business is almost entirely suspended, it being impossible to move goods in any direction."

At nightfall on the 23d Cincinnati was almost at the mercy of the mob. During the night a party of thieves and tramps, having no connection with the railroad strike, set fire to the bridge of the Ohio & Mississippi Railroad over Mill Creek. The alarm was quickly given, and the fire was put out. The rioters who had been engaged in the effort to burn the bridge then withdrew to a point on the river sufficiently remote to secure them from the interference of the police, and passed the night there. At early dawn on the 24th they seized all the milk and market wagons coming into the city by that road, and gutted them. The danger which threatened Cincinnati on the morning of the 24th was very great, and aroused the authorities to the necessity of taking more vigorous action than they had yet thought necessary. The officers of the various railroads running from Cincinnati, with the exception of the Ohio & Mississippi road, which was still engaged in the strike, determined to run their trains in spite of the mob, and accordingly armed their employés with revolvers and coupling pins. A number of these armed employés were placed on each train, and whenever a gang of roughs undertook to interfere with the running of the trains, they were met by the determined employés, who informed them that they could not succeed in their objects without fighting. The rioters did not choose to fight, and the trains were unmolested. The men of the Ohio & Mississippi road refused to join the rioters in plundering, and by this refusal greatly disheartened the mob. A meeting of the Police Commissioners was held in the morning, and a call was made upon the citizens to volunteer as special policemen. Large numbers of citizens responded to the call, and on every side a stern determination was manifested to make short work of the mob should the necessity for a conflict arise. The rioters were overawed by this determination on the part of the citizens, and gradually slunk away. By the night of the 24th the danger in Cincinnati was practically over. The city continued in a feverish state for several days longer, but no further trouble was experienced. A number of arrests of rioters were made by the police, and the mob was shown that the sternest measures would be used against it.

The strike on the Pittsburgh, Fort Wayne & Chicago road, which, began at Allegheny City, Pennsylvania, rapidly extended westward. At eight o'clock, on the night of the 21st of July, the trainmen of this company at Fort Wayne joined in the strike. The freight train, which should have left Fort Wayne for Chicago at eight o'clock, was made up, but the brakemen and firemen refused to go on duty. The engineer and conductor declined to take the train out without any crew, and the officials were unable to obtain substitutes for the strikers. Every employé of the company peremptorily refused to take their places. In a very short time a crowd of several hundred men had gathered at the railway station and proceeded at once to spike the switches. Squads were detailed to guard the main and side tracks extending through the city, to prevent the passage of trains. News of the strike spread rapidly, and soon the crowd swelled to several thousand. The employés of the Wabash and other railways appeared in force, and encouraged the strikers to persist, offering to render any assistance required. The excitement was quickly at fever heat, and the officials announced to the strikers their determination to run trains out at all hazards, and the men declared that no train should be moved from the city by any power less formidable than the United States troops, until the order making the ten per cent. reduction in wages was rescinded. Some of the general officers of the road attempted to turn the switches, but were driven away without accomplishing anything. They got on an engine and made repeated efforts to take the train out of the yards, but were forced to desist. One engine wiper, who volunteered to serve as fireman, was taken off the engine by the strikers and subjected to rough usage. Master Mechanic, Superintendents and Masters of Transportation were also compelled to dismount from the locomotive. The police made several ineffectual efforts to scatter the mob, and at two o'clock, on the morning of the 22d, the Mayor read a proclamation ordering the crowd to disperse and refrain from disorderly conduct and obstruction of traffic. He was hissed down. The proclamation was printed and circulated among the strikers, who paid no attention to it.

On the morning of the 23d of July the aspect of affairs at Fort Wayne was very threatening. About eight o'clock a large force of strikers visited the extensive shops of Pittsburgh, Fort Wayne and Chicago Railway, where 1,000 men are employed, and insisted that they should be closed up. The men said they would not stop work until they received orders from the officials, but they were threatened with force and succumbed. The shops were at once closed up, and the fires put out. Committees then went east and west on hand cars, and induced the section and trackmen for a considerable distance to stop work. These men came to the city in the afternoon, and added a very ugly element to the crowd already assembled. A rumor prevailed that all the railroad shops and manufactories in the city would be compelled to shut down, but they ran all day as usual without interference. In the afternoon the strikers held a large meeting, and made exorbitant demands of the railroad officials, stating that they would not resume work until the force was replaced as it existed prior to June 1st, both as to number and rate of wages, and insisting upon the abandonment of all classifications in the rank and pay of engineers. They also adopted an address to the strikers, which was printed and circulated, and had a good effect. The address was as follows:

Strikers—News from Pittsburgh and other railroad points of terrible sacrifices of life and property is something that should be justly considered by you all. The latest despatches show that a very small percentage of strikers are taking an active part in the great and terrible destruction of the company's property, but that it is mostly done by outsiders, who, by such acts, believe themselves practically expressing the wishes of the strikers. Your friends and co-laborers hereby desire to express the earnest hope, and will give their assistance, that you will, should any such thing occur here, endeavor, by every means in your power, to protect the property of the company in this city. You are perfectly able to bring about a compromise without violence, or suffer others to destroy the property of the company. To destroy property will positively not remedy the matter, but, on the contrary, cause a slow restoration of better times. Do your work justly, honorably, quietly and thoughtfully, and allow no disinterested persons to meddle with the properties you helped to create, and which stand as everlasting monuments to your skill, perseverance and energy. Do as you would be done by, and do not act in too great haste. If the company has been unjust in its demands upon you, settle it as peaceably as you can without allowing the destruction of railroad institutions, that—to a very great extent—constitute the future prosperity, life, comfort and pride of our city.

The City Council met in special session during the afternoon, and issued a call to the strikers to disperse. An extra police force of 200 men was ordered to be sworn in at once, which was done, and the Mayor was directed to close all the drinking saloons of the city. The strikers remained firm. They took possession of the depots, yards and shops of the company, and prevented the passage of all freight trains. At the same time they made arrangements to guard the company's property from injury or destruction. Up to this time the Pittsburgh, Fort Wayne & Chicago Railroad was the only road entering Fort Wayne which was affected by the strike. On the 24th, however, the train men on the Wabash and the Grand Rapids & Indiana Railroads demanded an increase of ten per cent. in their wages, and notified the officers of their respective roads that they would strike if their demands were not complied with. During the night of the 24th, Fort Wayne was ably guarded by large bodies of armed men, who were kept on duty to protect the railway shops, rolling stock and private manufactories. The strikers furnished guards wherever desired, and rendered all the protection to property which was necessary. At a late hour two gangs of drunken tramps, numbering from fifty to a hundred each, gathered at the stock yards and railway bridge across the St. Mary's river and made vicious demonstrations and ugly threats. The strikers, upon being apprised of this, sent squads of men on hand cars to disperse the mob, which they did most effectually, driving all of the tramps some distance beyond the city limits. The men were kept going on the hand cars all night to prevent the gathering of any more such assemblages. During the evening a large mob of section and track men from the Western division of the road, many of them under the influence of liquor, seized a number of hand cars and entered Columbia City, where the Pittsburgh & Fort Wayne Company was buiding a new depot, and compelled the men employed therein to stop work. These hands drank freely and soon became very riotous. They started for the city on hand cars, making threats of violence and incendiarism. A force of strikers, learning of the threatened invasion, took an engine and coach and went out and met the mob. The strikers were well armed, and they compelled the drunken rabble to turn back and abandon their intended invasion of Fort Wayne. The strikes in this as in other instances were uniformly on the side of good order, and saved the city from the serious dangers which menaced it. Passenger trains were still running on the Pittsburgh, Fort Wayne & Chicago Railway and were not molested. On the night of the 24th the strikers notified all of their number who desired to come from Crestline to Fort Wayne to get on the passenger trains, and if the conductors insisted upon collecting fare they were instructed to take possession of the train and run it to suit themselves. Their fare was remitted, however, by the conductors, and all difficulty was thus avoided. The officers of the Pittsburgh, Fort Wayne & Chicago Railroad made no attempt to move the trains of their road. They appealed to the Governors of the States through which their line ran for protection, and ordered the discontinuance of all trains. The strikers thereupon took possession of the road, and those at Allegheny City and Fort Wayne, acting in concert, ran the passenger trains with considerable regularity. On the night of the 25th a secret meeting of the strikers was held at Fort Wayne, which, among other things, determined to take formal possession of the road, and run it to suit themselves. The strikers selected three of their own number to fill the positions held by the Superintendent, Master Mechanic and Master of Transportation. These officials soon learned that it was the intention of the strikers to take possession of their offices and control the telegraph wires, and determined to hold their offices against any attempt to oust them. They obtained from the city authorities a strong guard of police for their offices, and made their preparations for resistance. The strikers, upon hearing of these preparations, wisely decided not to attempt the seizure of the offices, which would surely bring them in conflict with the civil authorities. They had practical possession of the road, and the seizure of the offices mentioned would have given them no real advantage. On the morning of the 26th a Committee of the Pittsburgh & Fort Wayne strikers left for Pittsburgh to confer with the railroad officers, having receved an invitation to do so. They were joined at Crestline, Alliance and other stations by Committees from those points bound on a similar errand. On the same day a Committee of twenty-two train men of the Wabash Railroad, which had been sent to Toledo to confer with the officers of that road, returned to Fort Wayne. A meeting of the Wabash employés was at once called, and the committee stated the results of their conference. They reported a very satisfactory interview with the President of the road, who had agreed to redress their real grievances and to advance their pay whenever the business of the Company would admit. The meeting was very stormy, one element desiring to go to extremes. Better counsels finally prevailed, and at noon the meeting adjourned, having decided to abandon the strike if the employés at other portions of the line would do the same. A Committee was appointed to go to Lafayette and Logansport to urge the cessation of the strike, but this was not necessary, as the men at those places telegraphed that they had decided to resume work as soon as the Company desired them to do so.

The collapse of the strike on the Wabash Railroad caused a perceptible discouragement of the Pittsburgh & Fort Wayne strikers, and they were from this time somewhat less defiant than before, though they declared themselves confident of bringing the company to their terms. The sentiment of the people, who were put to great inconvenience by the embargo on freight traffic and on travel, was turning speedily against the strikers. On the night of the 26th the citizens of Fort Wayne held a meeting, and pledged their support to the authorities in their efforts to put down the strike and place the railroad company in possession of their property. The Committee appointed by the Fort Wayne strikers proceeded to Pittsburgh, and had an interview with the officials of the road. The result was a refusal by the Company to grant the demands of the strikers, and a resolve on the part of the strikers to continue their movement. On the afternoon of the 29th an effort was made by the officers of the road to start a train from Fort Wayne. An engine was run from the round house into the yard, but the strikers gathered en masse, and took the engine back, having forced the engineer and firemen from their posts. The city authorities now demanded that the strikers should cease their interference with the railroad, but met with a stubborn refusal. Not being strong enough to enforce the law, a call was made upon the Governor of Indiana for troops. As has been related, the strike on the Fort Wayne road at Allegheny City, Pennsylvania, ended on the arrival of the Governor at Pittsburgh with troops. Seeing that they were powerless to resist the force brought by the Governor, the Allegheny strikers surrendered to the Company and ceased their interference with the railroad. This surrender greatly disheartened the strikers at Fort Wayne and at other points on the road. Towards the last of July many of the men began to withdraw from the strike, which they now saw was hopeless, and these desertions still further disheartened their comrades. On the 2d of August the Sheriff notified the men that troops were on their way to Fort Wayne, and that the blockade of the railroad would be raised the next day regardless of consequences. He advised them not to provoke a conflict in which their defeat was certain. A meeting of the strikers was then held, and the men decided that they would return to work, provided that the Superintendent would promise that no man should be removed for taking part in the strike, and that he would use his personal influence with the Board of Directors to have all the grievances of the strikers redressed. He readily gave these pledges, and the men thereupon abandoned the strike and reported for duty. From this time there was no further trouble on the Fort Wayne road. Other points of Indiana were also much excited by the strike. The Ohio & Mississippi Railroad runs across the southern part of Indiana. The strike extended rapidly along this road from Cincinnati towards St. Louis. On the 22d of July freight trains were stopped at Vincennes on this road, but passenger trains were not interfered with. No violence was resorted to by the men on this line, and after holding out for several days, the strikers, disheartened by the failure of the movement in other parts of the country, surrendered to the Company, and returned to duty. On the 23d the train men and shop men on the Vandalia Railroad struck at Terre Haute and other points along the road. The machine-shops at Terre Haute, employing about six hundred men, were closed. The strikers were quiet and orderly, and passed resolutions declaring that they would abstain from drinking intoxicating liquors during the strike. One of the principal centers of excitement was Indianapolis, the capital of the State. The strike began there on the 23d, and embraced all the lines entering the city. The freight trains were stopped, and on some of the roads only the mail and express cars were allowed to be taken over the line. The Indianapolis and St. Louis men stopped work on the 23d, and compelled all freight trains along the entire route to lie over.

On the 26th of July the Governor of Indiana issued the following proclamation: Many disaffected employés of the railroad companies doing business in this State have renounced their employments because of alleged grievances and have conspired to enforce their demands by detaining trains of their late employers, seizing and controlling their property intimidating their managers, prohibiting by violence their attempts to conduct their business, and driving away passengers and freight offered for transportation. The peace of the community is seriously disturbed. By these lawless acts every class of society is made to suffer. The conduct and happiness of many families not parties to the grievances are sacrificed. A controversy which belongs to our courts or to the province of peaceful arbitration or negotiation is made the excuse for an obstruction of trade and travel over chartered highways within our State; the commerce of the entire country is interfered with, and the reputation of our community threatened with dishonor among our neighbors. This disregard of law and the rights and privileges of our citizens and of those of sister States cannot be tolerated. The machinery provided by law for the adjustment of private grievances must be used as the only resort against debtors, individual or corporate. The process of the Courts is deemed sufficient for the enforcement of civil remedies as well as the penalties of the criminal code, and must be executed equally in each case. To the end that the existing combination be dissolved and destroyed in its lawless form I invoke the aid of all law-abiding citizens of our State. I ask that they denounce and condemn this infraction of public order and endeavor to dissuade these offenders against the peace and dignity of our State from further acts of lawlessness. To the judiciary I appeal for the prompt and rigid administration of justice in proceedings of this nature. To the Sheriff of the several counties I commend a careful study of the duties imposed upon them by the statute which they have sworn to discharge. I admonish each to use the full power of his county in his preservation of order and the suppression of breaches of the peace, assuring them of my hearty co-operation, with the power of the State at my command, when satisfied that occasion requires its exercise. To those who have arrayed themselves against government and are subverting law and order and the best interests of society, by the waste and destruction of property, the derangements of trains and the ruin of all classes of labor, I appeal for an immediate abandonment of their unwise and unlawful confederation. I convey to them the voice of the law, which they cannot afford to disregard. I trust that this admonition may be so promptly heeded that a resort to extreme measures will be unnecessary, and that the authority of the law and the dignity of the State, against which they have so grievously offended, may be restored and duly respected hereafter.

The Indiana Central, Lafayette & Illinois, and Bloomington & Western Railroads were being operated at the time of the strike by receivers appointed by the United States Circuit Court. The Judge ordered the United States Marshal to protect these roads against the interference of the srtikers, and it was announced that the force of United States troops quartered in Indianapolis would be used, if necessary, to enforce the orders of the Court. The necessity for employing force never arose, however. The failure of the strikers in other parts of the country, and the manifest determination of the citizens to uphold the authorities in their repressive measures, disheartened the strikers. Throughout the whole movement all the strikers refrained from violence, and so avoided a conflict with the civil authorities. After holding out for a few days they began to show signs of weakness, and gradually surrendered to their respective companies. By the 1st of August, the trouble was over, and Indiana was at peace again. The roads had resumed their business, and no further interruption with them was experienced.

Chicago was quickly affected by the strike. The city contains a large and well-organized party of socialists and communists, who on several occasions had manifested an unruly disposition and a determination to bring on a riot whenever a favorable opportunity should occur. For some weeks previous to the railroad strike these men had been preparing for a public meeting, after which they intended to march in procession to the City Hall and demand of the Common Council the collection of the back taxes due the city, and the employment of all the unoccupied laborers by the municipal authorities. The certainty of the railroad strike reaching Chicago gave the communists very great encouragement. Meetings were held in various parts of the city, on the 22d of July, and were roused to fever heat by the news of the terrible outbreak at Pittsburgh. The communists seemed to scent, in the general uneasiness that prevailed, their opportunity for plunging the beautiful Lake City into anarchy and ruin. The Workingmen's Party, a communist organization, issued the following addresses to the workingmen of the United States:

COMRADES:—In the desperate struggle for existence now being maintained by the workingmen of the great railroads throughout the land, we expect that every member will render all possible moral and substantial assistance to our brethren, and support all reasonable measures which may be found necessary to them.

COMRADES:—We call your attention to the following questions, believing that the measures suggested will, if adopted, solve the difficulty now pending on all the great railroad lines of the land: *First.* Proper steps should be taken by the national government to enable it to take possession of and operate all the railroads and telegraph lines in the country, as is now done in all the more advanced countries of Europe, thus destroying the present and most powerful monopoly of modern times. *Second.* The establishment in every State, and by the national government, of an eight hour work day—thus employing all the idle workmen wherever increasing numbers, constantly added to by the rigid introduction of labor-saving machinery, is a constant menace to all those fortunate enough to have employment, and must invariably reduce wages to a rate consistent with the standard of living. The most ignorant and uneducated workers whose labor can be utilized.

It was hoped by the communist leaders that these documents would bring them large reinforcements from the genuine working classes. Throughout the 22d of July great uneasiness and anxiety prevailed among the citizens of Chicago. All were apprehensive of the effect of the excitement upon the poorer classes of the city, many of whom were sympathizers with the communists. The Mayor remarked that he did not fear the Irish or Germans, but the large class of half-savage Bohemians who inhabit the lumber district of the city, along the south branch of the river. These men work for fifty cents a day, are thoroughly imbued with communistic ideas, and are ripe for anything. Meetings were held during the day by Michigan Southern, Rock Island, Chicago & Northwestern, and Milwaukee & St. Paul Railroad men, but their proceedings were kept secret. "No one knows what took place," says a letter from Chicago, "but from expressions gleaned among the men to-day, it seems that they passed resolutions of sympathy for their striking brethren East. The excitement continued during the 23d. The streets were thronged with people hurrying from point to point in search of news, and spreading the most alarming rumors. The railroad men appeared to be the most quiet class. The citizens had little fear of them, their dread as on the previous day, being excited by the communists. The city authorities, in the meantime, were quietly but rapidly preparing to deal with the mob. It was decided, if a conflict did come, to put down the outbreak at once and with vigor. Muskets were sent to the various station-houses for the use of the police, and three pieces of cannon were placed in charge of an artillery company organized for the purpose. The militia regiments of the city were ordered under arms by the Governor and were directed to assist the municipal authorities whenever called upon.

On the night of the 23d, a mass-meeting of the "Grand Army of Starvation," as they styled themselves, was held in Market Street. Ten thousand persons were present. At eight o'clock the crowd began to gather, and a little later the torchlight processions from the various divisions of the city arrived, amid the deafening cheers of the crowd. Stands were at once improvised and speakers supplied in quick succession. Six men addressed the crowd at once in English and German, and in the most inflammatory language. The speakers openly appealed to the multitude to rise and follow the example of their brethren in the East. Said one of the men: "We, laboring men, have common cause with the railroad strikers at Pittsburgh, and we must rise up in our might, and fight for our rights. Better a thousand of us be shot down in the streets than ten thousand die of starvation." The meeting broke up at half-past eleven, after resolving to meet at the same place the next morning at ten o'clock, to sign the platform of the Laborers' League. They left without disorder, carrying their banner bearing such inscriptions as "We want Work, Not Charity;" "Life by Work, or Death by Fight." It was evident, on the night of the 23d, that the dissatisfaction of the railroad men was approaching a crisis. On the morning of the 24th of July, it culminated in a general open strike of the railroad hands. Early in the morning the employés of the Michigan Central Railroad sent a Committee to the officers of that road and demanded the restoration of their former wages. The General Superintendent refused to accede to their demand, and the Committee withdrew. The employés of the road at once stopped work and joined the strike. The Company made no effort to send out any trains during the day, and consequently there was no disturbance. At nine o'clock the freight men on the Illinois Central, who work in and around the yards, quietly stopped work. They were the switchmen and helpers who make up the trains, numbering about twenty-five; the laborers who handle freight in the freight houses, numbering about one hundred, and the men who pick, assort, and store the freight in the cars, numbering about forty. They were incited to strike by a delegation from the Michigan Central, and by the general feeling of dissatisfaction at the reduction of pay which pervaded every class of railroad employés. The strike was orderly, and the men exhibited no ill disposition, save in exceptional cases. The first action taken by the freight men was the informal appointment, by general consent, of a delegation of four from the switchmen and train-makers to call upon the Master of Transportation, and ascertain whether the wages could not be restored. He received them pleasantly, and talked to them fairly and squarely. The men acted reasonably and like men. They said that they represented only the switchmen. On July 1st a special reduction, not extending to other employés, had been made in their pay, and they felt that injustice had been done in making them specially subject to a decrease in salary. They had been called upon to join in the general strike, and they now wanted to know whether, before doing so, a restoration might not be promised. If not, they would have no reason to give the other strikers for not joining them, and so would be forced into the revolt. The delegation claimed that these reductions had been made only on the men they represented, and thus they considered unfair. It was explained that it was a mistaken idea that unequal reduction had been made by skipping certain departments, leaving them undisturbed. Of course, if the men wished to strike, he could not prevent it, and, though he deplored such an action and hoped they would try to prevent it, and preserve the harmony which had always existed, yet, if they did stop work, he would shut up the freight houses at once. The Committee left dissatisfied, however, and went out and reported to the men, who started immediately to go to the Michigan Southern yards to consult with the men there. The result was the visit of another delegation to the officials, which was more unsatisfactory than the first.

The crowd, composed of some 500 Michigan Central and Illinois Central men, then started in procession to visit the other yards and enforce a strike. They proceeded first to the Baltimore & Ohio, where the men fell in readily and without much persuasion. The crowd of howling men and boys then marched to the Rock Island yard, between Fifteenth and Sixteenth Streets, where they took the men off their engines and told them they must quit. The mob shut the water off the tanks, and when everything was fixed to suit them, they started for the Chicago, Burlington & Quincy. Here the men did not offer the most feeble resistance, but left their engines and switches at the word of command from the mob. The agent of the Rock Island freight house shut the doors at their approach, but was soon compelled to open them again. The crowd visited the Chicago & Alton freight depot, but were met by the men of that road who had quit the Company, having stopped the traffic, both passenger and freight.

The numerous outrages of the mob warned the civil authorities to be on the alert, and every effort was made to prepare for an emergency. The First and Second Volunteer Regiments and the Ellsworth Zouaves were held in readiness at their armories; the Grand Army of the Republic prepared to turn out with full ranks whenever called upon; and a large number of special policemen were sworn in and armed. The Mayor issued the following proclamation:

Whereas, The railroad troubles and strikes which have taken place in several of the large cities in the country have, in most cases, been attended with incendiarism and plunder; and, whereas, some of the employés of a few of the railroads in this city have struck for an advance of wages, and have been joined by the operatives in some of our factories; and, whereas, it is feared that the bad and vicious element in this community will seize this as a favorable opportunity to destroy property and commit plunder; therefore, I, by the authority vested in me as Mayor of the city of Chicago, call on all good citizens to aid in enforcing the laws and ordinances, and in suppressing riot and other disorderly conduct. To this end I request that the citizens organize patrols in their respective neighborhoods, and keep their women and children off the public highways. Proud of the deserved reputation of all classes of our people as law-abiding citizens, I trust and believe no act will be suffered or permitted by any of them now which would disgrace us in our own estimation and that of the country at large. The workingmen must remember that all industries are suffering from financial depression throughout the country, and that acts of violence, instead of tending to rectify their wrongs, will tend to deprive them of all sympathy. The city government has made ample preparation to protect the lives and property of all citizens, and any lawless acts will be promptly detected and punished.

This was followed by a second, closing the liquor saloons of the city, as follows:

Whereas, The public mind is unduly excited owing to rumors of strikes, and the fact that some excited and bad men are congregating and endeavoring to promote confusion and disorder, and deeming it for the best interests of our citizens of all classes that no cause be given or permitted to influence passions or prejudices; therefore, by virtue of the power and authority vested in me as Mayor of the city of Chicago, I hereby order that all saloons in the city be closed, and that no liquor be sold by any licensed saloon keeper or others from and after six o'clock P. M. of this date until further notice, under penalty of the law and forfeiture of license. All patrolmen and policemen are hereby instructed to see that this order is promptly and vigorously enforced.

On the same day, the Governor of Illinois issued a proclamation, in which, after reciting that troubles were occurring in certain States, he called upon the people to aid in maintaining the peace; enjoined vigilance upon Mayors, Sheriffs and others in authority in suppressing violence, and declared all these questions must be regulated by ballots instead of mobs. The merchants of the city also armed their employés and made preparations to defend their establishments against the mob. "The strike," said a Chicago letter, written on the 25th, "has brought business at the banks to a complete standstill. The Express Companies are unable to receive currency for shipment, hence the city banks are unable to respond to the calls of country institutions for funds. The impossibility of obtaining currency from New York is also inconvenient, and places some of the banks who had previously telegraphed there for funds to be forwarded by express, in an awkward position. Exchange is virtually unsalable from the fact that it is deemed useless to remit East with the expectation that it will go through.

The police and the mobs have met face to face about one dozen times. On Twenty-second Street, which penetrates the lumber districts, two skirmishes occurred. The police were attacked with stones, clubs, and missiles of all kinds, but they did not lose their temper nor their patience, and bloodshed was avoided. They have been provoked to the very verge of madness several times during the day; many of them have been hurt severely with clubs and stones, but they have obeyed orders and behaved admirably. At noon on the 25th, the aspect of affairs seemed so threatening, and the size of the communist mob appeared to be increasing so rapidly, that the Mayor issued a proclamation asking all good citizens to organize themselves into safety guards in their respective wards, called upon all to respect the laws, and asked aid and encouragement for the military companies then under arms. This was followed soon after by an address signed by the Mayor and a number of the leading merchants, bankers and journalists of the city, calling for a grand mass-meeting at the Tabernacle at half-past three P. M. At this meeting there were fully sixty thousand business men present, and a resolution was adopted approving the course of the authorities, and standing by them in their efforts to preserve the peace. A special meeting of the City Council was also held, and a resolution was adopted giving the Mayor plenary powers. The merchants held meetings in different parts of the city at night, for the purpose of effecting an organization. The strength of the mob was variously estimated at from 25,000 to 40,000 men. During the night they caused serious trouble. A mob gathered at the Chicago, Burlington & Quincy round house soon after dark, and began to put out the fire in the engines. For nearly an hour they stoned the building and crowded around the yards, when all at once a squad of police that had been summoned rushed up and were met by a volley of stones. The officers drew their revolvers and fired on the mob, which retreated at the first fire. Three men fell; one was carried away by the mob. It is said that sixteen were wounded by the firing, which lasted ten minutes. The officers at length exhausted their cartridges and charged upon the crowd with their clubs, when they retreated. Soon after the squad retired the rabble returned and stopped the street cars on the Halstead Street viaduct, stoning the inmates until they alighted. One car was torn to pieces, and the others taken to the stables. The rioters next broke into a gun shop, completely gutted it, taking away fifty breech-loading shot guns, one hundred and fifty revolvers, and several kegs of gunpowder. They then passed off south toward Bridgeport, and gave no further trouble during the day.

During the afternoon, a strong force of regular troops arrived from Chicago from the far West. The prospect was so threatening that it was deemed best to hold them at Chicago.

Chicago was profoundly excited on the morning of the 26th of July, and it was generally felt that the day would not pass without a serious conflict with the mob. The rioters called themselves workingmen, but they were generally loafers and bummers who never did an honest day's work. The leaders were communists. But few honest workingmen were found in the crowd, and the railroad men could scarcely be seen in it. About nine o'clock in the morning a meeting of self-styled workingmen, mainly made up of roughs and loafers, was convened at Turner Hall, within a block and a half of the police station. Nobody seemed to know what was going on, but it was understood that certain carpenters and cabinet makers, representing, or claiming to represent, their respective trades, were gathered there for conference. The mob began to gather, and surged up and down on the sidewalk and in the street, a howling, yelping mob of irresponsible idiots. They talked of what they were going to do, and how they had gotten things all their own way, every language except Chinese being used. The communistic element was largely represented, many of the lowest class of Poles and Bohemians being on hand. About ten o'clock a body of twenty-five policemen appeared on the scene. As they neared the surging crowd, the hooting and yelling became terrific, and the mob began to pelt the officers with bricks, stones, and other missiles. The police stood the attack quietly for a few minutes; but this encouraging the mob to greater violence, a charge was ordered, and the men turned upon their assailants, hitting right and left with their clubs, and hitting to hurt. Outside the police station was another detachment of officers, numbering about a score, who speedily came to the assistance of their comrades. There was a very lively fight for a few minutes, but discipline and organization proved too much for the rioters, who were soon put to rout. The police, having disposed of the outsiders, forced their way into the hall. In the second story they found a panic-stricken mob of perhaps one hundred and fifty, who, in their frantic efforts to escape, ran hither and thither like rats in a pit. Many jumped from the windows, and so gained the street, but some seized chairs and other pieces of furniture, with which they attempted to defend themselves. A good many were hurt during these operations, but none fatally, and only one of the special police received any damage. He was led back to the station, where it was found that, aside from a cut on the head, of no great depth, he was all right, and he remained on station duty during the day. The crowd spread itself over the neighborhood, many of the rioters having received a lesson which will lead them to respect the police a trifle more in the future. While the rioting about Turner Hall was in progress, a crowd of boys and roughs gathered about the Halstead Street viaduct. The street cars were stopped, and for some time it appeared as if the roughs were to have everything their own way. A detachment of twenty-five policemen sent to disperse them was received with stones and revolvers. The police returned the fire with good effect, knocking over several of the rioters with their bullets. But the crowd, being constantly swelled by reinforcements, maintained their ground. Stones were thrown at the police from the roofs of houses and from alleyways. Having exhausted their ammunition, the officers at length retired, the mob following, hooting, yelling, and throwing stones. On meeting with a detachment sent to reinforce them, the police turned, and made a vigorous charge on the rioters, and scattered them in all directions.

This defeat by no means disheartened the mob, and they gathered again at the Halstead Street viaduct. By eleven o'clock they numbered fully ten thousand men and boys. The undecided peacefulness of the horde had vanished; their numbers seemed to inspire them with the valor of savages; and it was evident that they were bent on violence, and would hesitate at nothing. The north approach to the Halstead Street viaduct, and the structure itself, were black with the mass of rioters. The aspect of affairs was so threatening that a strong body of police was sent to the viaduct with orders to disperse the mob. The moment the rioters beheld the approach of the police, who marched from the Harrison Street station, they broke indiscriminately and fled to the other side of the viaduct, howling like fiends. The police broke into a run, and pursued them, firing as they ran. A counter charge was made by the rioters in an attempt to pass the police on the viaduct, in order that there might be a force of desperadoes on each side of the beleaguered peace defenders. The scheme was promptly and creditably frustrated by a free use of the baton and a display of pistols, from which blank cartridges were fired. The mob then pitched itself headlong down the descent across Sixteenth Street, and a similar crowd went east, in the direction of the Chicago, Burlington & Quincy freight houses. There was a brief moment of inactivity; during which the police formed in line and prepared for a charge. This was the signal for a shower of stones, pistol shots and other missiles. For a little time the wildest disorder prevailed, and it was evident that the police were just a little alarmed, as well they might have been, at the overwhelming force arrayed against them. For half an hour the discharge of weapons was kept up at short intervals, in reply to stones that were being continually pelted down from all sides. With every moment of delay, during which the rioters were unharmed, the belief grew in their minds that the police were not firing bullets, and they began surging near a central focus. Several times did a few of the more daring attempt to break in upon the police, and each time they were successfully repulsed. The police had now but a few rounds of ammunition left, and it was evident they could not stand their ground much longer unless reinforcements came. Seeing that the rioters were again closing in on his men, as if they knew they could not fire many more times, the Sergeant gave the order to his men to fire off rapidly all the charges they had left, and at the same time to withdraw across the viaduct towards the station. The order was obeyed, and the police having exhausted their ammunition, formed in line, and started back across the viaduct. The tremendous crowd of maddened roughs at once started in hot pursuit, throwing volley after volley of stones, which fortunately failed to do any damage. The police attempted to guard their retreat at first, but soon found it absolutely impossible, and they turned and fled. The chase for life and death was one of the wildest excitement. The vast throng hung closely upon the heels of the police, and did not cease to pursue till the latter arrived at Fifteenth Street. The position of the police was now critical in the extreme. The rioters were pressing them hard, and unless assistance should come it was plain they would never reach the station. At this moment, however, a cheer was heard, and a body of veteran cavalry dashed into the street and rode rapidly at the rioters. This force was followed by several large wagons, bearing reinforcements of police. These came up on a run, and the men dismounted and joined their comrades, who had made so gallant a stand against the mob. When the rioters saw the cavalry and reinforcements of police, they turned to retreat. Then began the most destructive scene of the morning. As they ran the police began firing. One of the mob was shot through the brain and instantly killed; another was killed by a projectile hurled by one of his own party. The police used their clubs effectively, sparing no one. The police made no attempt to cross the viaduct a second time, but stopped a little northward.

The cavalry pushed on over the bridge and drove back the rioters. During the remainder of the day the cavalry were kept on duty in the vicinity of Halstead Street, breaking up crowds wherever they would collect, and capturing rioters, over one hundred of whom were sent to the station houses. About eleven o'clock orders were received by the Second Illinois Regiment to proceed at once to the scene of disturbance. The men were instantly gotten under arms, and the regiment set out on the double quick for Halstead Street, accompanied by two pieces of artillery.

During the day additional companies of regular troops arrived. The regulars were posted at various points in the city which were believed to be in danger. The Second Illinois Regiment was kept on duty at the Halstead Street viaduct, and the First Regiment was stationed close by. Parties of cavalry and police patrolled the city during the day, making many arrests. The rioters did not dare to gather in force again, but small crowds constantly assembled on the streets as fast as broken up, and while no effort was made to oppose the troops with force, the rioters vented their rage by cursing them roundly. Several minor encounters took place between the police and the mob during the afternoon, but no general outbreak was attempted. The rioters were still noisy and loud in their threats, but they were too thoroughly cowed by the determined attitude of the military and police to attempt a renewal of their efforts of the morning.

The night of the 26th passed away without further disturbance, the city being held by the regulars, the volunteers and the police. The rioters were feverish and restless, but avoided a conflict. They had lost their courage, and were afraid to meet the force opposed to them. On the morning of the 27th a crowd was reported to be gathering in the quarter known as "Bridgeport." Three cavalry companies and two companies of the Second Regiment were ordered to the spot. The Board of Trade cavalry and Colonel Agramonte's veterans, some three hundred strong, repaired to the scene, supported by the infantry. The mob was dispersed without difficulty. The Halstead Street viaduct, the scene of the disturbance on the previous day, was held by the Second Regiment. The cavalry patrolled the western part of the city throughout the day. The mob was sullen and cross, but it was beaten, and the danger was at an end. The police and the cavalry had orders not to allow people to gather in crowds in the streets, and this order was rigidly enforced. The Mayor issued the following proclamation:

The city authorities having dispersed all lawlessness in the city, and law and order being restored, I now urge and request all business men and employers generally to resume work, and give as much employment to their workmen as possible. I consider this the first duty of our business community. I am now amply able to protect them and their workmen. Let every one resume operations, and report any interference at police head-quarters. Citizens' organizations must continue in force, and on no account relax their vigilance, as the cause of trouble is not local and not yet removed. All such organizations should form themselves into permanent bodies, continue on duty and report regularly as heretofore.

From this time the excitement in Chicago gradually subsided. The communist leaders and their desperate followers saw that they were no match for the force at the command of the authorities, and were terrified by the wholesale arrests of their comrades. They slunk out of sight, and in a day or two Chicago was enjoying its normal repose. The railroad men, disheartened by the failure of the strikes on other parts of their roads, surrendered to their respective companies, and returned to duty at the old wages.

Other parts of Illinois shared in the general excitement, but no serious conflict occurred, nor was any great damage done outside of Chicago. At Peoria a mob seized several of the railroads entering the city, and attempted to stop the running of the trains. The local authorities took prompt measures to put down the outbreak, and the volunteer companies of the town were ordered out to assist the police. On the 26th of July the police made a gallant charge on the mob, and arrested three of the principal leaders. The prisoners were taken to the jail, and the mob followed with the intention of rescuing them. The military at once repaired to the jail, and forced back the mob at the point of the bayonet. The mob, deprived of its leaders, was powerless, and though threats were freely indulged in, no further violence was attempted. On the 27th of July the Governor of Illinois issued the following proclamation:

Whereas, Certain persons active in the violation of law have assumed to interfere with and prevent the movement of railroad trains in this State, and have sought to intimidate honest workingmen engaged in the avocations by which they earn their daily bread, and to compel them to cease from their labor; and

Whereas, This condition of affairs continues, and is intolerable, entailing as it does disastrous consequences, the nature and extent of which it is impossible to foresee: *Therefore*, I, Shelby M. Cullom, Governor of Illinois, acting under and by the authority of the laws of this State, do command all such riotous and disorderly persons to desist and return to their homes, and do call upon all Sheriffs, Mayors, and other officers charged with the execution of the laws to break up all conspiracies against the rights of property and of persons, and to that end to employ every lawful means in their power, and do enjoin upon all good citizens to assist in bringing about the restoration of order, the resumption of business, the moving of trains, and the revival of manufactures. I further give notice that the entire military force at my disposal as Commander-in-Chief of the militia will be employed for the support of the civil authorities in this endeavor, and that orders will be given to the troops to use whatever amount of force may be necessary to compel obedience to the laws. In testimony whereof I have hereunto set my hand and caused the great seal of the State to be affixed.

There were slight disturbances at Decatur, Effingham, Galesburg, Joliet, and Carbondale, but no outbreak. Braidwood, an important place in the mining regions, was profoundly excited by a strike of the miners, but no trouble was experienced. At East St. Louis, on the Illinois shore of the Mississippi River, opposite the city of St. Louis, there was quite a formidable strike, and the State authorities were compelled to break it up by a concentration of the State troops.

The city of St. Louis is the terminus of a number of important railway lines. The Mississippi is here spanned by a magnificent iron bridge which gives St. Louis direct connection with the States lying east of the great river. The eastern end of the bridge is at East St. Louis, in the State of Illinois. Here the shops and round houses of the various railroads using the bridge are located. East St. Louis is thus a very important railroad point, and being so closely connected with its greater neighbor over the river, the strikes on the two sides of the river were really one movement, and must be treated as such. On the 22d of July, signs of excitement and disaffection began to show themselves at East St. Louis. A secret meeting of the railroad men was held in the afternoon, at which it was resolved to make a formal demand upon the various lines centering at St. Louis for an increase of wages, and to inaugurate a general strike, should the demand be refused. After the adjournment of the secret meeting, an out-door meeting was organized, in which about two hundred members of the French, German, Bohemian, and English sections of the workingmen's party of the United States from St. Louis participated. Their coming was greeted with cheers and much enthusiasm. Several speeches were made by the leaders of this section, in which they offered sympathy for the strikers, and pledged themselves to stand by them in their struggle. It was stated from the stand that there would be another meeting at night, composed strictly of railroad men, at which a declaration of their purpose, and what action they proposed to take, would be made. The section of the workingmen's party before referred to held a meeting at Turner's Hall in the afternoon, and after several speeches on the labor question in general, and the present situation in particular, they unanimously adopted the following resolutions:

Whereas, The workingmen of the different railroads in this country are rising *en masse* to demand their just rights; and, *Whereas*, The United States Government has allied itself on the side of capital and against labor; therefore, *Resolved*, That we, the workingmen's party of the United States, heartily sympathize with the employés of all the railroads of the country who are attempting to secure just and equitable reward for their labor. *Resolved*, That we will stand by them in this most righteous struggle of labor against robbery and oppression, through good and evil report, to the end of the struggle.

The demand agreed upon by the meeting of railroad men was made upon the various Companies on the night of the 22d, but was refused. At midnight a general strike was begun on all the roads at East St. Louis. On the morning of the 23d it was announced by the strikers that passenger and mail cars might be run on the eastern roads, but that no freight trains would be permitted to pass. The men were quiet and orderly, but determined. The Companies generally accepted the situation, and made no effort to run their freight trains. The men of the Toledo & Wabash road had not had their wages reduced, and declared that, though they had no grievance against their Company, they struck out of fellowship for the employés of the other roads. An effort was made during the morning to start a freight train on the Chicago & Alton road, but the strikers stopped it and took it back into the yard. Everything was very quiet in the Union depot, and in the yards of the Union Railway & Transit Company of St. Louis during the morning. One stock train was allowed to cross the bridge, but none were permitted to pass after twelve o'clock. The employés of the Transit Company, who do duty in East St. Louis, fifteen in number, struck with the firemen and brakemen of the railroad. The employés of the Company on the St. Louis side of the river, whose duties are performed at and in the vicinity of the Union depot in moving trains in the yard, through the tunnel, and across the bridge, did not formally strike, but they were idle for the reason that there was nothing for them to do, as the strikers across the river would not permit the freight trains to pass. The Transit Company rescinded their order for a reduction of ten per cent. on wages, and notified their employés to that effect, but the latter took no notice of it. During all, the trains on the Missouri, Pacific & St. Louis, Kansas City & Northern roads went out and came in as usual, there being no strike on those roads yet, nor had the employés manifested any disposition to take action in the matter. The St. Louis, Iron Mountain & Southern Railroad does not connect with the Union depot, but has its own depot in the southern part of the city. Everything was quiet on that road, and business was progressing in the regular way. The strikers in East St. Louis gave a special permit to the National Stock yard people to use their own locomotives to haul feed to the yards for the stock there. They also permitted the Union Railway & Transit Company to select ten men to switch passenger trains coming to the Relay depot at East St. Louis, and destined for the city. On the morning of the 24th, the East St. Louis strikers, encouraged by having been unmolested by the civil authorities, changed their plan of operation and refused to allow the running of passenger trains. Upon the arrival of the eastern bound train on the Vandalia road at the Relay house at East St. Louis, an effort was made to impede its progress. After the short halt there, which is customary with all trains, and when the train was just getting in motion, a striker drew the coupling pin behind the mail car and called out roughly to the conductor, "Go on with your United States mail; we've got nothing to complain of against the Government." This rash act and declaration was greeted with loud shouts by the five hundred strikers. The conductor stepped out on the platform of a car and appealed to the mob to replace the coupling pin and permit him to proceed. He said, "I have one hundred and twenty-five passengers on board, and they have paid their passage to eastern points on the faith of your promise that you would not interfere with passenger travel. You are in honor bound to let them pass." [Cries of "That's so." "Let them go," etc.] "It's a mean, contemptible trick," said the plucky conductor, "and if you persist in it, it proves that you are not honorable men." The appeal of the conductor created a dissension in the ranks of the strikers, many of them contending that the train should be allowed to proceed, and others declaring it should not. Nearly an hour was spent in wrangling among the men, and finally the Committee in charge decided to let the train go, and it is unnecessary to say it went very rapidly. In the meantime there was great excitement among the passengers inside, and two or three of the ladies fainted, one of them, an invalid, being still unconscious when the train took its departure. When the mail train on the Cairo narrow gauge road arrived at the Relay house the passenger car was detached from the mail coach, and the conductor proceeded without his passengers. In the meantime the leaders telegraphed across the river to their representatives in the city not to allow any more passenger trains to pull out from the Union depot. At eleven o'clock, twenty-five strikers, boarded an engine and tender, steamed through the tunnel, and dashed into the Union depot. This was the first appearance of the strikers in the limits of St. Louis proper, and their arrival caused a great sensation in that hitherto quiet neighborhood. They quickly alighted from the engine that had borne them over, and, with a shout, proceeded across the depot sheds, where they seized two engines belonging to the Missouri road, and, mounting the engines, steamed rapidly up the track a mile and a half to the machine shops of that company. The workmen in the employ of the Missouri Pacific Railroad at the machine shops, numbering two hundred and fifty, had been advised by the strikers that they would be visited during the day, and when the strikers arrived, they received them cordially, though they continued their work; and in answer to the question whether they were willing to strike, replied that the Pacific Company had partially acceded to their demands, and they thought they should continue at work. "But you must help us out," replied the leader of the strikers, "and in order to do this you must quit work." A long conference between the strikers and workmen ensued, and, at the end of half an hour, the former, despairing of success in inducing the latter to strike, withdrew. A number of policemen stationed at the machine shops attempted to prevent the entrance of the strikers into the shops, but their efforts were fruitless. From here the strikers returned to the Union depot, and at two o'clock, when the Belleville passenger accommodation train on the Cairo road was about to start out, one of, the leading strikers, stepped aboard the engine and whispered to the engineer, who, with the firemen immediately left their posts, and the strikers announced that the train would not be permitted to leave the depot. Officers of the road expostulated, but for over two hours the strikers were firm in their refusal to grant the request. At the end of that time the train was allowed to go. A large force of police were on hand, but did not undertake to interfere with the strikers. Three or four thousand people, composed of discontented and unemployed laboring men, gathered under the depot sheds, and much incendiary talk was engaged in.

As a result of these riotous demonstrations the police cleared the saloons in the neighborhood, and ordered them to be kept closed. About four o'clock another engine, with the flat cars loaded with 400 strikers from the eastern shore, arrived at the depot, and were received with loud cheers by the crowd. The strikers disembarked, formed in line, and, with the music of the fife and drum, marched in the direction of the Pacific machine shops. At every street crossing the procession was joined by numbers of sympathizers, and by the time the shops were reached there were 2,000 men in march. Arrived at the shops, they found that the shopmen, being advised of the approach of the strikers, had already quit work, and were on the platform ready to receive the strikers. A representative machinist received the visitors and made a speech to them, saying the shopmen had concluded not to strike, but to quit work in deference to the demands of the strikers. They had no cause of complaint against their employers, but would not return to work until the strikers had secured a redress of their wrongs.

From this place the strikers marched to the North Missouri Railroad track on the levee, where they took possession of an engine and ten flat cars, and boarding them proceeded to the round house of that company in the northern part of the city, where they were met by the employés of the company. A conference was held, and as a result the employés agreed that no more freight trains should be allowed to go out on the road from St. Louis. The strikers returned to the Union depot at six o'clock.

The arrival of the troops had no perceptible effect in cooling the ardor of the strikers, the leaders declaring that they would avoid collision with the troops, but were determined to carry their point at every risk. By nightfall nearly all the strikers had deserted the eastern side of the river, and were congregated at the Union depot, where they passed the night. During the day there was great popular excitement throughout the city, and the strike was the absorbing theme of conversation. A serious feeling of apprehension was abroad among the people, and a general belief prevailed that the crisis was bound to result in blood and devastation. The city authorities had been very passive since the beginning of the strike, and their attitude excited much indignant comment at the time. It was based upon the fact that there were not 1,000 stand of arms in St. Louis at the disposal of the authorities, and it was deemed best not to undertake to interfere with the mob until it could be done in an effective manner. In the meantime every exertion was made by the municipal authorities, in concert with a number of prominent citizens, to obtain arms and ammunition for a force of five thousand men. On the night of the 24th the Internationalist, or Communist leaders, who have a large following in St. Louis, held meetings in several parts of the city, which were attended by monster audiences. The most incendiary speeches were made and threats of burning the buildings of the newspapers, which had criticised them only, were indulged in. Processions of excited men marched through the streets yelling and making other noisy demonstrations. A large proportion of the city police force had been withdrawn from the regular beats and held in readiness at the points of danger.

The morning of the 25th found the city greatly excited. About nine o'clock a crowd of 1,000 men assembled in Lucas' market place around a stand erected by the workingmen's party, while two or three thousand spectators gathered in the vicinity. The crowd was made up mostly of wire-workers who had struck, and strikers from other manufacturing establishments. At ten o'clock they formed in column and marched past the City Hall to Turner Hall, where the executive committee of the workingmen's party was in session. Half an hour later a body of 500, made up chiefly of negroes, was sent to the levee, and marched its entire length for the purpose of inducing the roustabouts to join them. The strikers said they were to receive explicit orders from hour to hour, and expected to stop all manufacturing establishments before night.

A crowd of 2,500 people gathered at the Union depot, but nothing of importance occurred there. The only passenger train which passed over the bridge during the morning was the Toledo, Wabash & Western, the strikers making an exception in favor of that road because of its position toward the employés in the past. On all the other roads only the postal cars were allowed to leave. The Chicago & Alton people refused to be dictated to, and at the regular hour sent out their postal car and baggage car and one passenger coach. The train reached East St. Louis, but the strikers refused to allow any but the engine and postal car to proceed. This discrimination was declined, and the whole train was backed over to the depot on the city side. The Missouri Pacific machine shops and freight depots and yards were closed, and none of the men were at work. They told the officers of the road that they were satisfied to work, but that it would only precipitate an attack and general trouble with the strikers. The position of the men was approved by the company, and the shops and depots closed by mutual consent. The company sent out three or four freight trains between one and five o'clock in the morning, but decided not to start any more for the present.

A large delegation of strikers from the city visited Cheltenham, four miles west of the city, during the morning, and ordered the men out of the smelting and fire clay works. They offered their employers to continue at work if protected, and a request was sent to police head-quarters for a detail of police, but it was refused. The police force was on duty at station houses, and the city was almost entirely unpatrolled. The force was kept in reserve, to be used only when the strikers should resort to violence or a mob should be formed. Another urgent request for a detail was received from officers of the Union Street Railway, an important line, which runs from Fourth and Locust Streets to the Fair Grounds. The employés notified the company that unless the recent cut of ten per cent. was restored, they would strike at twelve o'clock and stop the cars. Fears were entertained for the safety of property. The police were instructed to be in readiness to march to the stables upon the commission of any overt act, but not before.

A "Citizen Organization for the Protection of Property" was organized at the Four Courts. Meetings were held by citizens in various parts of the city, and companies were also formed and officered. These at once reported for duty, and by nightfall the organization numbered 1,500 armed men. A company of fifty men was organized for gun-boat service, and placed on the city harbor steamer, with order to patrol the river. The work of organization was carried on rapidly, and by noon the next day 10,000 citizens had enrolled themselves. At ten o'clock on the morning of the 26th a procession of 2,000 men, consisting partly of workingmen who had joined the strikers, but mostly of loafers and idlers, marched from Lucas Market to the manufacturing district north of Washington Avenue. They first visited Belchers' sugar refinery, where some 400 employés were forced to quit work on the day before, and finding the doors closed, broke them open, rushed in, extinguished the fires in the furnaces and displaced the machinery, so the employés could not return to work, as they had announced their intention of doing. Many of the workingmen protested against injuring or destroying property and aban doned the procession; but the mob continued its march, visiting about forty different factories and flour and planing mills, compelling the employés, aggregating nearly one thousand, to quit their work and close the doors, although the employés in many cases earnestly protested against being interfered with. Several planing mills were among the establishments closed by the mob. No respect of persons was shown, women and girls being treated in the same manner as the men. All were forced to stop work whether they were willing or not. The operations of the mob were generally uniform.

A mob of negroes proceeded to the levee, and forced the officers of all the steamboat companies and independent steamers represented there to sign pledges to increase the wages of all classes of steamboat and levee laborers. Their demands were of the most extortionate character, the increase insisted upon ranging from sixty to one hundred per cent. They were very peremptory, and would not allow a boat to leave the wharf until their demands were complied with. The rioters were very insolent and defiant throughout the day, and announced their intention to close every workshop and place of manufacture in St. Louis. As was to have been expected, the negroes were by far the most turbulent and unmanageable of the rioters. But little business was transacted in the city. Many of the stores were closed, and the work of arming and drilling the citizens' force at the Four Courts was carried on rapidly. The Sheriff also organized and armed a posse of 2,000 men. The Governor arrived in the city during the morning and gave his aid to the work of suppressing the disorder. The arming and drilling of the citizens was carried on actively all morning at the Four Courts building. No outward demonstration was made up to noon save that heavy guards were on patrol duty in front of the building. Two large brass field-pieces loaded with shrapnel, and with horses attached and ready to move at a moment's notice, were kept in waiting in the yard of the jail in charge of a company of sixty men. About half-past ten o'clock a large crowd marching in procession arrived in front of the Four Courts building. The rioters broke ranks at once, and surging up to the pavement pressed hard upon the guards, who were doing duty on the side-walk. The guards were immediately reinforced by details from within, and the companies were formed to resist an attack. A detachment of police left the building at a run, charged the rioters, drove them back a short distance, and arrested two of their leaders. A few stones were thrown, but the mob made no effort at resistance. As the police withdrew, the mob pressed up close to the side-walks again, and jeered and taunted the military force in the most insulting manner, daring them to fire and commence a fight. The police pressed the crowd back again, and it withdrew for a square without resistance. A number of noisy and unruly men were arrested by the police and confined in the jail. No disturbance occurred during the day. In the afternoon the Governor of Missouri issued a proclamation calling upon the rioters to cease their disorderly conduct and interference with private property, and to disperse. By the morning of the 27th the city authorities felt themselves strong enough to put down the mob, and determined to check the disturbance. The rioters, up to this period, had been encouraged by the failure of the police to stop their lawlessness, and many of them were convinced that neither the Mayor, the police, nor the citizens' force would dare provoke a conflict with them. They were now to learn their error. At an early hour on the 27th the mob began to gather at Schuler's Hall, and by two o'clock upwards of two thousand men were congregated in the immediate vicinity, waiting to obey the orders of their so-called executive committee, the body specially delegated to direct the movements of the crowd. The last proclamation of the Mayor and that of the State Government commanding them to disperse and return to their homes or else take the consequences, was freely circulated among them, but a general spirit of defiance prevailed, and bold threats of armed resistance was made on all hands. Inside the hall the executive committee were in session with closed doors, and there, too, the sentiment expressed was that any attempt on the part of police or militia to drive them away should be resisted to the last. Verbal orders were circulated among the mob to stand firm and that an armed force would not dare to molest them. This meeting being reported to the Mayor, it was resolved by the city authorities to break it up and arrest the leaders. For this purpose fifty mounted police, twenty-five armed with muskets, and about the same number with the usual club and pistol, were ordered to proceed to the hall and make the arrests. That there should be no failure, five hundred of the Citizens' Guard and two companies of the National Guard, with one piece of artillery, were ordered to accompany and support the police should the crowd offer any resistance, or attempt to rescue the prisoners. This force left Four Courts at 2.30 P. M.

About three o'clock the military force, headed by the mounted police, appeared coming up Fifth Street. The column halted within a square of the crowd, and drew up in line across the street, ready for a charge, while the piece of artillery was prepared for action. The military advanced no further, but the order was given to the police to charge the crowd and seize the hall. About one-half of the police swept down on the mob at a gallop, scattering the rioters right and left, driving fully three thousand men before them. They drew their pistols and charged on the crowd, riding their horses along the sidewalks, using their revolvers as clubs while the least hesitancy to move on occurred. In five minutes the street was cleared, and not a rioter was to be seen in the vicinity of Schuler's Hall save those in custody. In the meantime the other part of the police force, had advanced to the foot of the stairs leading to the above hall. The whole squad went up, and two minutes later they brought down about seventy men whom they found in the hall, and placed them between lines of police, armed with muskets, and the whole thing was over. Every one in the upper part of the building was arrested. One man attempted resistance, but a blow over the head from a club subdued him very quickly. Having secured their prisoners, the police and military marched back to the Four Courts, and were greeted along the route with cheers from the citizens. After the departure of the police, a few of the mob returned and indulged in bitter denunciations of their leaders for deserting them, but it was evident that the backbone of the riotous assemblage was completely broken, and that they would not likely have such another large gathering. Another victory was won by the authorities earlier in the day. When the 27th opened, the Union depot was held by a force of strikers. The civil authorities resolved to put an end to this state of affairs, and at eleven o'clock a battalion of four hundred men was despatched from the Four Courts to the Union depot, with orders to take possession of and occupy that building and drive out the strikers. The arrival of the military was a surprise to the strikers, who held the depot in large force. About half-past eleven the battalion marched in with loaded rifles and fixed bayonets. Without the loss of a moment the order was given to clear the building and yards, and the troops executed it with a will, driving out the strikers with the bayonet. The movements of the troops were greeted with cheers and yells. The depot and yards being secured, the authorities announced that no more interference with trains would be permitted in St. Louis. Encouraged by the promise of protection, some of the roads on the west side of the Mississippi resumed their freight traffic on the 27th, and the rest prepared to do so in the next day or two. The city authorities also announced their readiness to furnish armed guards for such shops and manufacturing establishments as desired to resume work. Three meetings were called by the Executive Committee of the workingmen's party, in various parts of the city, on the night of the 27th, but two of them were total failures, the speakers not appearing, and the small crowds which gathered at the appointed places soon dispersing. The third meeting brought together quite a large crowd, but before the meeting opened the crowd was dispersed by a force of five hundred policemen. The mob was now thoroughly cowed, and the danger was over. The 28th of July passed away quietly in St. Louis, there being no disturbance of any kind. A number of the leaders of the outbreak were arrested and imprisoned: their followers made no attempt to rescue them, having no desire to meet the five thousand armed citizens, the regulars, and the police who now stood ready to crush any uprising. On the 28th, nearly all the roads on the St. Louis side of the Mississippi resumed their freight business. Sunday, the 29th, passed away tranquilly, and by Monday the danger was at an end in St. Louis, and the business of the city had resumed its accustomed course. The expulsion of the strikers from the Union depot on the 27th confined the strike to East St. Louis. The strikers congregated there in considerable force, and, being very bitter over their defeat in the city, declared that they would maintain the blockade on the Illinois shore with even greater vigor. They were not to succeed, however. The Ohio & Mississippi, and the St. Louis & Southeastern Railroads were being operated by receivers appointed by the United States Court. The Court ordered the United States Marshal to prevent the strikers from interfering with these roads. The strikers resisted, and the Marshal, being unable to execute the orders of the Court, asked for troops to assist him. His appeal was granted, and orders were sent from Washington granting the Marshal all necessary military assistance.

The City of San Francisco contains a large Chinese population. Between these and certain portions of the white inhabitants there has always been a bitter enmity. The working classes are especially hostile to the Chinese, as they regard them as rivals in the labor market; but the bitterest enemies of the Mongolians are the "Hoodlums," or the idle loafers, street loungers, and "bummers," of the city. Many riots have occurred between the Chinese and their enemies in San Francisco, and not long since it was seriously proposed by the whites to organize a deliberate movement for the purpose of compelling the Chinese to leave the entire State of California. It was well understood in San Francisco that this feeling of hatred to the Chinese only lacked a favorable opportunity to break out into open hostility. The news of the labor troubles in the Eastern and Western States was received with profound interest in San Francisco, especially by the working classes. On the evening of the 23d a workmen's meeting was held, and was attended by about 10,000 persons. These riots were in no way connected with the railroad riots east of the Rocky Mountains. They were a brutal and unprovoked outbreak of the worst elements of the city, and were caused by nothing but a love of violence and disorder on the part of those who engaged in them. As they occurred simultaneously with the railroad troubles in the East, they are generally classed with them: and for this reason have been noticed here.

The anthracite coal regions of Pennsylvania, " generally recognized as the 'northern,' 'middle,' and 'southern' coal basins, are comprised within or bounded by a line of mountain, which, forming itself some distance eastward from Mauch Chunk, takes, under the name of the 'Second Mountain,' a southwesterly course to the Susquehanna River, leaving the towns of Mauch Chunk, Tamaqua, Pottsville, and Tremont to the north; thence in a northeasterly course, as the " Peters Mountain," to a point nearly southwest from Tower City; thence northwestwardly, as 'Berrie's Mountain,' again crossing the Susquehanna; thence southwestwardly to Taylorsville, as the 'Mahantongo Mountain'; thence nothwestwardly again in the direction of the Susquehanna, as the 'Line Mountain'; thence bearing in a southeasterly direction, as the 'Little Mountain,' leaving Shamokin, Ashland, Shenandoah, and Mahanoy City to the south, to a point in Union Township, Schuylkill County. Here the mountain runs almost due north for some miles, as the 'Catawissa Mountain,' when its course is again changed to southeasterly, as the 'Nescopeck Mountain'; thence north and northwest, as the 'Wyoming Mountain;' and thence again in an easterly direction, running north of Wilkesbarre and Scranton, as the 'Shickshinny Mountain.' Within the area inclosed by this mountain lies all the at present discovered anthracite coal of Pennsylvania. It embraces not only the large basins before named, but also a number of comparatively small detached coal fields. . . . Within this area are enclosed the coal producing portions of Carbon, Schuylkill, Dauphin, Northumberland, Columbia, and Luzerne Counties, and it is to a great extent occupied by a series of majestic mountains, the Sharp, the Broad, the Big Mahanoy, the Little Mahanoy, the Locust, the Green, the Macauley, and others." Dauphin and Columbia are agricultural as well as mining counties, but the others are strictly mining counties. By the census of 1870, the population of the purely mining counties was as follows: Carbon, 28,144; Schuylkill, 116,428; Northumberland, 41,444; Luzerne, 160,755. Since the census of 1870 the population of these counties has largely increased.

The business of mining coal has drawn large bodies of men to these counties, and has gathered them at fixed points, in cities, towns, and large mining settlements. The amount of arable land being small, on account of the mountainous character of the country, but a limited portion of the area is under cultivation. The natural formation of the country is very favorable to lawlessness. A walk of a few minutes from any of the towns, in almost any direction, leads to glens and haunts where one might bide in safety for months from the police.

Not only is the singular feature presented of nearly the whole population of the coal regions living in cities, towns and small settlements, often called "patches," but the character and habits of the population in the several settlements differ widely from each other. Scranton, Wilkesbarre, Mauch Chunk, Pottsville, and Tamaqua are all business centers, wherein are located banks, manufacturing establishments, the general offices of railroads and coal companies, large stores, and where, to a great extent, the wealth of the region naturally clusters. The cities and towns are not only business centers, but offer additional inducements, social, educational, and religious, to the coal operator and those whose means enable them to retire from business, in the selection of a place of residence. As a consequence, they have lost, in a great degree, the distinctive character of mining settlements, and differ, perhaps, from other places of equal size throughout the country only in being more cosmopolitan; this arising from the wide range embraced by their business operations, and the varied character of the inhabitants. Towns such as Ashland, Shenandoah, Mahanoy City, Minersville, St. Clair, Hazleton, Pittston, Plymouth, and many others of large population, to a certain degree partake of the character of business and social centers, but the mining classes, being largely in the majority, regulate and altogether control them. Besides these two classes of towns there are a great number of 'patches' or settlements, whose population is entirely composed of miners and laborers and those whose business is directly or indirectly connected with the mines. While the admixture of the foreign element pervades every part of the region, in large cities and towns native born citizens of the

United States hold control, but at the colliery towns the power of the foreigner is absolute. In these last still further divisions are made, some being almost exclusively composed of Irishmen, with natives of Queens and other counties, Ireland, largely in the majority. In such towns not only have the manners, customs and modes of thought of the Irish people been transplanted, but even the local prejudices incident to certain localities in that beautiful but in many respects unfortunate land. Coming here fresh from the contest with the landlord and land agent in Ireland, with no surrounding influences to teach them their error, they transfer a prejudice which has grown with their growth and strengthened with their strength, to the coal operator and the boss from whom they derive their subsistence, and under whose direction they work. Taught from infancy to believe that as against them capital is never used except as an instrument of oppression, under the influence, sometimes, of real wrongs, but more frequently under a mistaken belief of encroachment upon their rights, a spirit of resistance is aroused, which wicked and designing wretches have so used and controlled as to render the undetected commission of horrid crimes not only easy, but, to a certain extent, sympathized with. That the above is no justification for such a state of affairs is true; nevertheless, it explains, or tends to explain, the possibility of its existence. Such is the region that has become notorious throughout the Union as the country of the Mollie Maguires and the scene of their terrible crimes.

The order of the "Mollie Maguires" is of foreign birth, and was imported into this country from Ireland. It was organized there by the Irish peasantry as a means of opposing a combined resistance to the exactions of the landlords. Brought to this country by the emigrants who found work in the coal regions of Pennsylvania, it became an organization which sought to control the relations of the miners towards their employers and to compel the latter to submit to any demand the former might impose upon them. The "Ancient Order of Hibernians" is a large and powerful Irish society extending throughout the United States. Its objects are professedly benevolent. It is regularly incorporated under the laws of the various States in which it exists. Outside of the coal regions of Pennsylvania, there is no positive proof that the society is at all criminal in its character. The worst charge that has been brought against it is that it supported and continued its relations with the Mollie Maguires after their exposure, and raised a large sum by assessments upon its members throughout the Union to defray the expenses of the defense of the Mollies charged with crime in the coal regions. The order is secret, and wields an immense influence over its members. Its members are Roman Catholics, notwithstanding the fact that it has been *nominatim* condemned by the Holy See, and is under the ban of the Church. The Mollie Maguires were all members of the Ancient Order of Hibernians. In the coal fields of Pennsylvania, they controlled the Order, and gave their society's name to it. Hence we shall speak of the order simply as the Mollie Maguires. The principal work of the order in Ireland was the shooting of the agents of the Irish landlords. It is said to have received its name from a ferocious Irishwoman who particularly distinguished herself in this work. The Mollies appeared in Pennsylvania as early as the year 1854, when it became evident to the authorities that a criminal organization existed in the counties of Schuylkill and Carbon. The members of this organization were popularly termed "Buckshots." They gave considerable trouble to the authorities, but were not considered especially dangerous during the next five or six years. The great demand for coal which the stimulus of the Civil War produced, and which set in about the year 1862, drew an immense population to the Pennsylvania coal fields, and as a very large proportion of the newcomers were Irishmen, the strength and power of the Mollie Maguires increased with the growth of the population. The existence of the order was known, but, as its members, when questioned, stoutly denied their connection with it and preserved the most rigid secrecy respecting its transactions, nothing was known with certainty by the authorities.

In the summer of 1862 the first draft for the purpose of filling up the ranks of the United States Army was ordered. Active preparations were made by the Mollies in Schuylkill and Carbon Counties to prevent the enrolment. In both counties the enrolment was effected, however. This led to numerous threats on the part of the Mollies, and in Carbon County to much violence. Men connected with the draft, or representing the capitalists operating the mines were assaulted, beaten and murdered, and houses were burned by unknown parties. The authorities seemed powerless to detect or punish the perpetrators of these outrages, and the country was plunged into a state of terror. Notices were served upon leading coal operators to suspend operations until after the discontinuance of the draft, and bosses and miners were warned that if they went to work, they would do so at the peril of their lives. Upon one occasion in the summer of 1863, a large body of armed Mollies entered the town of Mauch Chunk, overawed the citizens, seized the jail, and released a number of the prisoners. From this time on to 1867, more than fifty murders were committed in Schuylkill County. Of these, twenty-seven, or more than one-half, were committed by unknown persons, and may be safely set down to the Mollie Maguires. The chief stronghold of this order, however, was Carbon County, where they had matters very much their own way. During all this while none of the Mollies had been convicted of the crimes they had committed. Arrests of suspected parties had been made, and they had been brought to trial in some instances; but the State had been unable to convict them. The friends of the prisoners were always on hand, ready to swear to anything necessary to secure their acquittal. Whenever a member of the order was tried for an offense, a convenient *alibi* was set up and sustained by as many witnesses as were thought necessary. An acquittal was thus readily secured, and the law was rendered powerless to punish the guilty parties. Large rewards were offered by the civil authorities and the coal-mining companies, and strenuous efforts were made to bring the murderers to justice, but up to 1871, no Mollie had ever been convicted of murder in the first degree. So strong had the Mollies become, especially in Schuylkill and Carbon counties, that they did not believe the authorities could punish them, and regarded themselves as at liberty to carry out their plans as they liked.

As has been said, the authorities of the counties embraced in the coal regions were convinced that the reign of lawlessness in their midst was due to a powerful secret organization of Irishmen, and they had learned that it was known as the Mollie Maguires, but beyond this they could discover nothing. Detectives had been set to work to ferret out the mysterious order, but had been baffled and forced to give up their efforts in despair. The Mollies, secure in the mystery with which they enshrouded themselves, continued their horrid work, and laughed at the authorities. Meanwhile the respectable inhabitants of the coal regions lived in a state of constant terror. No man could tell when his life might be taken or his property destroyed by the terrible order, which struck its blows in the dark and without assigning any reason for them. So strong had the Mollies become, that they even ventured to take possession of the very machinery of the law by causing themselves to be elected to public offices in the counties of Schuylkill and Carbon. Having gained possession of the offices they proceeded to manipulate the public funds in the interests of their organization. They became a potent influence in State politics, and John Kehoe, county delegate for the Schuylkill branch of the Ancient Order of Hibernians, openly boasted of his ability to extend the influence of the society into national politics. Mollies were repeatedly elected as county commissioners and school directors. In one instance a member of the society was sent to the legislature, and one of their members ran for an associate justiceship, but was fortunately beaten at the polls. So powerful did the Mollies become in the coal regions, and so general was the feeling of terror and insecurity which they aroused, that the prosperity of that section began to be seriously affected. It was seen that the immense interests centered there were at the mercy of a mob of lawless ruffians, and that if these men were permitted to extend their power, capital and respectable industry of all kinds would be driven from the coal-fields. It was therefore resolved by certain parties deeply interested in the welfare of the coal counties that the Mollie Maguires should be exposed and brought to justice.

The Ancient Order of Hibernians exists in Great Britain and Ireland, as well as in the United States. It is controlled in this country and abroad by a Directory, known as the "Board of Erin," selected from members in England, Ireland, and Scotland. These regulate and give out the signs and passwords of the order, which are changed every three months. The headquarters of the order in the United States are at New York. The national officers are elected by the State officers, and consist of the National Delegate, National Secretary, National Treasurer, and President of the Board of the City and County of New York. Each State has its own officers. The headquarters of the order in Pennsylvania are at Pittsburgh. The officers consist of a State Delegate, State Treasurer, and State Secretary. They are elected by the County officers, who also consist of a County Delegate, County Treasurer, and County-Secretary. The county officers are elected by county conventions, which are made up by the officers of the various divisions. The division officers are the Division Master or Body-master, Secretary and Treasurer, and are elected by the members of their respective divisions. No man can be a member of the order but an Irishman or the son of an Irishman, and a Roman Catholic. It is stated that there are over six thousand divisions or lodges in the United States and that the membership of the order is over one hundred thousand. From this large body of men, with the exception of a portion of a division (No. 2) in Philadelphia, not one word of condemnation of the Mollie Maguires of the coal regions has been heard. On the contrary, every effort has been made and money has been liberally subscribed to enable them to escape justice.

The signs and passwords of the Order show its foreign character and sympathies. They are changed every three months. In addition to the signs and passwords given in the account of McKenna's initiation, the following were furnished by him in his evidence before the Courts at the trials of the Mollies: May 18th, 1874: Password.—"That the trouble of the country may soon be at an end." *Answer.*—"And likewise the men who will not her defend." Quarrelling Toast.—"You should not dispute with a friend." *Answer.*—"Not if I am not provoked." Night Password.—"Long nights are unpleasant." *Answer.*—"I hope they will be at an end." Sign.—The front finger and thumb of the right hand to touch the neck-tie or top button of the shirt. *Answer.*—Right hand to rub across forehead touching hair. August 10th, 1874: Password.—"What do you think of the Mayo election? I think the fair West has made a bad selection." *Answer.*—"Whom do you think will duty betray?" Quarrelling Toast.—"Don't get your temper so high." *Answer.*—"Not with a friend." Sign.—Putting the thumb of right hand into the pocket of the pantaloons. *Answer.*—Putting the thumb of left hand on lower lip. Jan. 11, 1875, Password: *Question.*—"Gladstone's policy must be put down: He is the support of the British crown." *Answer.*—"But our Catholic lords will not support his plan, For true to their church they will firmly stand." Quarrelling Toast: *Question.*—"Don't give way to anger." *Answer.*—"I will obey a friend." Night Password: *Question.*—"The nights are getting shorter." *Answer.*—"They will soon be at their shortest." Body-Master's Toast.—"Let every Irish peasant Espousing Erin's cause, In college green They may be seen There making Irish laws." Sign.—Nail of the right thumb across the bridge of the nose. *Answer.*—Tip of the fore-finger of the left hand to the chin. May 4th, 1875: Password: *Question.*—"What is your opinion of the Tipperary election? I think England broke her constitution by Mitchell's rejection." *Answer.*—"But didn't O'Connell resign his oath and seat? Yes, and by agitation gained the emancipation." Quarrelling Toast: *Question.*—"Keep your temper cool." *Answer.*—"I will not raise it to a friend." Body-Master's Toast.—"Here's that every Irishman may stand to his cause, And subdue the British government and its coercion laws." Sign.—The fore-finger of the right hand in the left sleeve of the coat. *Answer.*—The thumb of the left hand in the left side vest-pocket. November 4th, 1875: Password.—"Here's health to every Irishman That lives in Ireland, To assemble round in Dublin Town In memory of Great Dan." *Answer.*—"When born he found our country in chains and slavery; He labored hard to set her free, But now he's in the clay." Quarrelling Toast; *Question.*—"You seem to be getting vexed." *Answer.*—"Not with you, sir." Night Password: *Question.*—"These nights are fine." *Answer.* "Yes; we shall have a fine harvest." Sign.—Tip of the fore-finger of the right hand to the hole of the right ear. *Answer.*—Tip of the fore-finger of the left hand to the hole of the left ear. January 22d, 1876: Password: *Question.*—"Home rule in Ulster is making great progress." *Answer.*—"Yes, if every Irishman would support the cause." *Question.*—"I wonder if Ireland can gain tenant right?" *Answer.*—"Yes, if supported by the Irish members." Night Password: *Question.*—"Moonlight is pleasant." *Answer.*—"Yes, so is freedom." Quarrelling Toast: *Question.*—"Be calm, sir." *Answer.*—"I am never too boisterous." Body-Master's Toast.—"Here's to every Irishman that crossed the Atlantic wave, That they may return with heart and hand their native land to save."

Members of the Order are confined to the divisions to which they belong, and have no right to attend the meetings of other divisions. This is a check upon the spread of dangerous information. A member in good standing may change his division, but for such a purpose a card of recommendation from the Body-Master of his late division is necessary. Should it be proposed to use the card out of the county, the county delegate places upon it his private mark. The card may be presented to either a Body-Master or a County Delegate; if the former, the card is forwarded to the County Delegate for the verification of his private mark. In leaving the State, a travelling card, which also bears the County Delegate's private mark, is used. The use of the Body-Master's toast, which is given to those officers alone, is to enable them to recognize each other. The quarrelling toast is used to prevent broils among the members. If a blow is struck after it is given, the offender is liable to expulsion from the order. Among the Mollie Maguires there is a thoroughly arranged system for the commission of crimes. A member having made complaint of certain parties who have offended him, or who are considered dangerous to the order, the matter is referred to the Body-Master, or a meeting of the division, or to a meeting of the Body-Masters of all the divisions and other leading men of the Order.

Murder is the most common of all forms of punishment with the Mollies. "Dead men tell no tales," is the well known principle of the Order. It is quite enough for a man to incur the dislike of one single influential member of the Order to forfeit his own life. The murder is generally committed in some lonely place, and with all the aggravated features of assassination. Though the conduct of the murderers is in the highest degree cowardly, they are regarded as heroes by the Mollies, and large rewards have been paid by the society for the killing of particularly obnoxious individuals. Should a member commit a murder or a robbery on his individual account, the act is endorsed by the Society, and its whole influence is used to screen and protect the criminal. When a member is arrested for a crime, the others are assessed in a certain sum for the purpose of raising money to employ counsel to defend him. The next step is to find witnesses enough to establish an "alibi." Perjury in such a case being counted a virtue by the Mollies, the witnesses are always forthcoming. Evidence of any kind that is wanted, can be promptly furnished by the Order. Such is the Order of the Mollie Maguires, and such are its leading features. Though its members claim to be Roman Catholics, the Order has been anathematized by the Roman Catholic Church. The Church, however, has so far failed to influence its members. The Order flourishes in spite of the clergy, and while professing the utmost devotion to the Church, encourages crime and wickedness.

The following formations for *Street Riot Duty*, prepared for the National Guard of New York, by General Wm. H. Brownell, have secured most flattering recognition from all quarters. It must be acknowledged that to provide a plan which would be effective under *all* circumstances for the quelling of riots is simply impossible, as every occasion may present different features, so that the means to employ must be left to the occasion; for instance, were rioters in possession of buildings and had the advantage of shelter from roofs, windows, doorways, etc., or had barricades of all conceivable kinds, each occasion would present new combinations, and only the cool judgement of the officer commanding could provide methods to successfully cope with the enemy. While all of these difficulties are recognized respecting all *fortified mobs*, we are not prevented from providing plans to disperse *riotous mobs in the streets*, and it is for this purpose these formations are presented. A large proportion of all riotous mobs consists of people who are present simply through curiosity, with no desire to commit a breach of the peace, yet before they are aware of it are identified as rioters, and giving countenance to the outbreak with their presence, and it is presumed are willing enough to start for home, if they can be freed from the mob, particularly after a demonstration from the troops. It will be observed that provisions are made, in the movements here provided, to secure this most desirable object, as opportunities are offered at every intersecting street. Moderation that will cause riotous mobs to secure the slightest confidence, or an impression that there is hesitation on the part of the troops, cannot be afforded, hence movements should show decision, be promptly executed, and rid of all forms that will cause delays, rather depending upon force of habit secured through close application in the drill room. The movements are simply combinations from Upton's rules, and may be readily executed.

The assembly for riot duty should be with service uniform, overcoats, if not worn, slung in horse collar form over left shoulder, the tie under and to the rear of the right arm pit, canteens with water, and haversacks with rations, if possible knapsacks to be taken if ordered to a distant point. A small detachment of reliable men, in charge of an experienced officer, should be left in the armory for its protection. Recruits and others, not having the requisite instructions for street work, should be left with this detachment where, under the tuition of the experienced men, they may be taught to assist materially in the defense of the building, should it be attacked. Field musicians should be taken with the regiment for employment, if necessary, as an ambulance corps. The regiment should be equalized into an even number of companies, bayonets fixed. Before leaving the armory details of marksmen will be made, sufficient in number to provide each company with at least four to act as *sharpshooters*; they will march, if their company is in column of fours, just outside of line of file closers, and if in line, in rear of file closers. It is not unusual to have large crowds in front of an armory on the ordinary occasions of "marching out," and it is reasonable to suppose that under the circumstances of "Riot Call" still greater numbers will congregate. While these crowds may be entirely friendly, the experience of many, and the duty of the Commandant, demand that every precaution be taken to provide for any emergency, and it is this that prompts the first formation upon leaving the armory.

Provision for armories located on streets having a line of buildings on both sides. Armories located on corners usually have the main entrance on a wide street, and are provided with an exit on the side street, which is more narrow; under these circumstances, it would be preferable to use the exit on the street that will oblige the crowd to present the smallest front during the formation.

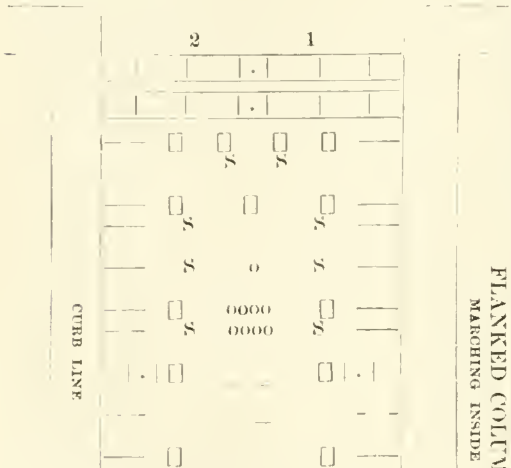
If the march is to be toward the left of the exit, form the first and fifth (or fourth, if only eight companies) divisions. As the doorway may not be wide enough for two columns of fours to pass, both divisions should be faced to the right; the first division, with the Captain, file closers and sharpshooters, on the right of the column; the fifth division, with the Captain, file closers and sharpshooters, on the left of the column. At the command, 1, *Forward*; 2, *March*; given by the Colonel, both divisions march by the flank, in parallel columns, the fifth division on the right, across the street to the fence, or building-line, when the Chief of the first division commands: 1, *First division*; 2, *By the left flank*; 3, MARCH. The Chief of the fifth division commands: 1, *Fifth division*; 2, *By the right flank*; 3, MARCH. The first division continues the march, driving the crowd entirely from the street and sidewalks, and halts inside the building-line of the first cross-street. The fifth division is marched company distance to the rear and halted; or, if near a crossing street, inside the building-line. The other divisions move out successively in columns of fours, right in front, and form line by "fours left," in trace of the first division, each at company distance. All divisions having become part of the column, the fifth division will be faced about, officers, file closers and sharpshooters in front, and moved up to company distance.

If the march is to be to the right of the exit, the first and fifth divisions march out by the left flank, with the first division on the right, and, after reaching building-line, the first division executes "*by the right flank, march*," and proceeds as previously explained; the fifth division, "*by the left flank, march*," and halted after marching company distance, or to the building-line. The other divisions march out successively in column of fours, left in front, and form line by "fours right," in the trace of first division, the fifth division facing about, and all closing up to company distance.

If the exit is near a corner to the left, and the march is to be to the left, the first and fifth divisions are marched out; the first division is halted just inside the building-line, and the fifth division is marched a sufficient distance to the rear to admit the interior divisions in the column, which march out as follows: column of fours, right in front; the fourth goes out first and forms line by "fours right," and when near the fifth "fours right about"; the second and third march out successively and form in rear of the first, when the fifth division faces about and all close to company distance.

If the exit is near a corner to the right, and the march is to be to the right, the first and fifth divisions are formed and marched out; the first division forms line "*by the right flank, march*," and marches company distance, or to the building-line, and halted; the fifth division forms line "*by the left flank, march*," and marches to the rear a sufficient distance to admit the interior divisions, which march out in columns of fours, left in front, in the following order: the fourth, forming line by "*fours left*," and when near the fifth division executing "*fours left about*; the second and third then follow, forming line by "*fours right*" in rear of first division, when the fifth division faces about and all close to company distance.

Marching to the place of disturbance in flanked column order. Being on the street in column of divisions, right in front, the Colonel commands: 1, *Flanked column order*; 2, *March*. At the first command Chief of first division commands: 1, *First division*; 2, *Stand fast*. Chief of fifth division: 1, *Forward*; 2, *Guide right*. Captains of third, fifth, and seventh companies command such company: 1, *Right forward, fours right*. Captains of fourth, sixth, and eighth companies command such company: 1, *Left forward, fours left*. The command "*March*" is repeated by all Captains of interior divisions and chief of fifth division, The companies of the interior divisions form the columns as ordered, file closers darting through the intervals between fours, and sharpshooters passing around the rear (in double

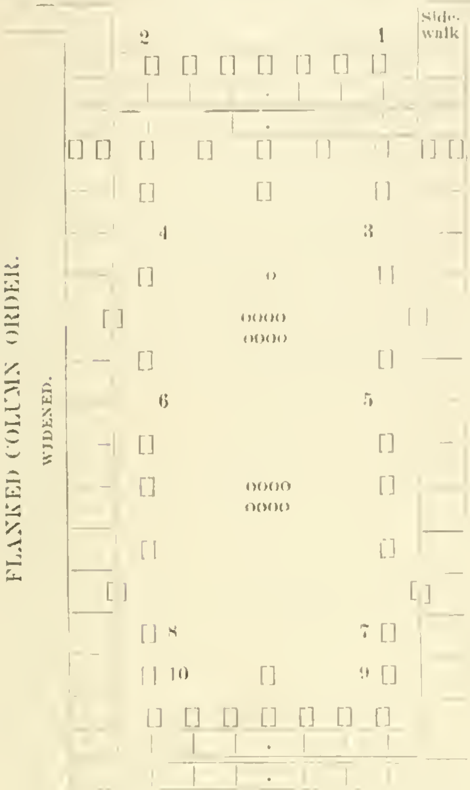


FLANKED COLUMN ORDER

time), to the side of the guide. The several companies close up until they are united in column of fours, the head of each flank column marching in trace of the flank fours of the leading division. The rear division is marched up until the flank fours unite with the rear of the columns. The left guides of the right companies of the first and fifth divisions cover the right guides of the left companies, who shall be the guides of the divisions, and the dressing, if necessary, shall be on the center. All officers, musicians, colors, signalmen, etc., will be placed in the interior of the column. The Colonel wherever he deems his presence necessary. Lieutenant-colonel between third and fourth companies, to supervise right wing. Major between seventh and eighth (or fifth and sixth, if eight companies), to supervise left wing. Staff, non-commissioned staff, and colors, in the center of the oblong. One drummer or trumpeter (the latter preferred) between third and fourth, and one between fifth and sixth companies. Chief of first division in rear of line of sharpshooters. Chief of rear division in front of line of sharpshooters. If the place of disturbance is at a distance and haste is demanded, it would probably be unnecessary to drive people from the sidewalks, until the troublesome district is reached; therefore, to facilitate the march, the column may be narrowed as follows. It can be, at any time, widened, as shown further on. The formation having been perfected and the "*Forward, March*" commanded, the Colonel directs the chief of the first division to order a sufficient number of fours from right and left to rear (equal number from each flank) to enable the front to march with flanks inside of the curb-line. The head of the flank columns will unite in column with the rear fours of the first division, and conform to their movements. The Commandant of the rear division will order a sufficient number of fours from right and left to the front (executing it according to principles of "right and left forward, fours right and left") to unite with the rears of the flank columns. Whenever the column is halted, the rear division will be faced to the rear by command of its chief (*such division about face*), and will be faced to the front at the command *forward* to the column. *Should the column be attacked* it can be halted, and the Colonel may command: 1, *Flank companies*; 2, *Fours right and left*; 3, March. 4, *Flank companies*; 5, Halt. The last command being given as line is formed. Fours thrown to the rear and front, forming line with the flank columns. The rear division will face to the rear, as previously explained. First Sergeants of flank companies will be in the line and covered by the Second Sergeant of next company.

If at any time it may be necessary to entirely drive the crowd from the streets and sidewalks, the Colonel will command: 1, *1st division*; 2, *Rear fours front into line*, 3, March. At the command *march*, flank column companies will conform to the increased front heads of the columns marching in rear of the flank fours on the sidewalk and rear division completing its front, with the fours previously thrown to the front. If only one four has been thrown to the front from each flank, the division line will unite with them, as the flank fours must march in trace of the rear of the flank columns. If more than one four was thrown to the front from each flank, at the command to widen the rear division marches forward, and, as the line is even with its leading flank fours (they having obliqued with the flank columns) the Chief commands *Flank fours*; 2, *Left and right front into line*; 3, *March*, when they execute the command on the leading fours and unite with the division line.

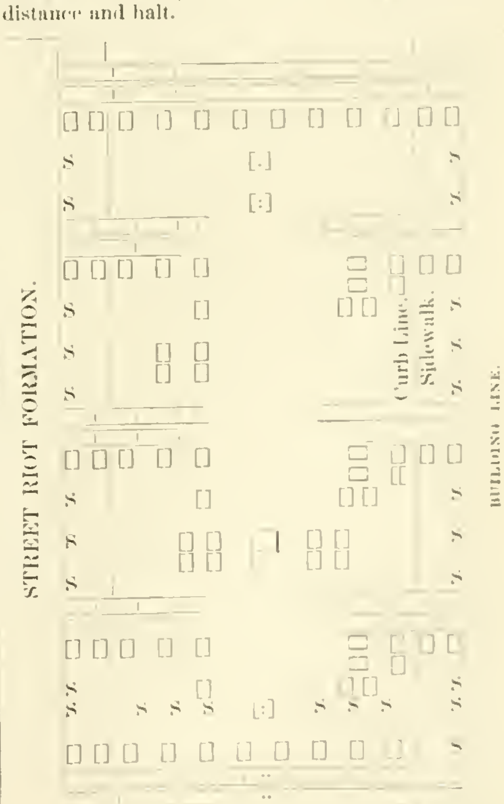
To form flanked column order from column of companies, right in front, the Colonel commands: 1, *Flanked column order*; 2, *Form first and fifth* (*or fourth, if eight companies*) *divisions*; 3, March. At second command, Captains of first and ninth (or seventh, if eight companies), command: *such company right oblique*. Captains of second and tenth (or eighth, if eight companies), command: *such companies left oblique*. Captains of odd numbered interior companies, third, fifth and seventh, command: *such company right forward; fours right*. Captains of even numbered interior companies, fourth, sixth and eighth, command: *such company left forward, fours left*. The third command "*march*," is repeated by all the captains When the left of the first company reaches the center of the street, it will be marched forward, and halted when it has advanced company distance. When the right of the second company reaches the center of the street, it is marched forward, and halted when uniting with the first company, the left guide of the first company stepping to the rear of the right guide of the second, who shall be the guide of the



division, and the dressing, if necessary, shall be on the center. As soon as the division is formed, its chief will order a sufficient number of fours from right and left to rear (equal number from each flank), to enable the division front to march with flanks inside of the curb. The interior companies will form the column, as ordered, file closers darting through the fours, and sharpshooters passing around the rear to the side of the guide (in double time); the several companies closing up until they are united in columns of fours, the head of each column marching in trace of the fours thrown to the rear of the 1st division. The rear division will be formed on the same principle as explained for the first, excepting that the file closers and sharpshooters will place themselves in front, and fours from right and left be thrown to the front, executing "right and left forward, fours right and left," and conform to the column ahead, the division marching forward and completing the "flanked column order."

When the exit of an armory faces a large open space, the flanked column order may be formed as follows: First company being in column of files (double rank), right in front; second company on the left of the first, in column of files (double rank), left in front — both march out in parallel columns. When the head of columns are clear of the doorway the first company executes column right and the second company column left: as the rears have executed the change, the first company forms line by the left flank, the second company by the right flank, thus forming the first division and moving forward. In meantime the odd numbered companies are formed in columns of fours, right in front, even numbered companies left in front, and march out as follows: third and fourth, fifth and sixth, seventh and eighth, ninth and tenth; odd numbered companies in column of fours, uniting with the right flank four of the first division, even numbered uniting with the left flank four. When the ninth and tenth companies have cleared the building and united with the flank columns, they will execute right and left front into line respectively, thus forming the rear division and completing the formation. The column can be narrowed as previously explained. In changing direction care must be observed to have the men on the pivot side of the column shorten step until they have passed the changing point, so as not to advance more rapidly than the marching flank. The command for changing would be simply, 1, "Column right (or left);" 2, "March," the leading division executing a wheel.

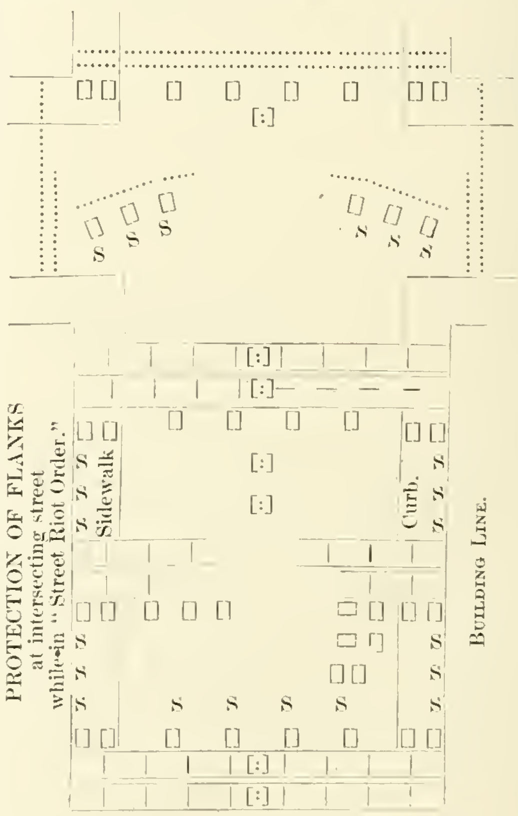
The assaulting or fighting formation is termed *Street-riot order*. This formation is simply a column of divisions, formed *from "column of fours," "column of companies," or the "flanked column order."* The command for forming divisions being prefixed with "*street-riot order*." To form from "flanked column order," the Colonel commands: 1, *Street-riot order*; 2, *Flank companies left and right, front into line*; 3, MARCH. At second command, the Chief of 1st division commands: 1, *1st division*; 2, *Forward*; 3, *Guide center*. Chief of rear division commands: 1, *Such division*; 2, *Forward*; 3, *Guide center*. Captains of right flank companies command: 1, *Such company*; 2, *Left front into line*. Captains of the left flank companies command: 1, *Such company*; 2, *Right front into line*. At command "*march*," repeated by all Commandants, 1st division will march division distance and halt.



Flank companies will execute front into line, from a halt, as explained in Tactics (in quick time), corresponding companies uniting and forming the interior divisions, file closers darting through the intervals, and sharpshooters passing, in double time, around either flank. Rear division is marched forward, company distance, and halted. When divisions are formed *either from "column of fours," "companies," or "column order,"* the right guide of each left company will remain on the right of his company, and will be covered by the left guide of the right company; the guide of divisions will be center. Right and left guides of divisions will place themselves in rear of, the extreme flank files of their respective companies, all officers and file closers in rear of the division, and chiefs of divisions, excepting the rear division, in rear of the center of their respective divisions. Sharpshooters, as the column of divisions is formed, will be placed in column (as in column of skirmishers), with equal intervals between the flanks of divisions, excepting those belonging to rear division, who will continue to march in front of that division. Colonel wherever he may deem his presence necessary. Lieutenant Colonel to be between 1st. and 2nd. division. Major between 4th and 5th (or 3d and 4th should there be four divisions). Staff, noncommissioned staff, music, and colors, between 2d and 3d, or 3d and 4th divisions. In this formation distances between divisions may be *increased* or *decreased*, either uniformly or not, as circumstances may demand. Sharpshooters, in either case, regulating the length of their intervals. In case of obstruction to the advance during action, interior divisions may be put under cover if available, although the front and rear should each have a division at hand for support or relief, as may be necessary. Being formed in street riot order, the column can be moved either to front or rear, by simply facing to the rear or front, as may be desired. Should fronts not be wide enough to cover sidewalks, they may be increased with rear rank men on each flank. If an avenue of unusual width is entered, the front and rear divisions may be reinforced by men from the interior divisions. *To afford free passage* from front to rear for officers or messengers, for quick communication, all divisions, when formed in street riot order excepting 1st and rear, will cause one four to break to the rear from the left of right company, the left guide of such company (who has covered the guide of the division) placing himself on the left of front rank, and preserving the interval necessary for the four. *When a division ceases to be a rear* division, officers, file closers, and sharpshooters pass through the intervals created in the center, and place themselves in their proper places in the rear.

If moving forward, and driving the mob, numbers of it will naturally break right and left through the intersecting streets, either for the purpose of attacking the flanks, or to escape the effects of severe measures from the troops; in either case the flanks, while passing, should be covered, and for this purpose is provided the following *important movement:*

As an intersecting street is approached the command is given: 1, *1st and 2d divisions*, 2, *Arms;* 3. *Port*. At this command should the mob be large and aggressive, the second division, the rear four being ordered, "front into line" (all officers in front passing through the interval before closing it), the left guide taking his place as previously explained, may be moved up quickly to within a few yards of the 1st. As the street is reached the command is given: 1. *1st. division;* 2. *Companies right and left turn;* 3. MARCH; just as the building line is reached, each Captain giving the proper command to his company. This being the quickest change of direction for a front, and being done promptly and resolutely, resolves itself into a rush on the mob. The "turns" being completed, companies are halted just inside the line of buildings. Should the fronts not be sufficient to command the street turned into, they will be widened immediately with rear rank men, to extend the line. Sharpshooters of the turned companies will secure positions (with cover, if possible) where they may command a clear view of the mob cut off, and select the leaders, so that should firing be ordered they can pick off the most active rioters. During the execution of the turns the column is still advancing, and forcing the main body of the mob ahead of it. The 2d division now having become the 1st (and all other divisions having changed their numerical designation), and must execute the same as explained above, at the next street, again dividing the mob, and so at each street presenting new and fresh fronts, without unnecessary exposure; in fact each change being in itself a *direct attack on three sides*. The first division must not, under any circumstances, approach the turning points in face of a crowd, until the second division is close at hand to take its place as the leading division. *As the rear of the column* passes, the turned flank companies will be *faced to left and right, execute column left and right, and formed to the front as the rear division*, file closers and sharpshooters placing themselves in front, thus completing again the formation and shutting out the mob. *Should the mob in the rear be violent*, as the column has passed, *the rear division of the main column* will be halted, faced about, and cover the formation of the flank companies, which will form division between the one halted and the main column.



Should it be deemed necessary at any time to relieve the first, or any division, even in the middle of a block, the same system can be employed as explained for passing an intersecting street. It is admitted that some exposure must exist. With the formation in "street riot order" it would be comparatively slight, as the interior divisions, should the resistance be severe, *could be moved back to full distance* or more if desired, so that missiles thrown at the 1st division would not be apt to reach the 2d. It is not necessary that wheeling distances be preserved. Staff officers, colors, and music will pass through the intervals provided in the center of the division, whenever the division they are in front of is about to become the 2d division. If, as is frequently the case, an intersecting street does not cross the one that the column is on, both companies turn (right and left) the same as explained for a crossing street, as the integrity of the division should be preserved. Advancing in "street riot order," should it be necessary to change direction—for instance turning a corner into another street—*if to the right*, the second division will be moved up close to the first, the right company of the first division will continue the march forward; as the changing point is reached the rear rank will extend to the left; the left company executes the left turn, the second division (both companies) right turn, as the building-line is reached, and continues the march, both companies of the first division halting at the building-line, when the column has passed, they face to the right, march to the right and form "by the left flank" as rear division. If the change is to be *to the left*, the left company of the first division advances and its rear rank extends to the right, the right company executing the right turn, the second division executing the left turn and continuing the march. Both flank companies, as the column passes, execute left face, march to the left and form "by the right flank" as the rear division. All divisions in rear of the second execute the "turn" at the changing point. While advancing in street rior order, should a large opening be reached, such as a square, or park, the flanked column order may be used, or such formations provided by Tactics for field work, as the circumstances may demand. While double rank formation is recommended, these movements can be executed in single rank, if necessary owing to lack of numbers. Should the regiment equalize with companies of sufficient size, the same principles can be used with platoons and companies as explained for companies and divisions. If it may be desirable to divide the force, for the purpose of flanking barricades, marching in parallel streets or detaching companies for special duty, three divisions (or companies, if large enough) are sufficient for "street riot order."

Firings are left to the judgment of the officer commanding, but great caution is advised in clearly indicating the front that is to fire. It is suggested that one trumpeter or drummer in each wing be used, to indicate cease firing. If a drummer, a short sharp roll should be given. *As the din in a street fight* would prevent to a great extent, commands being heard clearly, the Commandant may employ his staff officers to *communicate commands* directly to officers, when the noise is great. *The Lieutenant Colonel and Major will each be provided* with a non-commissioned staff officer, to enable them to promptly report anything of importance; in this connection it will be remembered that intervals to pass through are provided in the column for this purpose. The usual manner of directing dressings must be omitted in the face of an angry mob, and the habit secured in company drills of perfecting alignments be depended upon, the dressing in column being always toward the center.

Sharpshooters should be generally supervised by the Inspector of Rifle Practice, who should be especially detailed for that purpose. When the column is in "*street riot*" *order*, sharpshooters will be constantly on the alert, and if the district is dangerous, watch the windows and roofs of houses on the side opposite their flanks, and should a halt occur, will immediately seize any prominence that will afford them *view of the mob*, those of the 1st and 2d divisions watching the front, and those of the rear division watching the rear, but must not fire until individually ordered, unless they have special or general instruction to the contrary. Of course during a general engagement with rioters, they could be instructed to pick off any who are noticed as assailants. *Leaders of mobs* are usually shrewd enough to know the importance of disposing of commanding officers of troops, and thereby, in some instances, perhaps, cause demoralization. For this very reason, the knowledge that sharpshooters were with the column, would be apt to secure from the leaders of mobs a most profound respect for the troops they are resisting.

Should Artillery be employed with the regiment, the sections will be placed between the 1st and 2d divisions, and 4th and 5th, or 3d and 4th (if four divisions), and, if not to be engaged, will, as an intersecting street is approached, be halted until the 2d division has passed and reformed, as explained in Tactics for the passage of obstacles. When the companies who have executed the "turn" have reformed as rear divisions, the same movement will be executed by the division in rear of the rear sections. Should it become necessary to use the guns, owing to a heavy onslaught of the mob, *promptness* will be of the utmost importance, and from whichever front the guns are to be served, sufficient fours will be moved to rear to enable the guns to be run out on the line. While it is of course desirable to move the fours back, in order, the great object is to get them back *immediately*, and to accomplish this, captains will direct in such manner as will be the most practicable for the occasion. The fronts remain protecting the guns, and firing if deemed necessary.

By these formations it may be seen that several advantages are secured, for instance: 1. A precautionary formation in leaving the armory. 2. A column consisting of an oblong, marching inside the curb, ready for any emergency, and which can be widened so as to entirely clear the street. 3. The turns while in street riot order, affording protection to the flanks while passing. 4. The repeated changes of fronts caused by the leading division of the column being used to cover the flanks at intersecting streets, the 2d division as it passes becoming the first, and so on to the end, one company or division is not required to bear the whole brunt of the resistance as the changes occur as often as it becomes necessary, to protect the flanks. 5. Frequent separation of the mob. Respecting this feature, it may be claimed that the turbulent element cut off would soon unite again with the main body; very possible, but it must be borne in mind that the most active of the rioters would be in the front, and to separate any from their fellows (even if but temporary), would be of vast assistance in quelling the riot, besides affording a means of escape for many innocent people. 6. The piece being at arms port, is clutched firmly with both hands, can be used as a powerful pushing lever, at the same time be ready for charge bayonets or firing, or to use the butt as explained in the bayonet exercise. 7. A continuous advance on the main body of the mob. 8. The simplicity of the "*street riot order*," as it can be formed from "*flanked column order*," *column of fours, column of companies, or column of divisions*, etc., etc. 9. Artillery can be employed without changing the formation. In a street of ordinary width a regiment with five divisions can hold four city blocks at one time, and, if companies are large enough to operate with platoon formation, nine blocks can be held.

In providing these formations it is not supposed that an advance will be an unbroken march; it is therefore very important for all officers to watch the movements of the column and guard against confusion that might follow a sudden check. Commanding Officers should exercise extreme caution in entering dangerous districts, and not expose their men needlessly to the dangers of fortified defiles, as streets with buildings on both sides might be such in effect. These formations are simply tactical; methods for the erection or destruction of barricades, defending or assaulting of fortified buildings, attack or defense in general of fortified places, and matters incidental thereto, should be subjects for private instruction and discussion, as publicity might tend to neutralize the effect of any measure that might be employed.

RISBAN.—In fortification, any flat piece of ground upon which a fort is constructed for the defense and security of a port or harbor. It likewise means the fort itself.

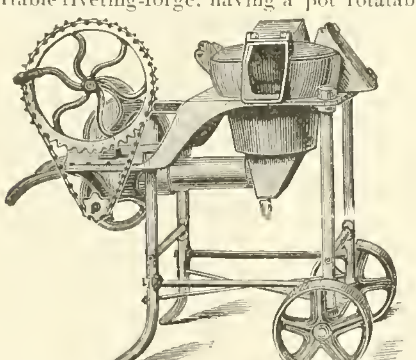
RISBERME.—A work composed of fascines, such as is sometimes constructed at the bottom of a town-wall. A sort of glacis of fascine-work used in jetties, the sides of which, towards the sea, are so formed as to withstand its violence.

RISING.—In Heraldry, a term applied to a bird when represented opening his wings as if about to take flight.

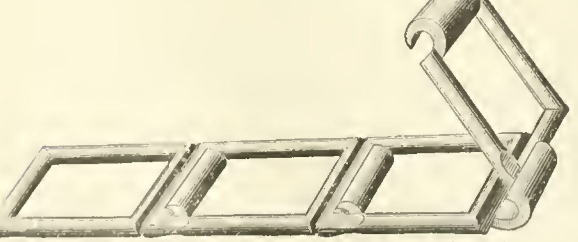
RISING FROM THE RANKS.—To pass through the successive stages in the ranks until a Non-commissioned Officer attains the rank of a Commissioned Officer. Each Non-commissioned Officer rising from the ranks in the English Army receives, on getting his commission, a grant of £150 in the cavalry, and of £100 in the infantry, to enable him to purchase his outfit.

RIVET.—A metal pin for connecting two plates of metal or other material together. The rivet is put through holes in both plates, and the projecting ends are then beaten down so as to represent the head of a nail on each side, and thus hold the plates in close contact. Rivets are of most essential importance in armor making, and in building iron ships. They are often put through the holes and beaten down while red-hot, in order that the contraction of the rivet as it cools, may produce more intimate contact of the plates. The principle of the *riveting-machine* is simply the bringing a powerful lever to bear upon the head of the rivet, so that the smith can hammer upon the other and softened end without displacing it. See *Riveting-machines*.

RIVETING FORGE.—A variety of forge much used in arsenals and founding shops. The drawing shows a portable riveting-forge, having a pot rotatable by



gearing, and having three doors, so as to employ three operatives; it contains a grate-like basket, which allows the blast from the tuyere to pass through. At the bottom of the basket is a grate and a comb-raker, operated from the outside. Beneath



the grate is the tuyere box. A fan is provided for creating a blast.

Various devices have been resorted to for transmitting power to the fan used on portable forges. All the standard Keystone forges have what is here shown and known as the "Square-Linked Malleable Iron Chain," which is very satisfactory in operation. It is more durable than cog gear and more reliable than friction pulleys. It is positive in its action, and from its construction it cannot slip, and may, therefore, be run slack, with much less friction upon the journals and bearings. As it neither stretches nor contracts by heat or dampness, it is always the same in all kinds of exposure. To use the chain, place it upon the wheel, with the open hook of the link out. To hook or unhook a link, make an angle, as represented in the drawing, and slide the link out by a side motion; the two depressions on the side of the link are for this purpose.

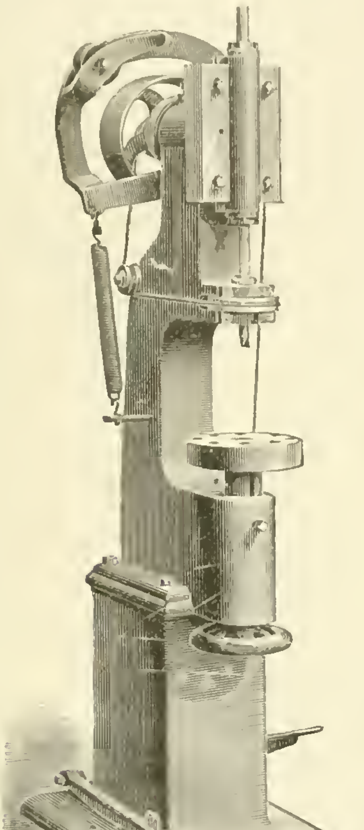
RIVETING-MACHINES.—As manufacturers in the United States of Mr. Ralph H. Tweddell's various Hydraulic Machines for riveting, so extensively used in England, Messrs. William Sellers & Co., have largely increased the applications of his invention in riveting armor-plates, etc., as well as improved the machines. The improvements in their steam riveting machines have been in the direction of greater strength and increased durability, and the application of the best features of the hydraulic system to the steam system. That is to say, they now make the steam riveters do their work by pressure, and not by impact or blow. Where the boiler pressure can be varied to suit the size of the rivets being driven, and can be maintained at a uniform pressure during the entire work, the steam riveter will be in all respects as effective as the hydraulic in stationary machines.

The attractive feature of the hydraulic system is, that the pressure to be applied in each case is gauged at the accumulator by an adjustment of the weights, which determine the pressure per square inch on the ram of the machine. If the water be admitted to the machine from the accumulator slowly, the pressure on the ram will be that in the accumulator as determined by the weights, and if the valve is opened quickly, so as to admit a very free flow of water and a consequent rapid fall of the accumulator, there may be an increase of the pressure over that due to the weight from the impetus of the falling load on the accumulator, but not amounting to any injurious increase.

The very much higher pressure per square inch at which hydraulic machines are run, as compared to either steam or pneumatic machines, makes the cylinder smaller, and consequently the machines are less cumbersome with equal power, a matter of very great importance with portable riveting machines, and of some moment in many kinds of stationary riveting machines. The hydraulic riveting machine can be used wherever power by belt is obtainable, and the pumps and accumulator may by placed at any point most convenient for the application of the power, their distance from the riveting machine involving no serious loss in efficiency.

Very extended experience with the hydraulic riveting machine system in its various forms has led to make alterations in the steam-system of riveting to bring it to the same standard of excellence. So long as it was believed that blows were needed to do good riveting by power, the improvements in the machines were in the direction of making them stronger and better able to withstand the severe shocks which sooner or later break down all such structures. Hydraulic riveting demonstrated not only that the work could be as well done without a blow, but that it could be *better done without a blow*, and that the riveted material was stronger when so secured than when subjected to the more severe treatment under impact. Many experiments with steam riveting machines led to the adoption of a system of very small steam-pipe connections from the boiler to the riveter, coupled with an increase in the diameter of the riveting cylinder and the use of a very large valve on the machine to permit a free flow of steam in exhausting and effecting the draw-back with the charge used in driving the rivet. This improvment has brought the steam riveting plant up to the best conditions of hydraulic riveting, so far as stationary machines are concerned, with the one single exception that the regularity of the steam pressure is still left to the discretion of the persons employed in doing the work. When a separate boiler is employed to run the riveter no great trouble is found in a close regulation of the steam, and the steam riveting system is very satisfactory.

The drawing shows what is known as the Elastic Blow Riveting-machine, and much used in arsenals



for a great variety of the lighter work. The most remarkable feature of the machine is the peculiar elastic blow, the force of which can be varied at the will of the operator, from a slight to a heavy blow, by more or less pressure applied to the treadle, and without moving the work in any manner.

A self-acting device attached to the machine stops instantly the blow of the hammer, allowing the operator to withdraw his work. An adjustable anvil allows vises or other suitable contrivances to be attached, for holding work of different shapes and thicknesses, and an extra treadle (shown in engraving) is furnished with each machine, to allow these vises to be operated by the foot if desired.

The work, while in the machine, is stationary, thus insuring the hammer always striking on the rivet and heading it equally. Both hands of the operator being free, he is able to handle the work with ease and rapidity. The hammer being rotated while the blows are given, the work can be riveted flush, or with a smooth, rounded head, as desired. The machine is used in five sizes, for heading soft rivets of $\frac{3}{16}$, $\frac{7}{32}$, $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ inch diameter respectively.

RIVETING PLATES. In gun-carriages, the small, square, thin pieces of iron, through which the ends of the bolts pass and are riveted upon them.

RIVERS. Rivers traversing the theater of war occupied by hostile armies have a marked influence on the operation of each. Whenever they are to be crossed in the presence of an enemy, either in advancing or retiring, the use of artillery and of field-works becomes of great importance; this, for the reason that the operation of crossing necessarily consumes considerable time, during which the army is

divided—astraddle, as it were, the stream and requires the aid of that arm which, from a fixed position, possesses the power of covering at long range the movements of other troops. The place of crossing, whether bridge, ferry, or ford, is simply a defile through which the army has to pass, and which must be completely covered from the fire of the enemy, who must not be permitted to establish batteries within range of the crossing. This is best effected by covering every point accessible to him with the fire of artillery.

A river in front of an army operating on the defensive, stands to it, somewhat, as a wet ditch does to a fortification, and should be so guarded as to make the crossing of it a difficult, if not a hazardous, operation to an advancing enemy. Points at which the communications of a country converge are those most advantageous for an enemy to select for crossing. These should be secured by strong inclosed works, armed with artillery of such power as to cause him to make a long detour and to adopt a less advantageous point. If the stream is navigable, such works form a place of refuge for the craft that ply on it, and which, falling into the hands of the enemy, would furnish him with means of crossing and assist him in carrying on his operations. The size of the work will, to a great degree, depend upon the force that can be detached from the main body for garrisoning it; but, generally, a well-constructed work containing a thousand men, adequately supplied with artillery, will prove a formidable obstacle to the crossing army. Points thus established should not be so numerous as to cripple the efficiency of the defending army by dispersion. They should be rather in the nature of bases for temporary points of observation along the river, secure against capture by *coup de main*, and threatening to the flanks and rear of the crossing army.

A bridge is protected by a *tête-de-pont*, the nature and extent of which will depend upon the character of the attack to be expected. Against mere raiding parties, a mere redan or lunette will amply suffice Two or three pieces of artillery may be put in it, but it is preferable to locate batteries, on the opposite side of the river, to flank the redan and cross their fire in front of it. Against a large force well supplied with artillery, a *line* of works must be thrown up and well armed with artillery, for the purpose of keeping him beyond artillery range from the bridge. Batteries of heavy pieces are placed, to flank the line.

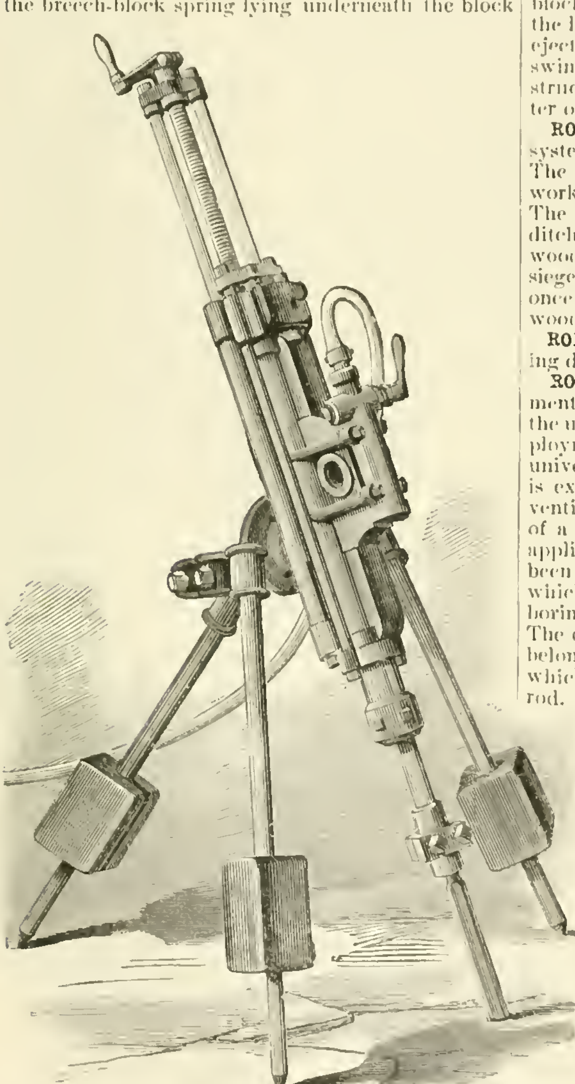
The operation of crossing a river by an army in presence of a vigilant enemy, is one of great delicacy, as it necessarily consumes considerable time, during which it is more or less divided and subject to every disadvantage. Judicious use of artillery is of the first importance. The first thing to be done is to gain a footing on the opposite side. This is usually accomplished by stratagem or by surprise. Before a large opposing force can arrive, batteries must be established on the side from which the crossing is made to cover with their fire a large area of ground opposite. Every available piece must be put in, and the enemy kept back until bridges can be laid and a strong line of infantry passed over and intrenched. Siege guns, owing to their great range and power, are the best adapted for this service. The batteries should be extended up and down the stream for three or more miles on each side of the crossing-place; this, for the main purpose of enfilading the flanks of the enemy and preventing him from bringing his artillery to bear upon the crossing. The place for crossing should be selected, as far as practicable, with a view to advantageous positions for batteries. The convex side of a curve with hills dominating the opposite side gives every advantage. This secures a cross-fire upon the opposite peninsula, under cover of which the infantry line and light field batteries can be thrown forward to a distance of two or three thousand yards and established in an intrenched line as represented in the drawing.

If the enemy has gun-boats on the river, especially if they are iron-clads, provision against them must be made by laying across the channel lines of submarine mines, with heavy batteries established for their protection. These batteries must be strongly intrenched. The operation of crossing a river by an army pressed in rear by another, is the reverse of that just described. When practicable, the concave side of a bend is selected, across which a line of temporary intrenchments is constructed: batteries are established on the opposite side, and the army withdrawn under protection of their fire. The batteries should cover themselves with gun-pits, and give special attention to such artillery as the enemy may bring forward for the purpose of reaching the place of crossing. See *Bridges*.

RIZAMEDAR.—In the East Indies, an officer commanding a small body of horse.

ROADS.—When it is proposed to construct a line of road, extending between two places, the officer upon whom such duty devolves, first makes himself well acquainted with the surface of the country lying between the two places; he is then to select what he thinks, all circumstances being taken into consideration, the best general route for the proposed road. But previously to laying it out with accuracy, it is necessary to make an instrumental survey of the country, along the route thus selected; taking the levels from point to point throughout the whole distance, and making borings in all places where excavations are required, to determine the strata through which such cuttings are to be carried, and the requisite inclinations of the slopes or slanting sides as well of the cuttings as of the embankments to be formed by the material thus obtained. It is also requisite, in the selection of the route for the proposed road, to have regard to the supply of materials, not only for first constructing it, but for maintaining it in repair. The results of such an investigation should be reduced to plan and section; the plan of the road being on a scale not less than 66 yards to an inch, and the section not less than 30 feet to an inch. The loss of *tractive* power and consequent danger produced by steep acclivities, render it necessary that a proper and carefully determined limitation should be imposed on the acclivities or inclinations on every line of road. As, however, in most instances, this reduction of hills in a country where much inequality of surface exists, is attended with great labor and expense, greater rates of inclination must be allowed to hills or roads where the traffic is not sufficient to repay the expense of excavations. A dead level, even where it can be obtained, is not the best course for a road; a certain inclination of the surface facilitates the drainage, and keeps the road in a dry state. There is one certain inclination or acclivity, which causes, at a uniform speed, the traces to slacken, and the carriages press on the horses, unless a drag or brake is used; the limiting inclination within which this effect does not take place is called the *angle of repose*. On all acclivities less steep than the angle of repose, a certain amount of tractive force is necessary in the descent, as well as in the ascent: and the mean of the two drawing forces, ascending and descending, is equal to the force along a level road. The exact course of the road, and the degree of its acclivities being determined, the next thing to be considered is the formation of its surface. The qualities which ought to be imparted to it, are twofold: first, it should be smooth; secondly, it should be hard; and the goodness of the road will be exactly in proportion as these qualities can be imparted to it, and permanently maintained upon it. The means resorted to accomplish these objects are: 1. *Gravel Roads*. A coating of four inches of gravel should be spread over the road bed, and vehicles allowed to pass over it, till it becomes tolerably firm—men being required to rake in the ruts as fast as they appear; a second coating of 3 or 4 inches of gravel should be then added and treated like the first, and finally a third coating. 2. *Broken Stone Roads*, or McAdam roads. French engineers value uniformity in size of the broken stone less than McAdam. They use all sizes from $1\frac{1}{2}$ inches to dust. McAdam considers from 7 to 10 inches of depth of stone on the road sufficient for any purpose. He earnestly advocates the principle, that the whole science of road-making consists, in most cases, in making a solid dry path on the natural soil, and then keeping it dry by a durable water-proof coating. 3. Broken stone roads with a paved bottom or foundation, or *Tilford Roads*; a road thus constructed will, in most cases, cost less than one entirely of broken stone. 4. *Roads of Wood*. The abundance, and consequent cheapness of wood renders its employment in road-making of great value. It has been used in the form of logs, of charcoal, of planks, and also of blocks. When a road passes over soft, swampy ground it is often made passable by felling straight young trees, and laying them side by side across the road at right angles, or very nearly so, to its length. This is the primitive and very well known *corduroy* road. A very good road has been lately made through a swampy forest, by felling and burning the timber, and covering the surface with charcoal thus prepared. Timber from 6 to 18 inches through is cut 24 feet long, and piled up lengthwise in the center of the road about five feet high, and then covered with straw and earth in the manner of coal pits. The earth required leaves two good ditches, and the timber, though not split, is easily charred; and when charred the earth is removed to the side of the ditches, and the coal raked down to a width of 15 feet, leaving it two feet thick at the center and one at the sides. 5. *Plank Roads*. Two parallel rows of small sticks of timber (called sleepers) are imbedded in the road three or four feet apart. Planks, 8 feet long and 3 or 4 inches thick, are laid on these sleepers across them. A side track of earth to turn out upon is carefully graded. Deep ditches are dug on each side to insure perfect drainage; and thus we have the plank road. 6. *Roads of Earth*. These roads are deficient in the important requisites of smoothness and hardness, but they are the only roads usually made in the field to carry on military operations. Their shape, when well made, is properly formed with a slope of but 1 in 20 each way from the center. Its drainage should be made thorough by deep and capacious ditches, sloping not less than 1 in 125. Trees should be removed from the borders of the road, so as not to intercept the sun and wind. The labor expended upon it, will, however, depend upon circumstances. Every hole or rut in the road should, however, be at once filled up with good materials, for the wheels fall into them like hammers, deepening them at each stroke, and thus increasing the destructive effect of the coming wheel. The cross-section of a road embraces: 1. *The width of the road*—from 16½ to 30 feet, according to its importance, and the amount of travel upon it. 2. *The shape of the road-bed*—The best shape of the transverse profile for a road on level ground is two inclined planes meeting in the center of road, and having their angle slightly rounded. On a steep hill, the transverse profile should be a single slope inclining inwards to the face of the hill. 3. *Footpaths, etc.* 4. *Ditches*—The ditches should, if possible, lead into the natural water-courses of the country. 5. *The side slopes of the cuttings and fillings*—These vary with the nature of the soil.

ROBERTS GUN.—A breech-loading rifle having a fixed chamber closed by a movable breech-block, which rotates about a horizontal axis at 90° to the axis of the barrel, lying above the axis of the barrel and in rear, being moved from above. The piece is opened by raising a hooked catch-lever, at the end of the tang of the breech-block, out of its notch in the tang of the receiver. This depresses the forward end of the block so as to expose the chamber. The reaction of the breech-block spring lying underneath the block



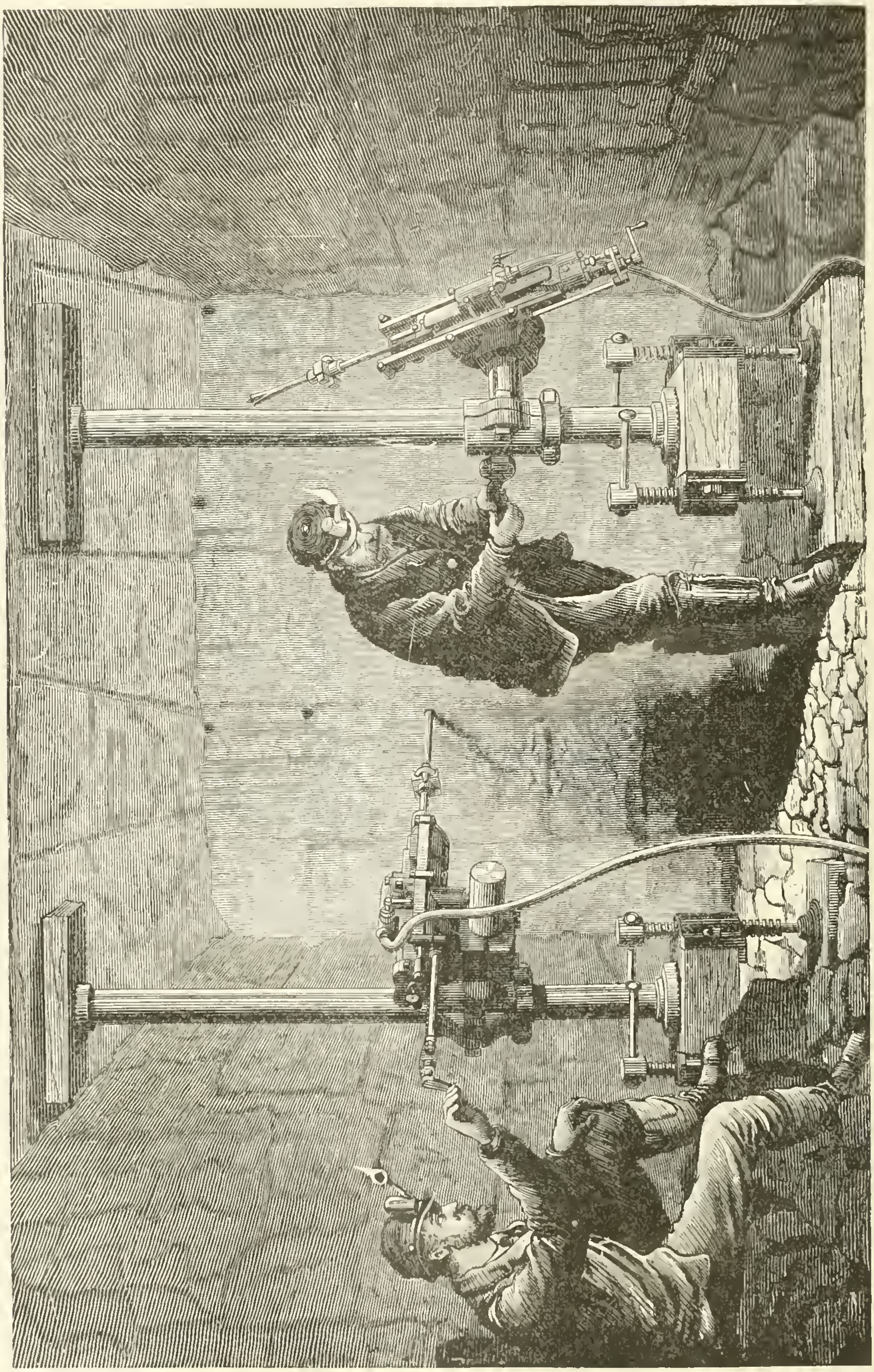
throws up the front of the block sufficiently to keep the cartridge from falling out of the chamber before the breech is fully closed. The closing is done by returning the lever to its place, or automatically by cocking the piece. The back of the hammer in the latter case presses against the end of the slot in the tang of the breech-block in which it plays, and so raises the front of the block into place. The piece is locked by the position of the breech-block, which is also kept in place by the engaging of the hook of the catch-lever with a corresponding notch in the tang of the receiver. Extraction and ejection are accompanied by a bent lever pivoted to the side of the receiver below the chamber, and struck by the breech-block face in its descent.

ROBERTSON RIFLE.—A breech-loading small-arm having a fixed chamber closed by a movable breech-block, which rotates about a horizontal axis at 90° to the axis of the barrel, lying below the axis of the barrel and in front—being moved from below by a lever. By depressing the lever the block is pulled down by a link connecting the two. By reversing the lever the block is raised into place against the end of the barrel, and is locked by the middle joint of the linked combination rising above the line joining the other two, and causing the strain upon the block from the discharge to tend towards bringing the lever more closely into place. Extraction and ejection are accomplished by a small straight lever, swinging on a center below that of the block, and struck by the block, during the opening, near its center of motion.

ROBILLARD SYSTEM OF FORTIFICATION.—This system has been called the "system of demolition." The enceinte resembles that of Vauban. The outworks consist of ravelins, counterguards, and fleches. The terrepleins of all these works are intersected by ditches, which are covered either by masonry or by wooden frames and earth, so that when the besieger has breached a work, the defenders obtain at once a retrenchment by removing that masonry or wood by the mine.

ROBINET.—An ancient military machine for throwing darts and stones.

ROCK DRILL.—The two most important improvements in modern rock-drilling apparatus consists in the use of compressed air as a motor, and the employment of diamond points. The former is now universally used in operations on a large scale, and is extensively employed in coal-mining, serving to ventilate the shaft besides performing the functions of a motor. The drilling-machines to which it is applied are various, very great improvements having been made within the past few years, previous to which time the old systems of turning the drill, and boring or pounding by hand, held undisputed sway. The drawing illustrates the Rand Rock Drill, which belongs to the class known as "striking drills," in which the drill steel is an extension of the piston-rod. The cylinder slides in a shell or guide, which is in turn mounted upon a tripod with a universal joint. The cylinder is fed toward the rock as fast as the steel penetrates it. The tripod legs are adjustable, and can be placed in any position desirable. The weights are removable. The positive valve movement insures certain operation when steam or air is admitted, without depending upon close fits or clean parts. It allows of a variation in design between the up and the down stroke, thus economizing steam and increasing the working capacity of the machine. By a patented feature, the valve is moved in the same direction with the piston. The rotating bar is made full size where it enters the ratchet, and, unlike the other forms, it does not break. The piston-rod and chuck, or drill-holder, is made rather small and solid outside of the cylinder, whereby a much greater lifting power is attained than is ever possible in any other machines of the same diameter of cylinder. The split crank-nut, feed-nut, and adjustable-slides



RAND'S LITTLE GIANT ROCK DRILL.

Mounted on Tunnel or Drifting Column.

provide for taking up wear as fast as it occurs. The throttle or stop cock, employed in the Rand drill is placed in the steam chest, where it cannot be lost or injured in handling, as is the case where a common valve attached to the hose is used. The lightning coupling provides for instantaneous connection of the hose without the use of wrench or spanner; it does not leak, and has no gaskets that can drop out.

The full page engraving opposite shows this drill mounted so that several holes can be drilled each side of the column without taking down the drill or moving the column. The arm is made so that by loosening one nut it can be swung around to any position, or it can be raised or lowered on the column. The Rand air-compressors, used with this drill are of the horizontal duplex type, with air and steam cylinders in line. This arrangement makes a machine that is very accessible, that is correctly designed, and readily available as an engine as well as a compressor, and that has its framing so disposed as to take the strains in direct lines. The engine is fitted with the Meyer valve gear, the cut-off being adjusted by a hand wheel, while the machine is in motion, the point of cut-off being shown by a pointer moving over a graduated scale. The machine is run with a wide-open throttle, and is controlled entirely by the cut-off. At the same time an ordinary ball-governor protects the machine from running away in case of breakage of the air pipes, or sudden loss of pressure from any cause—a not infrequent occurrence. Attached to the ball-governor is a pressure governor, whose object is to slacken speed whenever the air pressure reaches the maximum desired—usually 65 lbs. per sq. in. The main frames are of the Corliss pattern, and very heavy. The air and steam cylinders are tied together by a heavy cast-iron sole-plate and tie-rod, which take the strain in direct lines. The bearings are of brass, very large, and fitted for taking up wear. The cranks are of wrought iron, the crank pins and cross head pins of steel. The fly wheel is very heavy, in order to give smooth motion when it is desired to run one side at a time. The method of absorbing the heat of compression is believed to be the most perfect in use. Injection of water into the cylinder is not feasible in cold climates, owing to the freezing of the water in the air pipes. At the same time the ordinary cast-iron jackets for circulating water around the cylinder merely serve to keep the metallic parts of the machine from becoming overheated, and have but an insignificant effect in cooling the air. In this compressor the air-cylinder is made of hard brass, owing to the better conductivity of this material, and as thin as it can be made with safety; the cylinder heads are hollow and have water circulating through them, and finally the piston and piston-rod are hollow, and by means of a telescopic arrangement of tubing at the back end of the air-cylinder, are kept supplied with cold water. The piston packing consists of four composition rings arranged in pairs at each end of the piston. Before escaping, the water of the piston circulation is made to pass between these rings, completely around the piston in contact with the inside cylinder walls.

ROCKET GAUGES.—Brass rings, which are employed to ascertain whether the case is exteriorly of the proper dimensions.

ROCKETS.—Projectiles set in motion by forces residing within themselves, and performing the twofold functions of pieces and projectiles. A rocket is essentially composed of a strong case of paper or wrought iron, enclosing a composition of *niter, charcoal* and *sulphur*—the same as gunpowder, except that the ingredients are proportioned for a slower rate of combustion. If penetration and range be required, its head is surmounted by a *solid shot*; if explosion and incendiary effect, by a *shell* or *spherical case-shot*, to which is attached a fuse, which is set on fire when it is reached by the flame of the burning composition. The base is perforated by one or more *vents* for the escape of the gas generated within, and sometimes with a screw-hole to which a guide-stick is fastened. The disposition of the different parts

will be readily understood by reference to the drawing which represents a section through the long axis of a Congreve rocket.

The rocket is set in motion by the reaction of a rapid stream of gas escaping through its vents. If it be surrounded by a resisting medium, the atmosphere, for instance, the particles of gas, as they issue from the vent, will impinge against and set in motion certain particles of air, and the force expended on the inertia of these particles will react and greatly increase the propelling force of the rocket. It follows, therefore, that, though a rocket will move with very great ease *in vacuo*, its propelling force will be increased by the presence of a resisting medium. Whether the effect will be to accelerate the rocket depends upon the relation between the resistance which the medium offers to the motion of the gas, and that which it offers to the motion of the rocket. As the rate of combustion of the composition is independent of the pressure of the gas in the bore, it follows, that if the size of the vent be contracted, the flow of the gas through it will be accelerated. The strength of the case, and the friction of the gas, which increases as the vent diminishes, alone limit the reduction of the size of the vent. For vents of the same size, but of different shapes, that one which allows the gas to escape most freely, will be most favorable to the flight of the rocket. A conical form of vent, with the larger orifice next to the bore, will allow the gas to escape more rapidly than one of cylindrical form.

As the composition of a rocket burns in parallel layers of uniform thickness, the amount of gas generated in any given time, or the velocity of its exit from the case, depends on the extent of the inflamed surface. Experience shows that to obtain the required surface of inflammation, it is necessary to form a very long cavity in the mass of the composition. This cavity is generally called the *bore*. In small rockets, the bore is as a general thing formed by driving the composition around a spindle which is afterward withdrawn; but in the larger ones, the composition is driven into the case in a solid mass by a powerful hydrostatic press, and then bored out with a bit. In all rockets the bore should be concentric with the case; its shape should be made conical to facilitate the drawing out of the spindle, and to diminish the strain on the case near its head, by reducing the amount of surface where the pressure on the unit of surface is greatest.

Suppose the rocket in the state of rest, and the composition ignited; the flame immediately spreads over the surface of the bore, forming the gas, which issues from the vent. The escape is slow in the first moments, as the density of the gas is so slight; but as the surface of the inflammation is large compared to the size of the vent, the gas accumulates rapidly, and its density is continually increased until the velocity of the escape is quite sufficient to overcome all of the several resistances which the rocket always offers to motion. These resistances are, inertia, friction, the component of weight in the direction of motion, and, after motion takes place, the resistance of the air. The constant pressure on the head of the bore accelerates the motion of the rocket until the resistance of the air equals the propelling force; after this, it will remain constant until the burning surface is sensibly diminished. When the gas ceases to flow, the rocket loses its distinctive character, and becomes, so far as its movement is concerned, an ordinary projectile. The increase in the surface of combustion whereby more gas is developed in the same time, and the diminution in the weight of all the remaining composition, cause the point of maximum velocity to be reached with increased rapidity. If the weight of the rocket be increased, the instant of maximum velocity will be prolonged, but the amount will remain the same. A change in the form of the rocket which increases the resistance of the air, will have the effect to diminish the maximum velocity. The maximum velocity of French rockets, and the distances at which they are attained, are given in the following table:—

Caliber.	Distance.	Maxm. Velocity.
$2\frac{1}{2}$ inches.	121 yds.	273 yds.
$3\frac{1}{2}$ "	139 "	364 "

According to the calculations of Piobert, for small rockets it takes about $\frac{3}{4}$ second for the gas to attain its maximum velocity of 837 yards.

It is readily seen that the propelling force of a rocket changes its direction with the axis along which it acts; it follows, therefore, that without some means of giving stability to this axis, the path described will be very irregular, and so much so, at times, as to fold upon itself; and instances have been known where these projectiles have returned to the point whence they started. An example of this irregular motion may be seen in "serpents," a species of small rockets without guide-sticks. The two means now used to give steadiness to the flight of a rocket are, *rotation*, as in the case of a rifle-ball, and the *resistance of the air*, as in an arrow.

The first is exemplified in Hale's rocket, where rotation is produced around the long axis by the escape of the gas through five small vents situated obliquely to it. In his first arrangement, the inventor placed the small vents in the base, completely surrounding the large central vent, so that the resultant of the tangential forces acted around the posterior extremity of the axis of rotation. In 1855, this arrangement was changed by reducing the number of the small vents to three, and placing them at the base of the head of the rocket. The rocket thus modified is the one now used by the United States Government for war purposes.

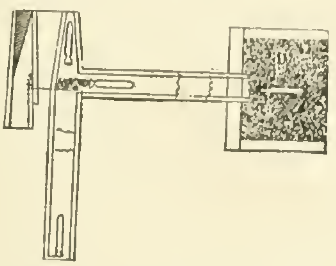
A Congreve rocket is guided by a long wooden stick attached to its base. If any cause act to turn it from its proper direction, it will be opposed by resistances equal to its moment of inertia and the lateral action of the air against the stick. The effect of these resistances will be increased by placing the center of gravity near the head of the rocket, and by increasing the surface of the stick. In *signal* rockets, where the case is made of paper, the stick is attached to the side by wrapping around twine; and there is but one large vent, which is in the center of the case. In *war*-rockets the stick is attached to the center of the base, and the large central vent is replaced by several smaller ones located near its circumference. The former arrangement is not so favorable to accuracy as the latter, inasmuch as rotation will be produced if the force of propulsion and the resistance of the air do not act in the same line. Rockets are generally fired from *tubes* or *gutters*; but should occasion require it, they may be fired directly from the ground, care being taken to raise the forward end by propping it up with a stick or stone. As the motion is slow in the first moments of its flight, it is more liable to be deviated from its proper direction at this time than any other: for this reason the conducting tube should be as long as practicable, say from five to ten feet. Take that portion of the trajectory where the velocity is uniform. The weight of the rocket applied at its center of gravity, and acting in a vertical direction, and the propelling force acting in the direction of its length, are two forces the oblique resultant of which moves the rocket parallel to itself; but the resistance of the air is oblique to this direction; and acting at the center of figure, a point situated between the center of gravity and extremity of the guide-stick, produces a rotation which raises the stick, and thereby changes the direction in which the gas acts. As these forces are constantly acting, it follows that each element of the trajectory has less inclination to the horizon than the element of an ordinary trajectory in which the velocity is regarded as equal. When the velocity is not *uniform*, the position of the center of gravity has a certain noticeable influence over the form of the trajectory. To understand this, it is necessary to consider that the component of the resistance of the air which acts on the head of the rocket is greater than that which acts on the side of the stick. It is also necessary to consider that the pressure of the inflamed gas acts in a direction opposite to the resistance of the air, that is to say, from the rear to the front, and that the center of gravity is near the rear extremity of the case.

At the beginning of the trajectory, when the motion of the rocket is accelerated, its inertia is opposed to motion, and being applied at the center of gravity, which is in rear of the vent, the point of application of the moving force, it acts to prevent the rocket from turning over in its flight. But when the composition is consumed, the center of gravity is thrown further to the rear, and the velocity of the rocket is retarded, the inertia acts in the opposite direction, and the effect will then be, if the center of gravity or inertia is sufficiently far to the rear, to cause it to turn over in the direction of its length. If the rocket be directed toward the earth, this turning over will be counteracted by the acceleration of velocity due to the weight, and the form of the trajectory will be preserved.

When the wind acts obliquely to the plane of fire, its component perpendicular to this plane, acting at the center of figure, will cause the rocket to rotate around its center of gravity. As the center of figure is situated in rear of the center of gravity, the point will be thrown toward the wind, and the propelling force acting always in the direction of the axis, the rocket will be urged toward the direction of the wind. To make an allowance for the wind, in firing rockets, they should be pointed toward the opposite side from which the wind comes, or with the wind instead of against it. If the wind act in the plane of fire from front to rear, it will have the effect to depress the point, and with it the elements of the trajectory in the ascending branch, and elevate them in the descending branch; as the latter is shorter than the former, the effect of a front wind will be to diminish the range. The converse will be true for a rear wind.

Rockets were used in India and China for war purposes before the discovery of gunpowder; some writers fix the date of their invention about the close of the ninth century. Their inferior force and accuracy limited the sphere of their operations to incendiary purposes, until the year 1804, when Sir William Congreve turned his attention to their improvement. This officer substituted sheet-iron cases for those formed of paper, which enabled him to use a more powerful composition; he also made the guide-stick shorter and lighter, and removed a source of inaccuracy of flight by attaching the stick to the center of the base instead of fixing it to the side of the case as before. He also states that he was enabled by his improvements to increase the range of 6-pdr. rockets from 600 to 2,000 yards. Under his direction they were prepared, and used successfully at the siege of Boulogne and the battle of Leipsic. At the latter place they were served by a special corps. The advantages claimed for rockets over cannon are, unlimited size of projectile; portability; freedom from recoil; rapidity of discharge; and the terror which their noise and fiery trail produce on mounted troops. The numerous conditions to be fulfilled in their construction in order to obtain accuracy of flight, and the uncertainty of preserving the composition uninjured for a length of time, are difficulties not yet entirely overcome, and which have much restricted their usefulness for general military purposes. See *Hale War Rocket*, *Life-saving Rockets*, and *Macdonald's Hale Rocket*.

ROCKET TROUGH. A small rocket with a hemispherical head of wood, which is frequently employed for firing mines. To use it, a wooden trough, with a smooth interior, must be placed from the charge to the point where the rocket is to start; tin tubes have been recommended, but are found not to answer. The rocket is then placed in the end of the trough, the quick-match with which it is pro-



vided is lighted, and the rocket starts with very great velocity, penetrates the charge, and fires it.

When the rocket has to pass elbows, or when it is desired to fire several mines at the same moment, a rocket is placed at each turn of the trough, with its quick-match secured around a nail; the first rocket arriving at the point where the other is placed, fires it. In order the better to insure the first rocket firing the second, a quantity of powder ($\frac{1}{4}$ ounce) should be scattered about the match of the latter, protected by a wedged-shaped slip of deal, nailed to the bottom of the trough; the rocket meeting this passes over the powder, which its rapid motion would otherwise disperse.

A rocket may be made to easily turn in a circular trough, when the radius of that part is not less than twice the length of the rocket. In order to prevent the smoke of the charge penetrating the gallery through the trough, one or two small iron traps may be placed in the trough, which, being raised by the rocket, fall again by their own weight, and cut off all communication between the gallery and the charge.

A rocket six inches long will travel 100 yards at least, and its velocity is so great, that two rockets fired at the same moment, to run very different distances, leave no perceptible interval in the times of their arrival. This property of rockets renders it easy to proportion the trains of mines to be fired simultaneously, which, with the powder-hose, requires great nicety.

The ordinary rocket for this service contains $\frac{3}{4}$ of an ounce of a composition formed $\frac{2}{5}$ of fine powder, $\frac{1}{5}$ of saltpeter, and $\frac{1}{5}$ of charcoal dust. These ingredients should be very carefully mixed, to make the rocket burn uniformly. Its usual diameter is nearly $\frac{3}{4}$ of an inch, and entire weight about $1\frac{1}{2}$ ounce. Rockets may be made much smaller when required. See *Box-trap* and *Monk*.

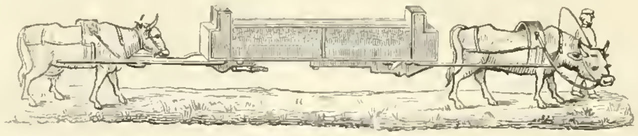
ROCKET WAGON.—A conveyance differing from the ordinary field ammunition wagon in the boxes being made deep enough to receive about 25 Hale's rockets, resting vertically in each box, and in having no center boxes.

ROCK FIRE.—A composition which burns slowly, is difficult to extinguish, and is used to set fire to buildings, ships, etc. That which is put into shells is cast in cylindrical cases of paper having a priming in their axes. The composition consists of *rosin*, 3 parts; *sulphur*, 4; *niter*, 10; *regulus of antimony*, 1; *mutton-tallow*, 1; *turpentine*, 1. To prepare rock-fire, pulverize the sulphur, niter, and antimony separately; mix them well with the hands, and pass them through sieve No. 2; melt the tallow first, then the rosin, stirring the mixture with spatulas; add the turpentine, and next the other materials in small quantities at a time, stirring the whole constantly with large spatulas. Let one portion of the composition be melted before more is added, and work with great precaution to prevent it from taking fire. When the composition becomes of a brown color, and white vapors are disengaged, the fire is permitted to go down; and when the composition is sufficiently fluid the cases are filled with the ladle not more than three-fourths full.

The cases are made of rocket-paper in the manner described for port-fire cases. The priming tubes are made of cartridge-paper, pasted after the first turn, and rolled hard. The cases are arranged in a frame, the lower end of each inserted in a socket, in the center of which is a spindle to support the priming tube. The upper ends of the cases are held in place by short cylindrical spouts attached to the lower side of a reservoir which rests on the top of the frame. The composition is poured into the reservoir, and the frame is gently shaken to settle the composition in the cases until they are filled. When the composition has become solid, the cylinders are taken out of the frame and trimmed; the priming tubes are charged with composition No. 1 for mortar-fuses, driven the same as mortar-fuses; the ends of the cylinders are last dipped in mealed powder. When rock-fire cannot be had to put into shells, the paper cases may be filled with port-fire composition, driven as usual; or pieces of port-fire may be inserted in the shells. See *Compositions* and *Fireworks*.

ROCK MORTARS.—Excavations resembling the interior of mortars, formed out of solid rocks, of which there are several in the Island of Malta, executed upon a large scale for the defense of the harbors, etc. The following interesting experiments have been made on two of these mortars situated in St. Julian's and St. George's Bays. 1st. At St. Julian's, 140 pounds of powder was inclosed in a sort of cask prepared to fit the chamber of the mortar, and being lodged there, a large cane tube filled with quickmatch was applied to a groove cut along the upper surface of the bore to receive it, and a bottom of wood covered the chamber. The stones were then piled, by four men, within the mortar as they were brought to it in baskets containing about 120 pounds each; a dozen stones, weighing from 120 to 80 pounds each, were first put in, then fifty baskets of other stones, from 60 to 30 pounds, then fifty more, of 20 to 5 pounds each, amounting in the whole to upward of 10 tons. This operation being completed, a piece of portfire was fixed to the end of the tube at the mouth, which communicated through a hole in the cask to the powder. In this manner it was fired as is usual in proving ordnance, and ranged about 700 yards. 2d. The same mortar was loaded with 180 pounds of powder and about ten tons of stones; they spread considerably more than the first time, but did not range quite so far. The explosion this time cracked the mortar in a direction nearly vertical, leaving a fissure in the rock about one-twelfth of an inch wide, ten feet in the rear and four feet in front. 3d. The other mortar of similar dimensions was fired with a charge rather larger than the first of these, but the effect was not quite so considerable; from whence it is concluded that the first proportion should not be exceeded, especially if after repeated. The stones used in these experiments were chiefly fragments of the rock, which, having been exposed to the air, were become something harder, and did not suffer so much as might be expected from such violent explosions, which in some degree resembled the tremendous discharge of a volcano.

RODLICH LITTER.—A large litter for two or more wounded men, suspended between two oxen. The drawing shows the manner of its construction and use. It is too large and unwieldy to be of prac-



tical or any general application; and, moreover, the movements of all oxen are very slow, and this unfits them for purposes of military transport. See *Litter*.

RODMAN CUTTER.—An instrument used for making indentations in castings. The indenting part of the tool is in the form of a pyramid, having a rhombus for its base, the diagonals of which are respectively one inch and two-tenths of an inch; the height of the pyramid one-tenth of an inch. In late experiments the form of the pyramid has been changed and improved somewhat by causing it to make a longer line, and mark minute differences more accurately. The volume of an indentation made with this tool is taken as the measure of the work required to produce it, and is inversely proportional to the hardness of the specimen, that is (denoting by H the hardness of any specimen), $H = \frac{k}{v}$....(1) k denoting any convenient constant, and v the volume of the indentation corresponding to H.

It has been found by experiment that a pressure of 10,000 on the base of the pyramid makes an indentation, in the softest metals used in guns, about nine-tenths of an inch long. The maximum indentation, one inch in length, of the instrument is therefore assumed as the unit of hardness; and denoting by V the volume corresponding to an indentation one inch in length, we obtain from equation (1),

$$1 = \frac{K}{V}, \text{ or } K = V;$$

and, in general,

$$H = \frac{V}{v};$$

or, putting l = the number of tenths of an inch in the length of any given indentation,

$$H = \frac{V}{v} = \frac{1000}{l^3};$$

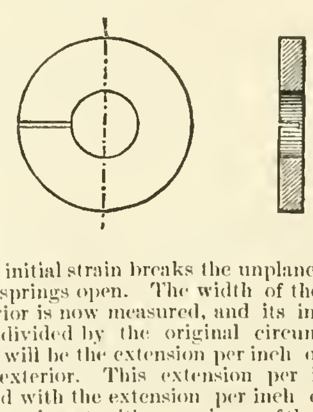
since pyramids are to each other as the cubes of any similar dimensions.

A pressure of less than 10,000 will probably be found better suited to the purpose, with the improved tools. A better standard of comparison may be found in some metal of an uniform density and hardness, easily obtainable in all places. The silver coin of the country will best fulfill these conditions. The volume of the cavity made in this, by the adopted unit of pressure, may be assumed as the unit of hardness; and this, divided by the volume of the cavity in any sample tested, will denote the hardness of that sample as compared with that of silver coin. See *Circular Cutter*.

RODMAN GUN.—The principal difficulty formerly experienced in manufacturing very large cast-iron cannon was the injurious strains produced by cooling the casting from the exterior. As far back as the year 1844, General Rodman, of the Ordnance Department, sought to discover the means to overcome this difficulty. After much observation and study, he developed his theory of the strains produced by cooling a casting like that of a cannon, and as a remedy for them he proposed that cannon should be cast on a hollow core, and cooled by a stream of water, or air, passing through it. After an elaborate series of experiments the truth of his theory was established, and his new mode of casting was adopted by the War Department. As a result of General Rodman's theory, he claimed that he could cast cannon of any practicable size, and asked that a 15-inch cast-iron gun might be made. This was done in 1860, and the gun was successfully tested shortly afterwards. General Rodman then projected a 20-inch gun, which was made at the Fort Pitt Foundry in 1863, under his directions.

Formerly it was customary to use but one kind or size of grain of powder for all cannon, whatever their size. General Rodman proposed for his large cannon that there should be a proportional increase in the size of the grain, expecting thereby to get as high a velocity for the projectile without a corresponding increase in the strain on the breech or weak part of the piece; this led to the introduction of our present mammoth powder. He also thought that the powder which would produce the least strain on the gun, giving certain initial velocity to the projectile, would be that which should develop its gas as the space behind the projectile increased; or in other words, that the powder should burn on an increasing instead of a decreasing surface. With this object in view he proposed to compress the substance of the powder into short hexagonal prisms, which could be easily fitted together without loss of space. These prisms were perforated with longitudinal holes, from which the combustion of the powder spread. While this idea has to a certain extent been confirmed by experiment, this powder has not been officially adopted in this country; it is understood that it has been to a certain extent in Russia for service in heavy rifle-guns.

The several operations in the manufacture of this gun are *molding, casting, cooling,* and *finishing.* These are noticed in detail under the separate headings. When these several operations have been complied with, a ring, about three inches thick, is taken off the gun-head parallel to the face of the muzzle, and as near thereto as is practicable. This ring is not reamed out or turned upon the exterior, but is a section of the rough casting. When two rings are taken from the same head, the one nearer to the muzzle is marked number 1, the other number 2. In the 15-inch gun the distance of ring No. 1 from the face of the muzzle measured to the center of the ring is 3.7 inches; and of ring No. 2, 7.5 inches. In a 10-inch gun the distance of No. 1 is three inches; of No. 2, 6⅝ inches. Each ring is cut through by planing a groove 0.5 inch wide from the exterior to the core



until the initial strain breaks the unplaned part, and the ring springs open. The width of the groove at the exterior is now measured, and its increase over 0.5 inch divided by the original circumference of the ring will be the extension per inch of the metal on the exterior. This extension per inch is then compared with the extension per inch obtained by actual experiment with a specimen of the same iron, and the corresponding stress required to produce it will be the initial tension.

For example, the ring from a 15-inch gun head is, say, 38 inches in diameter; the width of the groove before the bursting of the ring is 0.5 inch, and afterwards 0.65 inch, showing a total extension on the exterior of 0.15 inch, then

$$\frac{0.15}{\pi 38} = \frac{0.15}{119.38} = .00127$$

for the extension per inch of metal on the exterior. Upon examination of the tests of this metal we find the stress corresponding to this extension per inch to be 20,000 pounds per square inch, which will be the initial tension of the ring, supposing the iron to possess the same tenacity and elasticity, and that the breaking of the ring entirely relieved it of strain, which it cannot probably do. To illustrate the effect of this initial strain upon the strength of the gun, let us suppose that the initial strain of extension upon the exterior of a gun one caliber thick and of which the tenacity of iron is 30,000 pounds per square inch —is 15,000 pounds per square inch, the metal at the surface of the bore will be subjected to a compressive strain of 15,000 pounds per square inch.

Now if we suppose the tangential strain due to the action of a central force, such as fired gunpowder, to decrease directly as the distance from the axis of the bore increases, and that an interior force just sufficient to relieve the metal at the surface of the bore from compression has been applied, then will the exterior of the gun be brought to a strain of extension of 20,000 pounds per square inch. Now increase the interior pressure of gas until the metal at the surface of the bore is under a tensile strain of 30,000 pounds per square inch, and the tensile strain of the metal on the exterior of the gun will be increased to 30,000 pounds per square inch also, and the whole thickness of the walls of the gun would be brought to the breaking strain at the same instant, which is the object of initial strain. But in practice we know that the strain due to a central force diminishes in a higher ratio than directly as the distance from the axis, and this would require an increase of initial strain in order to bring the outer portions of metal to the breaking point at the same time, while on the other hand the fact that a given increase of load or strain will produce a much greater extension when applied to a specimen near to its breaking strain than when applied to the same specimen when strained within, or even considerably above the limits of its permanent elasticity, causes the maximum resistance of a gun, having too little initial strain, to approach more nearly than it would otherwise do to what its maximum resistance would be with a proper initial strain.

The law of diminution of tangential strain from the bore outward in a gun is not and cannot be accurately known, nor, therefore, can the exactly proper initial strain be determined. But, as the foregoing reasoning shows, after the initial strain shall be equal to that estimated on the hypothesis that this strain is inversely as the distance from the axis of the bore, it may vary considerably above that point without affecting to any considerable degree the maximum resistance of the gun; and we therefore know that we are safe in fixing the initial strain at, or a little above, that which the law of diminution of strain as the distance from the axis increases, would give.

The initial tension-rings for Rodman guns, on being planed through, should open on the exterior 0.25 inch for 20-inch guns; 0.17 inch for 12-inch rifles, 0.15 inch for 10-inch rifles. The properties of iron employed and the rate of cooling should be so regulated as to produce these openings. If the rings do not open sufficiently, add more water and fire longer, which will insure a higher tension. If the rings open too much diminish the quantity of water and the length of time the fire is kept up in the pit. The gun should not in any case be "steamed"; but, if necessary, the water may leave the casting at 200° or 205°. The more rapid the cooling the higher the iron, and the more rapidly the interior is cooled over the exterior the greater the tension. If a higher density of the metal is required a less fire will be required in the pit. Cold iron should not be put into a pool of melted iron. If the iron is not high, it should be kept in fusion and evenly stirred till a satisfactory result is obtained. In planing through the rings for initial tension they should be so clamped in the planing-machine that one-half should be free to spring open when the thickness is so far reduced by planing that the initial strain will break the metal thus left. In other words, the planing should be continued till the ring parts. The thickness of the metal broken should be accurately measured, as also the amount of opening in its exterior. For 10-inch guns the thickness of the broken part of the ring should be about one-tenth of the whole thickness of the ring. Should it be less, more water and a longer continued fire in the pit will correct the defect. The amount of initial tension on the exterior, which General Rodman thought should obtain in a properly constructed gun, was about one-half the ultimate tenacity of the metal. Bloomfield gun-iron, when employed in 20-inch guns, should be so far decarbonized as to have a density of 7.24 to 7.26, with a tenacity of 32,000 pounds. When employed in 12-inch rifles it should have a density of from 7.26 to 7.28, with a tenacity of 32,000 pounds. When employed for 12-inch shot to be chilled at the point it should have a density of from 7.32 to 7.35. Richmond gun-iron, when for 10-inch rifles, should have a density of from 7.28 to 7.30, with a tenacity of 32,000 pounds.

In the manufacture of 4.5-inch siege rifles the application of the water-cooling process is impracticable, owing to the great length and small size of the bore. These guns are, therefore, cooled from the exterior. The best quality of gun-iron should be employed in these guns, with a density not to exceed 7.25, say from 7.22 to 7.25. The guns should be cooled slowly in covered pits. The following are some of the particulars and charges of Rodman guns:

Name of Gun.	Length.	Length of Bore.	Maximum Diameter.	Weight.	Service Charge.	Bursting Charge, Shell.	Weight of Shot.	Weight of Shell.
Smooth Bores.	In.	In.	In.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs
20-inch gun	243.5	210.	64.	15200	100	...	1080	
15-inch do.	190.	165.	48.	49100	50 mammoth.	17	{ 440 / 425 }	330
13-inch do.	177.6	155.94	41.6	32731	30 cannon.	7	{ 300 / 280 }	224
10-inch do.	136.66	105.5	32.	15059	{ 15 for shell. / 18 for shot. }	3	127	100
8-inch do.	123.5	110.	25.6	8465	10	1	68	48

See *Casting*, *Cast-iron Guns*, *Cooling*, *Finishing*, *Molding*, *Ordnance*, and *Sea-coast Artillery*.

RODMAN PRESSURE PLUG.—An invention used when it is desired to ascertain the pressure per square inch exerted by the powder on the surface of the bore of a piece. To apply this instrument, it is first taken apart by unscrewing the cap and removing the piston and disc containing the knife. The whole is then thoroughly oiled with sperm oil. This done, place a copper disc in the plug, and after it the disc containing the knife, the latter being *slid* down so as not to cut the copper disc. Next pass the piston into the hole in the stem of the cap, and screw the cap into its place. For this operation the plug is held horizontally in a vise. A small copper gas-check is then inserted into the hole on top of the piston; a wooden drift is used to set the gas-check firmly in its place, and a small wad of cotton-waste is inserted over the gas-check; the plug is now put into the empty cartridge-bag, with its grooved end at the bottom and center of the bag, and the bag tied firmly to it from the outside, with twine passing around the grooves on the bottom of the plug. The powder is next put in, care being taken to distribute it evenly around the plug. The bag is tied close to the powder so as to make the cartridge firm and compact. When inserting the cartridge into the gun, care is taken that the plug, when at the bottom of the bore, is, as nearly as possible, in the axis of the piece. After the discharge, the plug is removed from the bore by a rake made for the purpose; the cap is unscrewed, the copper disc is removed, and, after being wiped, the cut made upon it by the knife is measured, from end to end, with a pair of dividers. The dividers are then applied to the scale and passed down the two long lines until they intersect a cross line the length of which corresponds to the width of the dividers; the figures at this point indicate the number of pounds pressure to the square inch. Pressure plugs are of three sizes: one for the 12-inch rifle and 13-inch and 15-inch smooth-bores; one for the 100-pounder Parrott rifle and 8-inch and 10-inch smooth-bores; and one for smaller calibers.

RODMAN TESTING MACHINE.—A machine used to determine the capacity of any metal to resist a *tensile*, *transverse*, *torsional*, or *crushing* force. It is also used to obtain the indenting force. By a combination of levers and cog-wheels, the action of the power employed is greatly augmented and transmitted to the specimen under trial. The machine consists essentially of a system of three levers, A C, A′ C′, and A″ C″. The position of the fulcrum in each of these cases is denoted by F F′ and F″, respectively. The power is applied at P, and the position of the weights is denoted by W. The levers are connected by rigid rods. The mechanical advantage of the levers A C is 10 to 1; that of A′ C′ is 20 to 1, and that of A″ C″ is 10 to 1. We have, therefore, by the formula for compound levers,

$$\frac{W}{P} = \frac{10}{1} \times \frac{20}{1} \times \frac{10}{1} = 2000.$$

A weight of one pound, therefore, applied to the platforms of the suspending rod on the same lever, exerts a force of 200 pounds on the straps connecting with the main lever, and of 2,000 pounds at the point where the strain acts upon the sample.

The weights used are of two denominations, viz, half-pounds and five pounds, representing respectively 1,000 and 10,000 pounds. Smaller increments of strain than 1,000 pounds are noted on the small lever, which is provided with a sliding weight, and graduated from zero to ten, each number representing an additional hundred pounds. Of the first denomination there are ten weights, representing a strain of 10,000 pounds, and of the second, there are nine weights, representing a strain of 90,000 pounds. The aggregate strains of all the weights, or the capacity of the machine, being 100,000 pounds.

The errors incidental to the use of this machine are due to three causes: 1st. Weight of its different movable parts. 2d. Motion of the centers of gravity of the levers towards or from their fulcrums. 3d. Friction.

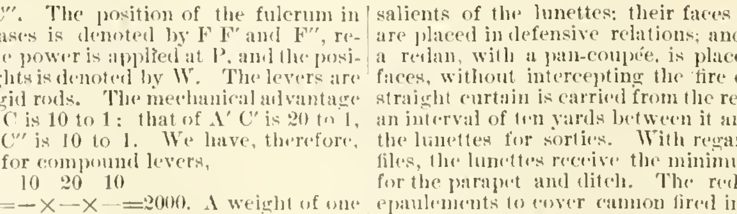
The first cause of error is avoided in practice by means of the adjusting weights already described. The system is brought into perfect equilibrium, so that any increase of W will be balanced by a proportionate increase of P.

The second cause of error is comparatively unimportant, because the levers A C and A′ C′ are so adjusted as never to make a large angle with a horizontal line passing through the fulcrum, and in the case of the lever A″ C″, which makes a larger angle, the shape is such as to bring the center of gravity very near the center of motion. Let D denote the distance through which the center of gravity moves; a denote the distance of the center of gravity from the center of motion; L denote the angle described by the lever during the breaking of a specimen. In general the levers are so adjusted that the line connecting the centers of gravity and of motion is horizontal when the movement of the lever is half completed. $\therefore D = a$ versine $\frac{1}{2}$ L. It is evident that one or both of these factors is very small in each case.

The third cause of error is made as small as possible by the use of knife-edges and steel-plates, and is practically inconsiderable.

The determination of the absolute breaking and other strains involve the elimination of errors due to friction, etc., but for obtaining the comparative strength of specimens, the machine is all that can be desired. See *Testing-machines*.

ROGNIAT LINE.—A system of defense has been proposed by General Rogniat, the spirit of the arrangement of which partakes both of the bastioned line with double flanks, and of the line with intervals. Points of 250 yards apart are taken for the



salients of the lunettes; their faces and the flanks are placed in defensive relations; and between them a redan, with a pan-coupée, is placed to flank the faces, without intercepting the fire of the flanks; a straight curtain is carried from the redan, and leaves an interval of ten yards between it and the flanks of the lunettes for sorties. With regard to the profiles, the lunettes receive the minimum profile both for the parapet and ditch. The redans are simple epaulements to cover cannon fired in barbette; and the curtains consist of a trench with the earth thrown in front to form a parapet, which is so arranged that the infantry may march from the trench in order of battle over it.

The advantages claimed for this system are, *first*, the short time required to form the works, by which an army may intrench its field of battle in one night; *second*, the lunettes form the first line of the order of battle, and contain only infantry, and the batteries are placed in the redans, where they are more secure, protect the lunettes, and withdraw the fire of the enemy's artillery from the lunettes; *third*, the curtains are well defended by infantry, who can sally from them at a moment's warning, and aided by the light artillery and cavalry, who débouche through the intervals between the curtains and lunettes, and attack the enemy in flank. If the flanks of his position are not secured by natural obstacles, Gen. Rogniat proposes to throw up towards the rear a strong square redoubt on each flank, and to place a heavy battery in the interval between the redoubt and the adjacent lunette.

Lines with intervals are peculiarly adapted to very well disciplined and active troops. The works thrown in advance constitute the first line of the order of battle, against which the first shock of the enemy is partially thrown away, and he dare not attempt to neglect them, for an endeavor to penetrate through the intervals would expose his flanks to a close and deadly cross-fire. If the enemy is repulsed, the main body of the army, which is drawn up in rear of the works immediately assumes the offensive, and, by a vigorous advance movement, charges the enemy in turn, relying on the works to cover its retreat if driven back. In every combination of this nature the flanks are the weak points; they should rest, if practicable, on some unassailable point, as a marsh, river, etc.; otherwise very strong works should be thrown up for protection. See *Lines*.

ROGUE'S MARCH.—Derisive music performed in driving away a person under popular indignation, or when a soldier is drummed out of a regiment.

ROI D'ARMES.—King-at-Arms, an officer formerly of great authority in armies; he directed the Heralds, presided at their chapters, and had the jurisdiction of armories.

ROLL CALL.—In military life it is necessary, for the sake of discipline, and to prevent soldiers from wandering about indiscriminately at all hours, as well as for the purpose of having them available at any moment in case their services are required, that the men of a regiment, company, or detachment should be present to answer their names during certain fixed periods of the day, or at any time the Commanding Officer may think advisable. This act is termed *Roll-call*. In the United States, there are daily at least three roll-calls, viz., at *reveille*, *retreat*, and *tattoo*. They are made on the company parades by the 1st Sergeants, *superintended by a Commissioned Officer* of the company. At all established roll-calls, except dress-parade, after the companies are dismissed, each officer superintending the company roll-call reports, to the Adjutant or other officer designated, the result of the roll-call; the Adjutant or officer designated reports the result of the roll-call to the Commanding Officer. Immediately after *reveille* roll-call (after stable-duty in the cavalry), the tents or quarters, and the space around them, are put in order by the men of the companies, superintended by the chiefs of squads, and the guard-house or guard-tent by the guard or prisoners.

ROLLER HANDSPIKE.—An implement for working the eccentric rollers of casemate carriages, and is made of round iron tapering to fit the mortise in the eccentric. It may be made single like a truck handspike, or with two branches to fit in both mortises of the roller at the same time.

ROLLERS. Solid cylinders of wood, used in mounting guns upon their carriages, or shifting them from one carriage to another, and in moving them on the ground. Their dimensions vary with the service for which they are intended. When a gun is moved on rollers, they must be horizontal, and handspikes should be applied to guard against accident, when the gun has a tendency to roll off. The rollers must be placed at right angles to the direction in which they are intended to move, projecting equally on each side of the axis of the gun. The gun upon rollers may be moved either by hauling upon it with ropes, or by means of levers. When a gun is moved on rollers, it passes over twice the distance passed by the rollers themselves. The term "roller" is also applied to a massive roller of iron, weighing about 4½ tons, having faces 18 inches broad, which are used in the incorporation of gunpowder.

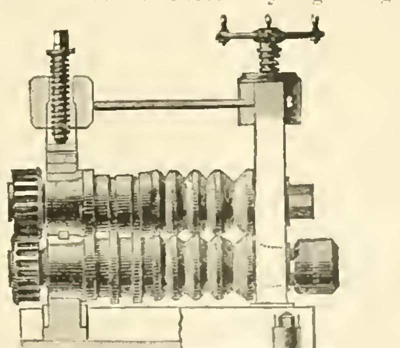
ROLLING BOARD. A smooth piece of plank, with a strap tacked over the upper side near the end under which the hand is placed in using it. It is employed in making the cases of port-fires and the like.

ROLLING FIRE. 1. A discharge of musketry by soldiers in line, in quick succession, and in the order in which they stand. 2. A fire where the axis of the piece is parallel, or nearly so, with the ground or water, and the projectile rebounds over the surface in a succession of ricochets.

ROLLING-HITCH. In cordage, a useful hitch formed as follows: Pass the end of a rope round a piece of timber take it round a second time riding the standing part then carry it across and up through the bight. See *Cordage*.

ROLLING MILL.—One of the most important of modern inventions for the working of metals. It was first introduced practically by Mr. Corb in 1784, and since then has gradually become more and more useful, as its capabilities have been developed. The rolls may be engraved so as to impress a pattern on the bar as it passes through; this is done by the brass-workers to a great extent; and tubes of brass, copper, tin, etc., are also operated on in a similar way, a mandrel or rod of iron being fitted inside the tube, to sustain the pressure of the rollers.

In its simplest form a rolling-mill consists of two cast-iron cylinders placed with their axes horizontally one above the other, as shown in the drawing, and connected by spur-gearing so as to revolve at the same velocity. The surface of the rolls may be either smooth, as is the case in the plate-mills, or grooved into various patterns, as in those used for the production of merchant bars. The reduction in the size of the bloom is effected by regulating the



vertical distance between the two rolls, by the use of grooves diminishing regularly in size, or by a combination of both methods.

As the direction of rotation of the rolls is constant under ordinary circumstances, it is necessary, after the bar has passed through one groove, to return it by lifting it over the top roll, in order to bring it in position to pass through the next smaller one, and so on in succession. This may be easily done with blooms of small size, but is attended with considerable difficulty when it is required to handle large masses of iron, and in any case gives rise to a certain loss of time and consequent waste of iron by scaling, from exposure to the atmosphere in a highly heated condition for a longer time than is absolutely required. Very heavy mills, such as are used for armor-plates, require to be reversed at each passage of the pile, the distance between the rolls being diminished each time. See *Iron*.

ROLL OF A DRUM.—The continuous and uniform beat of the drum for a certain time. What is known as the *long-roll* is a beat by which troops were formerly assembled at any particular spot of rendezvous or parade.

ROLL OF ARMS.—A heraldic record of arms, either verbally blazoned or illuminated, or both, on a long strip of vellum, rolled up, instead of being folded into leaves. Rolls of arms are the most important and most authentic materials for the history of early Heraldry. In England they go back to the reign of Henry III., the oldest being a copy of a roll of that reign, containing a list of the arms borne by the Sovereign, the Princes of the Blood, and the principal Barons and Knights between 1216 and 1272, verbally blazoned without drawings. The original has been lost, but the copy, which, having been made by Glover, Somerset Herald, in 1586, is called "Glover's Roll," is in the English College of Arms. This roll exhibits Heraldry as at that early period already consolidated into a system. In the British Museum is a copy of another roll of the middle of the 13th century, containing 700 coats tricked, that is, drawn in pen and ink. The *Roll of Caerlaverock* is a heraldic poem in Norman-French, reciting the names and Arms of the Knights present at the siege of Caerlaverock in 1300. It has been published with notes by Sir N. H. Nicolas. Copies exist of rolls of the Knights who were with Edward I. at the Battle of Falkirk.

ROMAN CANDLE.—A long and strong tube charged with stars, which are thrown out successively by a charge of powder placed under each star. The ends of gunbarrels, 20 inches long, are used for cases. When paper cases are used, make them about .65 to .7 inch interior diameter, and 1-inch exterior diameter; roll them like port-fire cases. Three drifts of different lengths are used; they are made of hickory or other hard wood, with brass tips on the lower ends.

Put in the case a ladleful of clay, and drive it with ten blows of the mallet; then a ladleful of composition, which is driven in the same way; next a charger of powder and a star, which is gently pressed down, then another ladleful of composition, a second charger of powder, and another star, driving the composition and pressing down the star gently; continue until the ten stars are in, and add a half ladleful of composition. Prime the candle with a strand of quick-match 6 inches long, held in place against the side of the case by a little composition driven in on its ends. Cover the end of the candle with a strip of paper pasted on. Roman candles are inserted in holes bored in frames, or tied with wire or twine in the direction in which they are to throw their stars. The stars used for Roman candles have a hole through their axes communicating the fire to the charge below, which throws it out. See *Fireworks*.

ROMAN LEGIONS.—To a truly illustrious Frenchman, whose reverses as a minister can never obscure his achievements in the world of letters, we are indebted for the most profound and most eloquent estimate that we possess of the importance of the Germanic element in European civilization, and of the extent to which the human race is indebted to those brave warriors who long were the unconquered antagonists, and finally became the conquerors of imperial Rome. Many very eventful years have passed away since M. Guizot delivered from the chair of modern history at Paris his course of lectures on the history of Civilization in Europe. During those years the spirit of earnest inquiry into the germs and primary developments of existing institutions has become more and more active and universal, and the merited celebrity of M. Guizot's work has proportionately increased. Its admirable analysis of the complex political and social organizations of which the modern civilized world is made up, must have led thousands to trace with keener interest the great crises of times past, by which the characteristics of the present were determined. The narrative of one of these great crises, of the epoch A. D. 9, when Germany took up arms for her independence against Roman invasion, has for England this one attraction—that it forms part of her national history. Had Arminius been supine or unsuccessful, her Germanic ancestors would have been enslaved or exterminated in their original seats along the Eyder and the Elbe. Great Britain would never have borne the name of England, and the mighty English nation, whose race and language are now overrunning the earth, from one end to the other, would have been utterly cut off from existence. Arnold may, indeed, go too far in saying that they are wholly unconnected in race with the Romans and Britons, who inhabited that country before the invasion of the Saxons; and that, "nationally speaking, the history of Cæsar's invasion has no more to do with them than the natural history of the animals which then inhabited the forests." There seems ample evidence to prove that the Romanized Celts whom her Teutonic forefathers found there influenced materially the character of that nation. But the main stream of her people was and is Germanic. The English language amply proves this. Arminius is more truly one of Britain's national heroes than Caractacus; and it was his own primeval fatherland that the brave German rescued when he slaughtered the Roman legions eighteen centuries ago, in the marshy glens between the Lippe, and the Ems.

Dark and disheartening, even to heroic spirits, must have seemed the prospects of Germany when Arminius planned the general rising of his countrymen against Rome. Half the land was occupied by Roman garrisons; and, what was worse, many of the Germans seemed patiently acquiescent in their state of bondage. The braver portion, whose patriotism could be relied on, was ill armed and undisciplined, while the enemy's troops consisted of veterans in the highest state of equipment and training, familiarized with victory, and commanded by officers of proved skill and valor. The resources of Rome seemed boundless; her tenacity of purpose was believed to be invincible. There was no hope of foreign sympathy or aid; for "the self-governing powers that had filled the Old World had bent one after another before the rising power of Rome, and had vanished. The earth seemed left void of independent nations.

The German chieftain knew very well the gigantic power of the oppressor. Arminius was no rude savage, fighting out of mere animal instinct, or in ignorance of the might of his adversary. He was familiar with the Roman language and civilization; he had served in the Roman armies; he had been admitted to the Roman citizenship and raised to the rank of the equestrian order. It was part of the subtle policy of Rome to confer rank and privileges on the youth of the leading families in the nations which she wished to enslave. Among other young German chieftains, Arminius and his brother, who were the heads of the noblest house in the tribe of the Cherusci, had been selected as fit objects for the exercise of this insidious system. Roman refinements and dignities succeeded in denationalizing the brother, who assumed the Roman name of Flavius, and adhered to Rome throughout all her wars against his country. Arminius remained unbought by honors or wealth, uncorrupted by refinement or luxury. He aspired to and obtained from Roman enmity a higher title than ever could have been given him by Roman favor. It is in the page of Rome's greatest historian that his name has come down to us with the proud addition of "Liberator haud dubie Germaniæ". Often must the young chieftain, while meditating the exploit which has thus immortalized him, have anxiously revolved in his mind the fate of the many great men who had been crushed in the attempt which he was about to renew—the attempt to stay the chariot-wheels of triumphant Rome. Could he hope to succeed where Hannibal and Mithradates had perished? What had been the doom of Viria-


ORCADES
CALEDONIA
OCEANUS
GERMANICUS
HIBERNIA
MONA
Eboracum
Lindum
BRITANNIA
Londinium
Tamesis
VECTIS
OCEANUS BRITANNICUS
OCEANUS
GALLICUS
CÆSAREA
LUGDUNENSIS
Lutetia
Rotomagus
Liger Fl.
GALLIA
AQUITANIA
Garumna Fl.
Burdigala
OCEANUS
CANTABRIUS
Lugdunum
NARBONENSIS
Massilia
Narbo
Tolosa
BELGICA
GERMANIA
Mogontiacum
Augusta Vindelicorum
VINDELICIA
NORICUM
RHAETIA
VENETIA
Aquileia
Verona
Mediolanum
ALPES MARITIMÆ
CORSICA
SARDINIA
Caralis
ROMA
ETRURIA
Neapolis
SICILIA
Syracusæ
Rhegium
Messana
MARE HADRIATICUM
PANNONIA
Salona
DALMATIA
HISPANIA
TARRACONENSIS
LUSITANIA
BÆTICA
Toletum
Emerita Aug.
Gades
Carthago Nova
Tarraco
Barcino
Saguntum
Valentia
BALEARES IÆ.
MINOR
MAJOR
EBUSUS
PITYUSÆ IÆ.
MARIANUS M.
PYRENÆI MS.
Numantia
Caesaraugusta
Ilerda
MEDITERRANEUM
MAURITANIA
ATLAS M.
Rusadir
Siga
Auzia
Sitifis
Saldae
Igilgilis
Hippo Regius
NUMIDIA
Cirta
Theveste
Lambæsa
Utica
Carthago
Zama
Hadrumetum
Thapsus
Capsa
Syrtis Minor
Sabrata
Oea
Leptis-magna
Syrtis Major
AFRICA
MELITA
COSSYRA
ÆOLIA IÆ.
Lilybaeum
Tauromenium
Consentia
Croton
Capua
Cannae
TROPIC OF CANCER
Longitude
15
10
5
0
55
50
45
40
35
30
25


ROMAN EMPIRE
IN ITS GREATEST EXTENT.
ROMAN MILES
0 50 100 200 300 400
SCALE OF MILES
0 50 100 200 300 400
SARMATIA EUROPEA
SARMATIA ASIATICA
Tanais Fl.
Rha Fl.
Borysthenes Fl.
Hypanis Fl.
Tyras Fl.
Porata Fl.
Maeotis Palus
CAUCASUS MONS
ALBANIA
IBERIA
COLCHIS
MARE CASPIUM
PONTUS EUXINUS
PAPHLAGONIA
BITHYNIA
GALATIA
PONTUS
CAPPADOCIA
ARMENIA
GOGARENE
OTENE
ATROPATENE
MEDIA
ASSYRIA
MESOPOTAMIA
SYRIA
CILICIA
CYPRUS
LYCAONIA
PHRYGIA
MYSIA
LYDIA
CARIA
LYCIA
PAMPHYLIA
THRACIA
MOESIA
DACIA
MACEDONIA
CYCLADES
SPORADES
CRETA
MARE
MARMARICA
CYRENAICA
LIBYAE DESERTA
AEGYPTUS
ARABIA PETRAEA
ARABIA
SYRIAE DESERTA
Arabicus Sinus
TROPIC OF CANCER
Euphrates Fl.
Tigris Fl.
Byzantium
Nicomedia
Nicaea
Ancyra
Sinope
Amisus
Trapezus
Phasis
Dioscurias
Tarsus
Antiochia
Seleucia
Palmyra
Damascus
Heliopolis
Sidon
Tyrus
Ptolemais
Caesarea
Hierosolyma
Bostra
Petra
Alexandria
Pelusium
Memphis
Heracleopolis
Oxyrynchus
Antinoe
Hermopolis
Lycopolis
Ptolemais Hermii
Abydus
Tentyra
Thebae
Latopolis
Apollinopolis
Syene
Philae
Berenice
Myos Hormos
Paraetonium
Apollonia
Cyrene
Paliurus
Paphos
Salamis
Nisibis
Carrhae
Edessa
Samosata
Melitene
Amida
Artaxata
Ctesiphon
Seleucia
Babylon
Nineveh
Arbela
Ephesus
Miletus
Pergamum
Smyrna
Sardis
Athenae
Sparta
Argos
Thessalonica
Philippi
Larissa
Olbia
Tyras
Apulum
Napoca
Odessus
Apollonia
Philippopolis
Hadrianopolis
Constantinopolis
Istropolis
Tomi
Durostorum
Nicopolis
Danubius vel Ister
East from Greenwich
25 30 35 40 45 50 55

thus? and what warning against vain valor was written on the desolate site where Numantia once had flourished? Nor was a caution wanting in scenes nearer home and more recent times. The Gauls had fruitlessly struggled for eight years against Cæsar; and the gallant Vercingetorix, who in the last year of the war had roused all his countrymen to insurrection, who had cut off Roman detachments, and brought Cæsar himself to the extreme of peril at Alesia—he, too, had finally succumbed, and had been led captive in Cæsar's triumph, and had then been butchered in cold blood in a Roman dungeon.

It was true that Rome was no longer the great military republic which for so many ages had shattered the kingdoms of the world. Her system of government was changed: and after a century of revolution and civil war, she had placed herself under the despotism of a single ruler. But the discipline of her troops was yet unimpaired, and her warlike spirit seemed unabated. The first year of the empire had been signalized by conquests as valuable as any gained by the republic in a corresponding period. It is a great fallacy, though apparently sanctioned by great authorities, to suppose that the foreign policy pursued by Augustus was pacific; he certainly recommended such a policy to his successors (*incertum metu an per invidiam.* Tac., *Ann.*, i., 11), but he himself, until Arminius broke his spirit, had followed a very different course. Besides his Spanish wars, his Generals, in a series of generally aggressive campaigns, had extended the Roman frontier from the Alps to the Danube, and had reduced into subjection the large and important countries that now form the territories of all Austria south of that river, and of East Switzerland, Lower Wirtemberg, Bavaria, the Valtelline, and the Tyrol. While the progress of the Roman arms thus pressed the Germans from the south, still more formidable inroads had been made by the imperial legions on the west. Roman armies, moving from the province of Gaul, established a chain of fortresses along the right as well as the left bank of the Rhine, and, in a series of victorious campaigns, advanced their eagles as far as the Elbe, which now seemed added to the list of vassal rivers, to the Nile, the Rhine, the Rhone, the Danube, the Tagus, the Seine, and many more, that acknowledged the supremacy of the Tiber. Roman fleets also, sailing from the harbors of Gaul along the German coasts and up the estuaries, co-operated with the land-forces of the empire, and seemed to display even more decisively than her armies, her overwhelming superiority over the rude Germanic tribes. Throughout the territory thus invaded, the Romans had, with their usual military skill, established fortified posts; and a powerful army of occupation was kept on foot ready to move instantly on any spot where any popular outbreak might be attempted.

Vast, however, and admirably organized as the fabric of Roman power appeared on the frontiers and in the provinces, there was rottenness at the core. In Rome's unceasing hostilities with foreign foes, and still more in her long series of desolating civil wars the free middle classes of Italy had almost wholly disappeared. Above the position which they had occupied, an oligarchy of wealth had reared itself; beneath that position, a degraded mass of poverty and misery was fermenting. Slaves, the chance sweepings of every conquered country, shoals of Africans, Sardinians, Asiatics, Illyrians, and others, made up the bulk of the population of the Italian peninsula. The foulest profligacy of manners was general in all ranks. In universal weariness of revolution and civil war, and in consciousness of being too debased for self-government, the nation had submitted itself to the absolute authority of Augustus. Adulation was now the chief function of the senate; and the gifts of genius and accomplishments of art were devoted to the elaboration of eloquently false panegyrics upon the prince and his favorite courtiers. With bitter indignation must the German chieftain have beheld all this and contrasted with it the rough worth of his own countrymen; their bravery, their fidelity to their word, their manly independence of spirit, their love of their national free institutions, and their loathing of every pollution and meanness. Above all, he must have thought of the domestic virtues that hallowed a German home, of the respect there shown to the female character, and of the pure affection by which that respect was repaid. His soul must have burned within him at the contemplation of such a race yielding to these debased Italians.

Still, to persuade the Germans to combine, in spite of their frequent feuds among themselves, in one sudden outbreak against Rome; to keep the scheme concealed from the Romans until the hour for action arrived; and then, without possessing a single walled town, without military stores, without training to teach his insurgent countrymen to defeat veteran armies and storm fortifications, seemed so perilous an enterprise, that probably Arminius would have receded from it had not a stronger feeling even than patriotism urged him on. Among the Germans of high rank who had most readily submitted to the invaders, and become zealous partisans of Roman authority, was a chieftain named Segestes. His daughter, Thusnelda, was pre-eminent among the noble maidens of Germany. Arminius had sought her hand in marriage; but Segestes, who probably discerned the young chief's disaffection to Rome, forbade his suit, and strove to preclude all communication between him and his daughter. Thusnelda, however, sympathized far more with the heroic spirit of her lover than with the time-serving policy of her father. An elopement baffled the precautions of Segestes, who, disappointed in his hope of preventing the marriage, accused Arminius before the Roman Governor of having carried off his daughter, and of planning treason against Rome. Thus assailed, and dreading to see his bride torn from him by the officials of the foreign oppressor, Arminius delayed no longer, but bent all his energies to organize and execute a general insurrection of the great mass of his countrymen who hitherto had submitted in sullen hatred to the Roman dominion.

A change of Governors had recently taken place which, while it materially favored the ultimate success of the insurgents, served, by the immediate aggravation of the Roman oppressions which it produced, to make the native population more universally eager to take arms. Tiberius, who was afterward Emperor, had recently been recalled from the command in Germany, and sent into Pannonia to put down a dangerous revolt which had broken out against the Romans in that province. The German patriots were thus delivered from the stern supervision of one of the most suspicious of mankind, and were also relieved from having to contend against the high military talents of a veteran commander, who thoroughly understood their national character, and also the nature of the country, which he himself had principally subdued. In the room of Tiberius, Augustus sent into Germany, Quintilius Varus, who had lately returned from the proconsulate of Syria. Varus was a true representative of the higher classes of the Romans, among whom a general taste for literature, a keen susceptibility to all intellectual gratifications, a minute acquaintance with the principles and practice of their own national jurisprudence, a careful training in the schools of the rhetoricians and a fondness for either partaking in or watching the intellectual strife of forensic oratory, had become generally diffused, without, however, having humanized the old Roman spirit of cruel indifference for human feelings and human sufferings, and without acting as the least checks on unprincipled avarice and ambition, or on habitual and gross profligacy. Accustomed to govern the depraved and debased natives of Syria, a country where courage in man and virtue in woman had for centuries been unknown. Varus thought that he might gratify his licentious and rapacious passions with equal impunity among the high-minded sons and pure-spirited daughters of Germany. When the General of an army sets the example of outrages of this description, he is soon faithfully imitated by his officers, and surpassed by his still more brutal soldiery. The Romans now habitually indulged in those violations of the sanctity of the domestic shrine, and those insults upon honor and modesty, by which far less gallant spirits than those of our Teutonic ancestors have often been maddened into insurrection.

Arminius found among the other German Chiefs many who sympathized with him in his indignation at their country's abasement, and many whom private wrongs had stung yet more deeply. There was little difficulty in collecting bold leaders for an attack on the oppressors, and little fear of the population not rising readily at those leaders' call. But to declare open war against Rome, and to encounter Varus's army in a pitched battle, would have been merely rushing upon certain destruction. Varus had three legions under him, a force which, after allowing for detachments, cannot be estimated at less than fourteen thousand Roman infantry. He had also eight or nine hundred Roman cavalry, and at least an equal number of horse and foot sent from the allied states, or raised among those provincials who had not received the Roman franchise. It was not merely the number, but the quality of this force that made them formidable; and, however contemptible Varus might be as a General, Arminius well knew how admirably the Roman armies were organized and officered, and how perfectly the legionaries understood every maneuver and every duty which the varying emergencies of a stricken field might require. Stratagem was, therefore, indispensable; and it was necessary to blind Varus to their schemes until a favorable opportunity should arrive for striking a decisive blow.

For this purpose, the German confederates frequented the headquarters of Varus, which seem to have been near the center of the modern country of Westphalia, where the Roman General conducted himself with all the arrogant security of the governor of a perfectly submissive province. There Varus gratified at once his vanity, his rhetorical tastes, and his avarice, by holding courts, to which he summoned the Germans for the settlement of all their disputes, while a bar of Roman advocates attended to argue the cases before the tribunal of Varus, who did not omit the opportunity of exacting court-fees and accepting bribes. Varus trusted implicitly to the respect which the Germans pretended to pay to his abilities as a judge, and to the interest which they affected to take in the forensic eloquence of their conquerors. Meanwhile, a succession of heavy rains rendered the country more difficult for the operations of regular troops, and Arminius, seeing that the infatuation of Varus was complete, secretly directed the tribes near the Weser and the Ems to take up arms in open revolt against the Romans. This was represented to Varus as an occasion which required his prompt attendance at the spot; but he was kept in studied ignorance of its being part of a concerted national rising; and he still looked on Arminius as his submissive vassal, whose aid he might rely on in facilitating the march of his troops against the rebels, and in extinguishing the local disturbance. He therefore set his army in motion, and marched eastward in a line parallel to the course of the Lippe. For some distance his route lay along a level plain; but on arriving at the tract between the curve of the upper part of that stream and the sources of the Ems, the country assumes a very different character; and here, in the territory of the modern little principality of Lippe, it was that Arminius had fixed the scene of his enterprise. A woody and hilly region intervenes between the heads of the two rivers, and forms the watershed of their streams. This region still retains the name (Teutoberger = Teutobergiensis saltus) which it bore in the days of Arminius. The nature of the ground has probably also remained unaltered. The eastern part of it, round Detmold, the modern capital of the principality of Lippe, is described by a modern German scholar, Dr. Platte, as being a "tableland intersected by numerous deep and narrow valleys, which in some places form small plains, surrounded by steep mountains and rocks, and only accessible by narrow defiles. All the valleys are traversed by rapid streams, shallow in the dry season, but subject to sudden swellings in autumn and winter. The vast forests which cover the summits and slopes of the hills consist chiefly of oak; there is little underwood, and both men and horse would move with ease in the forests if the ground were not broken by gullys, or rendered impracticable by fallen trees." This is the district to which Varus is supposed to have marched; and Dr. Platte adds, that "the names of several localities on and near that spot seem to indicate that a great battle has once been fought there. We find the names 'das Winnefeld' (the field of victory), 'die Knochenbahn' (the bone-lane), 'die Knochenleke' (the bone-brook), 'der Mordkessel' (the kettle of slaughter), and others."

Contrary to the usual strict principles of Roman discipline, Varus had suffered his army to be accompanied and impeded by an immense train of baggage-wagons and by a rabble of camp followers, as if his troops had been merely changing their quarters in a friendly country. When the long army quitted the firm level ground, and began to wind its way among the woods, the marshes, and the ravines, the difficulties of the march, even without the intervention of an armed foe, became fearfully apparent. In many places, the soil, sodden with rain, was impracticable for cavalry, and even for infantry, until trees had been felled, and a rude causeway formed through the morass. The duties of the engineer were familiar to all who served in the Roman armies. But the crowd and confusion of the columns embarrassed the working parties of the soldiery, and in the midst of their toil and disorder the word was suddenly passed through their ranks that the rear guard was attacked by the barbarians. Varus resolved on pressing forward; but a heavy discharge of missiles from the woods on either flank taught him how serious was the peril, and he saw his best men falling round him without the opportunity of retaliation; for his light-armed auxiliaries, who were principally of Germanic race, now rapidly deserted, and it was impossible to deploy the legionaries on such broken ground for a charge against the enemy. Choosing one of the most open and firm spots which they could force their way to, the Romans halted for the night; and, faithful to their national discipline and tactics, formed their camp amid the harassing attacks of the rapidly thronging foes, with elaborate toil and systematic skill, the traces of which are impressed permanently on the soil of so many European countries, attesting the presence in the olden time of the imperial eagles.

On the morrow the Romans renewed their march, the veteran officers who served under Varus now probably directing the operations, and hoping to find the Germans drawn up to meet them, in which case they relied on their own superior discipline and tactics for such a victory as should reassure the supremacy of Rome. But Arminius was far too sage a commander to lead on his followers, with their unwieldy broadswords and inefficient defensive armor, against the Roman legionaries, fully armed with helmet, cuirass, greaves, and shield, who were skilled to commence the conflict with a murderous volley of javelins, hurled upon the foe when a few yards distant, and then, with their short cut-and-thrust swords, to hew their way through all opposition, preserving the utmost steadiness and coolness, and obeying each word of command in the midst of strife and slaughter with the same precision and alertness as if upon parade. Arminius suffered the Romans to march out from their camp, to form first in line for action, and then in column for marching, without the show of opposition. For some distance Varus was allowed to move on, only harassed by slight skirmishes, but struggling with difficulty through the broken ground, the toil and distress of his men being aggravated by heavy torrents of rain, which burst upon the devoted legions, as if the angry gods of Germany were pouring out the vials of their wrath upon the invaders. After some little time their van approached a ridge of high woody ground, which is one of the offshoots of the great Hercynian forest, and is situated between the modern villages of Driburg and Bielefeld. Arminius had caused barricades of hewn trees to be formed here, so as to add to the natural difficulties of the passage. Fatigue and discouragement now began to betray themselves in the Roman ranks. Their line became less steady; baggage-wagons were abandoned from the impossibility of forcing them along; and, as this happened, many soldiers left their ranks and crowded round the wagons to secure the most valuable portions of their property; each was busy about his own affairs, and purposely slow in hearing the word of command from his officers. Arminius now gave the signal for a general attack. The fierce shouts of the Germans pealed through the gloom of the forests, and in thronging multitudes they assailed the ranks of the invaders, pouring in clouds of darts on the encumbered legionaries, as they struggled up the glens or floundered in the morasses, and watching every opportunity of charging through the intervals of the disjointed column, and so cutting off the communication between its several brigades. Arminius, with a chosen band of personal retainers round him, cheered on his countrymen by voice and example. He and his men aimed their weapons particularly at the horses of the Roman cavalry. The wounded animals, slipping about in the mire and their own blood, threw their riders and plunged among the ranks of the legions, disordering all around them. Varus now ordered the troops to be countermarched, in the hope of reaching the nearest Roman garrison on the Lippe. But retreat now was as impracticable as advance; and the falling back of the Romans only augmented the courage of their assailants, and caused fiercer and more frequent charges on the flanks of the disheartened army. The Roman officer who commanded the cavalry, Numonius Vala, rode off with his squadrons in the vain hope of escaping by thus abandoning his comrades. Unable to keep together or force their way across the woods and swamps, the horsemen were overpowered in detail, and slaughtered to the last man. The Roman infantry still held together and resisted, but more through the instinct of discipline and bravery than from any hope of success or escape. Varus, after being severely wounded in a charge of the Germans against his part of the column, committed suicide to avoid falling into the hands of those whom he had exasperated by his oppressions. One of the Lieutenant-generals of the army fell fighting; the other surrendered to the enemy. But mercy to a fallen foe had never been a Roman virtue, and those among her legions who now laid down their arms in hope of quarter, drank deep of the cup of suffering which Rome had held to the lips of many a brave but unfortunate enemy. The infuriated Germans slaughtered their oppressors with deliberate ferocity, and those prisoners who were not hewn to pieces on the spot were only preserved to perish by a more cruel death in cold blood.

The bulk of the Roman army fought steadily and stubbornly, frequently repelling the masses of the assailants, but gradually losing the compactness of their array, and becoming weaker and weaker beneath the incessant shower of darts and the reiterated assaults of the vigorous and unencumbered Germans. At last, in a series of desperate attacks, the column was pierced through and through, two of the eagles captured, and the Roman host, which on the yester morning had marched forth in such pride and might, now broken up into confused fragments, either fell fighting beneath the overpowering numbers of the enemy, or perished in the swamps and woods in unavailing efforts at flight. Few, very few, ever saw again the left bank of the Rhine. One body of veterans, arraying themselves in a ring on a little mound, beat off every charge of the Germans, and prolonged their honorable resistance to the close of that dreadful day. The traces of a feeble attempt at forming a ditch and mound attested in after years the spot where the last of the Romans passed their night of suffering and despair. But on the morrow, this remnant also, worn out with hunger, wounds, and toil, was charged by the victorious Germans, and either massacred on the spot, or offered up in fearful rites at the altars of the deities of the old mythology of the North. A gorge in the mountain ridge, through which runs the modern road between Paderborn and Pyrmont, leads from the spot where the heat of the battle raged to the Externsteine, a cluster of bold and grotesque rocks of sandstone, near which is a small sheet of water, overshadowed by a grove of aged trees. According to local tradition, this was one of the sacred groves of the ancient Germans, and it was here that the Roman captives were slain in sacrifice by the victorious warriors of Arminius. Never was victory more decisive, never was the liberation of an oppressed people more instantaneous and complete. Throughout Germany the Roman garrisons were assailed and cut off; and, within a few weeks after Varus had fallen, the German soil was freed from the foot of an invader.

At Rome the tidings of the battle were received with an agony of terror, the reports of which we should deem exaggerated, did they not come from Roman historians themselves. They not only tell emphatically how great was the awe which the Romans felt of the prowess of the Germans, if their various tribes could be brought to unite for a common purpose, but also they reveal how weakened and debased the population of Italy had become. Dion Cassius says (lib. lvi., sec. 23), "Then Augustus, when he heard the calamity of Varus, rent his garment, and was in great affliction for the troops he had lost, and for terror respecting the Germans and the Gauls. And his chief alarm was, that he expected them to push on against Italy and Rome; and there remained no Roman youth fit for military duty that were worth speaking of, and the allied populations that were at all serviceable had been wasted away. Yet he prepared for the emergency as well as his means allowed, and when none of the citizens of military age were willing to enlist, he made them cast lots, and punished by confiscation of goods and disfranchisement every fifth man among those under thirty-five, and every tenth man of those above that age. At last, when he found that not even thus could he make many come forward, he put some of them to death. So he made a conscription of discharged veterans and of emancipated slaves, and, collecting as large a force as he could, sent it, under Tiberius, with all speed into Germany."

Dion mentions, also, a number of terrific portents that were believed to have occurred at the time, and the narration of which is not immaterial, as it shows the state of the public mind, when such things were so believed in and so interpreted. The summit of the Alps were said to have fallen, and three columns of fire to have blazed up from them. In the Campus Martius, the temple of the war-god, from whom the founder of Rome had sprung, was struck by a thunder-bolt. The nightly heavens glowed several times, as if on fire. Many comets blazed forth together; and fiery meteors, shaped like spears, had shot from the northern quarter of the sky down into the Roman camps. It was said, too, that a statue of Victory which had stood at a place on the frontier, pointing the way toward Germany, had of its own accord turned round, and now pointed to Italy. These and other prodigies were believed by the multitude to accompany the slaughter of Varus's legions, and to manifest the anger of the gods against Rome. Augustus himself was not free from superstition: but on this occasion no supernatural terrors were needed to increase the alarm and grief that he felt, and which made him, even months after the news of the battle had arrived, often beat his head against the wall, and exclaim, "Quintilius Varus, give me back my legions." We learn this from his biographer Suetonius; and, indeed, every ancient writer who alludes to the overthrow of Varus attests the importance of the blow against the Roman power, and the bitterness with which it was felt. The Germans did not pursue their victory beyond their own territory; but that victory secured at once and forever the independence of the Teutonic race. Rome sent, indeed, her legions again into Germany, to parade a temporary superiority, but all hopes of permanent conquests were abandoned by Augustus and his successors. The strong blow which Arminius had struck never was forgotten. Roman fear disguised itself under the specious title of moderation, and the Rhine became the acknowledged boundary of the two nations until the fifth century of the present era when the Germans became the assailants, and carved with their conquering swords the provinces of imperial Rome into the kingdoms of modern Europe.

It will be interesting in this connection to append a brief account of that civil war in which Cæsar and Pompey contended for the mastery over Rome and the Republic. In his first Commentary Cæsar recorded his campaigns in Gaul,—campaigns in which he reduced tribes which were, if not hostile, at any rate foreign, and by his success in which he carried on and maintained the potency, traditions and purport of the Roman Republic. It was the ambition of the Roman to be master of the known world. In his ideas no more of the world was really known than had become Roman, and any extension to the limits of this world could only be made by the addition of so-called barbarous tribes to the number of Roman subjects. In reducing Gaul, therefore, and in fighting with the Germans, and going over to Britain, Cæsar was doing that which all good Romans wished to see done, and was rivaling in the West the great deeds which Pompey had accomplished in the East. In his second Commentary he is forced to deal with a subject which must have been less gratifying to Roman readers. He relates to us the victories which he won with Roman legions over other legions equally Roman, and by which he succeeded in destroying the liberty of the Republic. It must be acknowledged on Cæsar's behalf that in truth liberty had fallen in Rome before Cæsar's time. Power had produced wealth, and wealth had produced corruption. The tribes of Rome were bought and sold at the various elections, and a few great oligarchs, either of this faction or of that, divided among themselves the places of trust and honor and power, and did so with hands ever open for the grasping of public wealth. An honest man with clean hands and a conscience, with scruples and a love of country, became unfitted for public employment. Cato in these days was simply ridiculous; and even Cicero, though he was a trimmer, was much too honest for the times. Laws were wrested from their purposes, and the very Tribunes of the people had become the worst of tyrants. It was necessary, perhaps, that there should be a master;—so at least Cæsar thought. He had, no doubt, seen this necessity during all these years of fighting in Gaul, and had resolved that he would not be less than First in the new order of things. So he crossed the Rubicon.

The reader of this second Commentary will find it less alluring than the first. There is less in it of adventure, less of new strange life, and less of that sound, healthy, joyous feeling which sprang from a thorough conviction on Cæsar's part that in crushing the Gauls he was doing a thoroughly good thing. To us, and our way of thinking, his doings in Gaul were stained with terrible cruelty. To him and to his Romans they were foul with no such stain. How other Roman conquerors acted to other conquered people we may learn from the fact, that Cæsar obtained a character for great mercy by his forbearance in Gaul. He always writes as though he were free from any sting of conscience, as he tells us of the punishments which policy called on him to inflict. But as he writes of these civil wars, there is an absence of this feeling of perfect self-satisfaction, and at the same time he is much less cruel. Hecatombs of Gauls, whether men or women, or children, he could see burned or drowned or starved, mutilated or tortured, without a shudder. He could give the command for such operations with less remorse than we feel when we order the destruction of a litter of undesirable puppies. But he could not bring himself to slay Roman legionaries, even in fair fighting, with anything like self-satisfaction. In this he was either soft-hearted or had a more thorough feeling of country than generals or soldiers who have fought in civil contests since his time have shown. In the Wars of the Roses and in those of Cromwell we recognize no such feeling. The American Generals were not so restrained. But Cæsar seems to have valued a Roman legionary more than a tribe of Gauls.

Nevertheless he crossed the Rubicon. We have all heard of his crossing of the Rubicon, but Cæsar says nothing about it. The Rubicon was a little river, now almost if not altogether unknown, running into the Adriatic between Ravenna and Ariminum—Rimini,—and driving the provinces of so-called Cisalpine Gaul from the territory under the immediate rule of the magistracy of Rome. Cæsar was, so to say, at home north of the Rubicon. He was in his own province, and had all things under his command. But he was forbidden by the laws even to enter the territory of Rome proper while in the command of a Roman province: and therefore, in crossing the Rubicon, he disobeyed the laws, and put himself in opposition to the constituted authorities of the city. It does not appear, however, that very much was thought of this, or that the passage of the river was in truth taken as the special sign of Cæsar's purpose, or as a deed that was irrevocable in its consequences. There are various pretty stories of Cæsar's hesitation as he stood on the brink of the river, doubting whether he would plunge the world into civil war. We are told how a spirit appeared to him and led him across the river with martial music, and how Cæsar, declaring that the die was cast, went on and crossed the fatal stream. But all this was fable, invented on Cæsar's behalf by Romans who came after Cæsar. Cæsar's purpose was, no doubt, well understood when he brought one of his legions down into that corner of his province, but offers to treat with him on friendly terms were made by Pompey and his party after he had established himself on the Roman side of the river.

When the civil war began, Cæsar had still, according to the assignment made to him, two years and a half left of his alloted period of government in the three provinces; but his victories and his power had been watched with anxious eyes from Rome and the Senate had attempted to decree that he should be recalled. Pompey was no longer Cæsar's friend, nor did Cæsar expect his friendship. Pompey, who had lately played his cards but badly, and must have felt that he had played them badly, had been freed from his bondage to Cæsar by the death of Crassus, the third triumvir, by the death of Julia, Cæsar's daughter, and by the course of things in Rome. It had been an unnatural alliance arranged by Cæsar with the sole view of clipping his rival's wings. The fortunes of Pompey had hitherto been so bright, that he also had seemed to be divine. While still a boy, he had commanded and conquered, women had adored him, and soldiers had worshipped him. Sulla had called him the Great; and, as we are told, had raised his hat to him in token of honor. He had been allowed the glory of a triumph while yet a youth, and had triumphed a second time before he had reached middle life. He had triumphed again a third time, and the three triumphs had been won in the three quarters of the globe. In all things he had been successful, and in all things happy. He had driven the swarming pirates from every harbor in the Mediterranean, and had filled Rome with corn. He had returned a conqueror with his legions from the East, and had dared to disband them, that he might live again as a private citizen. And after that, when it was thought necessary that the city should be saved, in her need, from the factions of her own citizens, he had been made sole Consul. It is easier now to understand the character of Pompey than the position which, by his unvaried successes, he had made for himself in the minds both of the nobles and of the people. Even up to this time, even after Cæsar's wars in Gaul, there was something of divinity hanging about Pompey, in which the Romans of the city trusted. He had been imperious, but calm in manner and self-possessed—allowing no one to be his equal, but not impatient in making good his claims; grand, handsome, lavish when policy required it, rapacious when much needed, never self-indulgent, heartless, false, politic, ambitious, very brave, and a Roman to the backbone. But he had this failing, this weakness;—when the time for the last struggle came, he did not quite know what it was that he desired to do; he did not clearly see his future. The things to be done were so great, that he had not ceased to doubt concerning them when the moment came in which doubt was fatal. Cæsar saw it all, and never doubted. That little tale of Cæsar standing on the bridge over the Rubicon pondering as to his future course, —divided between obedience and rebellion, it is very pretty. But there was no such pondering, and no such division. Cæsar knew very well what he meant and what he wanted.

Cæsar is full of his wrongs as he begins his second narrative. He tells us how his own friends are silenced in the Senate and in the city; how his enemies, Scipio, Cato, and Lentulus the Consul, prevail; how no one is allowed to say a word for him. "Pompey himself," he says, "urged on by the enemies of Cæsar, and because he was unwilling that any one should equal himself in honor, had turned himself altogether from Cæsar's friendship, and had gone back to the fellowship of their common enemies,—enemies whom he himself had created for Cæsar during the time of their alliance. At the same time conscious of the scandal of these two legions which he had stopped on their destined road to Asia and Syria and taken into his own hand, he was anxious that the question should be referred to arms." Those two legions are very grievous to Cæsar. One was the legion which, as we remember, Pompey had given up to friendship,—and the Republic. When, in the beginning of these contests between the two rivals, the Senate had decided on weakening each by demanding from each a legion, Pompey had asked Cæsar for the restitution of that which he had so kindly lent. Cæsar, too proud to refuse payment of the debt, had sent that to his former friend, and had also sent another legion, as demanded to the Senate. They were required nominally for service in the East, and now were in the hands of him who had been Cæsar's friend but had become his enemy. It is no wonder that Cæsar talks of the infamy or scandal of the two legions! He repeats his complaint as to the two legions again and again.

In the month of January Cæsar was at Ravenna, just north of the Rubicon, and in his own province. Messages pass between him and the Senate, and he proposes his terms. The Senate also proposes its terms. He must lay down his arms, or he will be esteemed an enemy by the Republic. All Rome is disturbed. The account is Cæsar's account but we imagine that Rome was disturbed. "Soldiers are recruited over all Italy; arms are demanded, taxes are levied on the municipalities, and money is taken from the sacred shrines; all laws divine and human are disregarded." Then Cæsar complains to his soldiers his wrongs, and the crimes of Pompey. He tells them how they, under his guidance, have been victorious, how under him they have "pacified" all Gaul and Germany, and he calls upon them to defend him who has enabled them to do such great things. He has but one legion with him, but that legion declares that it will obey him, him and the Tribunes of the people, some of whom, acting on Cæsar's side, have come over from Rome to Ravenna. We can appreciate the spirit of this allusion to the Tribunes, so that there may seem to be still some link between Cæsar and the civic authorities. When the soldiers have expressed their goodwill, he goes to Ariminum, and so the Rubicon is passed.

There are still more messages. Cæsar expresses himself as greatly grieved that he should be subjected to so much suspense, nevertheless he is willing to suffer anything for the Republic; "omnia pati reipublicæ causâ." Only let Pompey go to his province, let the legions in and about Rome be disbanded, let all the old forms of free government be restored, and panic be abolished, and then,—when that is done,—all difficulties may be settled in a few minutes' talking. The Consuls and Pompey send back word that if Cæsar will go back into Gaul and dismiss his army, Pompey shall go at once to Spain. But Pompey and the Consuls with their troops will not stir till Cæsar shall have given security for his departure. Each demands that the other shall first abandon his position. Of course all these messages mean nothing. Cæsar, complaining bitterly of injustice, sends a portion of his small army still farther into the Roman territory. Marc Antony goes to Arezzo with five cohorts, and Cæsar occupies three other cities with a cohort each. The marvel is that he was not attacked and driven back by Pompey. We may probably conclude that the soldiers, though under the command of Pompey, were not trustworthy as against Cæsar. As Cæsar regrets his two legions, so no doubt do the two legions regret their commander. At any rate, the consular forces with Pompey and the Consuls and a host of Senators retreat southwards to Brundusium, Brindisi, intending to leave Italy by the port which we shall use before long when we go eastwards.

During this retreat, the first blood in the civil war is spilt at Corfinium, a town which if it now stood at all, would stand in the Abbruzzi. Cæsar there is victor in a small engagement, and obtains possession of the town. The Pompeian officers whom he finds there he sends away, and allows them even to carry with them money which he believes to have been taken from the public treasury. Throughout his route southward the soldiers of Pompey, who had heretofore been his soldiers,—return to him. Pompey and the Consuls still retreat, and still Cæsar follows them, though Pompey had boasted, when first warned to beware of Cæsar, that he had only to stamp upon Italian soil and legions would arise from the earth ready to obey him. He knows, however, that away from Rome, in her provinces, in Macedonia and Achaia, in Asia and Cilicia, in Sicily, Sardinia, and Africa, in Mauritania and the two Spains, there are Roman legions which as yet know no Cæsar. It may be better for Pompey that he should stamp his foot somewhere out of Italy. At any rate he sends the obedient Consuls and his attendant Senators over to Dyrrachium in Illyria with a part of his army, and follows with the remainder as soon as Cæsar is at his heels. Cæsar makes an effort to intercept him and his fleet, but in that he fails. Thus Pompey deserts Rome and Italy,—and never again sees the imperial city or the fair land.

Cæsar explains to us why he does not follow his enemy and endeavor at once to put an end to the struggle. Pompey is provided with shipping and he is not; and he is aware that the force of Rome lies in her provinces. Moreover, Rome may be starved by Pompey, unless he, Cæsar, can take care that the corn-growing countries, which are the granaries of Rome, are left free for the use of the city. He must make sure of the two Gauls, and of Sardinia, and of Sicily, of Africa too, if it may be possible. He must win to his cause the two Spains, of which at least the northern province was at present devoted to Pompey. He sends one Lieutenant to Sardinia with a legion, another to Sicily with three legions, and from Sicily over into Africa. These provinces have been allotted to partisans of Pompey; but Cæsar is successful with them all. To Cato, the virtuous man, had been assigned the government of Sicily; but Cato finds no Pompeian army ready for his use, and, complaining bitterly that he has been deceived and betrayed by the head of his faction, runs away, and leaves his province to Cæsar's officers. Cæsar determines that he himself will carry the war into Spain. But he found it necessary first to go to Rome, and Cæsar, in his account of what he did there, hardly tells us the whole truth. We quite go along with him when he explains to us that, having collected what sort of a Senate he could,—for Pompey had taken away with him such Senators as he could induce to follow him,—and having proposed to this meagre Senate that ambassadors should be sent to Pompey, the Senate accepted his suggestion; but that nobody could be induced to go on such an errand. Pompey had already declared that all who remained in Rome were his enemies. And it may probably be true that Cæsar, as he says, found a certain Tribune of the people at Rome who opposed him in all that he was doing, though we should imagine that the opposition was not violent. But his real object in going to Rome was to lay hand on the treasure of the Republic,— the sanctius ærarium,— which was kept in the temple of Saturn for special emergencies of State. That he should have taken this we do not wonder; but we do wonder that he should have taken the trouble to say that he did not do so. He professes that he was so hindered by that vexatious Tribune, that he could not accomplish the purposes for which he had come. But he certainly did take the money, and we cannot doubt but that he went to Rome especially to get it. Cæsar, on his way to Spain, goes to Marseilles which, under the name of Massilia, was at this time, as it is now, the most thriving mercantile port on the Mediterranean. It belonged to the province of Further Gaul, but it was in fact a colony of Greek traders. Its possession was now necessary to Cæsar. The magistrates of the town, when called upon for their adhesion, gave a most sensible answer. They protest that they are very fond of Cæsar, and very fond of Pompey. They don't understand all these affairs of Rome, and regret that two such excellent men should quarrel. In the mean time they prefer to hold their own town. Cæsar speaks of this decision as an injury to himself, and is instigated by such wrongs against him to besiege the city, which he does both by land and sea, leaving officers there for the purpose, and going on himself to Spain.

At this time all Spain was held by three officers, devoted to the cause of Pompey, though, from what has gone before, it is clear that Cæsar fears nothing from the south. Afranius commanded in the north and east, holding the southern spurs of the Pyrenees. Petreius, who was stationed in Lusitania, in the southwest, according to the agreement, hurries up to the assistance of Afranius as soon as Cæsar approaches. The Pompeian and Cæsarean armies are brought into close quarters in the neighborhood of Ilerda (Lerida), on the little river Sicoris, or Segre, which runs into the Ebro. They are near the mountains here, and the nature of the fighting is controlled by the rapidity and size of the rivers, and the inequality of the ground. Cæsar describes the campaign with great minuteness, imparting to it a wonderful interest by the clearness of his narrative. Afranius and Petreius hold the town of Ilerda, which is full of provisions. Cæsar is very much pressed by want, as the corn and grass have not yet grown, and the country supplies of the former year are almost exhausted. So great are his difficulties, that tidings reach Rome that Afranius has conquered him. Hearing this, many who were still clinging to the city, doubtful as to the side they would take, go away to Pompey. But Cæsar at lasts manages to make Ilerda too hot for the Pompeian Generals. He takes his army over one river in coracles, such as he had seen in Britain; he turns the course of another; fords a third, breaking the course of the stream by the bulk of his horses; and bridges a fourth. Afranius and Petreius find that they must leave Ilerda, and escape over the Ebro among the half-barbarous tribe further south, and make their way, if possible, among the Celtibri,—getting out of Aragon into Castile, as the division was made in after-ages. Cæsar gives us as one reason for this intended march on the part of his enemies, that Pompey was well known by these tribes, but that the name of Cæsar was a name as yet obscure to the barbarians. It was not, however, easy for Afranius to pass over the Ebro without Cæsar's leave, and Cæsar will by no means give him leave. He intercepts the Pompeians, and now turns upon them that terrible engine of want from which he had suffered so much. He continues so to drive them about, still north of the Ebro, that they can get at no water; and at last they are compelled to surrender. During the latter days of this contest the Afranians, as they are called—Roman legionaries, as are the soldiers of Cæsar—fraternize with their brethren in Cæsar's camp, and there is something of free intercourse between the two Roman armies. The upshot is that the soldiers of Afranius resolve to give themselves up to Cæsar, bargaining, however, that their own Generals shall be secure. Afranius is willing enough; but his brother-general, Petreius, with more of the Roman at heart, will not hear of it. We shall hear hereafter the strange fate of this Petreius. He stops the conspiracy with energy, and forces from his own men, and even from Afranius, an oath against surrender. He orders that all Cæsars's soldiers found in their camp shall be killed, and, as Cæsar tells us, brings back the affair to the old form of war. But it is all of no avail. The Afranians are so driven by the want of water, that the two Generals are at last compelled to capitulate and lay down their arms. Five words which are used by Cæsar in the description of this affair give us a strong instance of his conciseness in the use of words, and of the capability for conciseness which the Latin language affords. "Premebantur Afraniani pabulatione, aquabantur ægra." "The soldiers of Afranius were much distressed in the matter of forage, and could obtain water only with great difficulty." These twenty words translate those five which Cæsar uses, perhaps with fair accuracy; but many more than twenty would probably have been used by any English historian in dealing with the same facts.

Cæsar treats his compatriots with the utmost generosity. So many conquered Gauls he would have sold as slaves, slaughtering their leaders, or he would have cut off their hands, or have driven them down upon the river and have allowed them to perish in the waters. But his conquered foes are Roman soldiers, and he simply demands that the army of Afranius shall be disbanded, and that the leaders of it shall go, whither they please. He makes them a speech in which he explains how badly they have treated him. Nevertheless he will hurt no one. He has borne it all, and will bear it, patiently. Let the Generals only leave the Province, and let the army which they have led be disbanded. He will not keep a soldier who does not wish to stay with him, and will even pay those whom Afranius has been unable to pay out of his own funds. Those who have houses and land in Spain may remain there. Those who have none he will first feed, and afterwards take back, if not to Italy, at any rate to the borders of Italy. The property which his own soldiers have taken from them in the chances of war shall be returned to them, and he out of his own pocket will compensate his own men. He performs his promise, and takes all those who do not choose to remain, to the banks of the Var, which divides the Province from Italy, and there sets them down, full, no doubt, of gratitude to their conqueror. Never was there such clemency, or we may say, better policy! Cæsar's whole campaign in Spain had occupied him only forty days. In the mean time Decimus Brutus, to whom we remember that Cæsar had given the command of the ships which he prepared against the Veneti in the west of Gaul, and who was hereafter to be one of those who slew him in the Capitol, obtains a naval victory over the much more numerous fleet of the Massilians. They had prepared seventeen big ships, "naves longæ" they are called by Cæsar, and of these Brutus either destroys or takes nine. In his next book Cæsar proceeds to tell us how things went on at Marseilles both by sea and land after this affair.

In his chronicle of the Gallic war, Cæsar in each book completed the narrative of a year's campaign. In treating of the civil war he devotes the first and second books to the doings of one year. There are three distinct episodes of the year's campaign narrated in the second;—the taking of Marseilles, the subjugation of the southern province of Spain,—if that can be said to be subjugated which gave itself very readily,—and the destruction of a Roman army in Africa under the hands of a barbarian king. But of all Cæsar's writings it is perhaps the least interesting, as it tells us but little of what Cæsar did himself,—and in fact contains chiefly Cæsar's records of the doings of his Lieutenants by sea and land. He begins by telling us of the enormous exertions made both by the besiegers and by the besieged at Massilia which town was now held by Domitius on the part of Pompey,—to supplement whom at sea a certain Nasidius was sent with a large fleet. Young Brutus, as will be remembered, was attacking the harbor on behalf of Cæsar, and had already obtained a victory over the Massilians before Nasidius came up; and Trebonius, also on the part of Cæsar, was besieging the town from the land. This Decimus Brutus was one of those conspirators who afterwards conspired against Cæsar and slew him,—and Trebonius was another of the number. The wise Greeks of the city,—more wise than fortunate, however,—had explained to Cæsar when he first expressed his wish to have the town on his side, that really to them there was no difference between Pompey and Cæsar, both of whom they loved with all their hearts,—but they had been compelled to become partisans of Pompey, the Pompeian General, Domitius, being the first to enter their town; and now they find themselves obliged to fight as Pompeians in defence of their wealth and their homes. Thus driven by necessity, they fight well and do their very best to favor the side which we must henceforward call that of the Republic as against an autocrat;—for, during this siege of Marseilles, Cæsar had been appointed Dictator, and a law to that effect had been passed at Rome, where the passing of such a law was no doubt easy enough in the absence of Pompey, of the Consuls, and of all the Senators who were Pompey's friends.

The Massilians had now chosen their side, and they do their very best. We are told that the Cæsarean troops, from the very high ground on which Trebonius had placed his camp, could look down into the town, and see "how all the youth who had been left in the city, and all the elders with their children and wives, and the sentinels of the city, either stretched their hands to heaven from the walls, or, entering the temples of the immortal gods, and throwing themselves before their sacred images, prayed that the heavenly powers would give them victory. Nor was there one among them who did not believe that on the result of that day depended all that they had," namely, liberty, property and life; for the Massilians, doubtless, had heard of Avaricum, of Alesia, and of Uxellodunum. "When the battle was begun," says Cæsar, "the Massilians failed not in valor; but, mindful of the lessons they had just received from their townsmen, fought with the belief that the present was their only opportunity of doing aught for their own preservation; and that to those who should fall in battle, loss of life would only come a little sooner than to the others, who would have to undergo the same fate, should the city be taken." Cæsar, as he wrote this, doubtless thought of what he had done in Gaul when policy demanded from him an extremity of cruelty; and, so writing, he enhanced the clemency with which, as he is about to tell us, he afterwards treated the Massilians. When the time came it did not suit him to depopulate a rich town, the trade of whose merchants was beneficial both to Rome and to the Province. He is about to tell us of his mercy, and therefore explains to us beforehand how little was mercy expected from him. We feel that every line he writes is weighed, though the time for such weighing must have been very short with one whose hands were so full as were always the hands of Cæsar.

Nasidius, whom we may call Pompey's Admiral, was of no use at all. The Massilians, tempted by his coming, attack bravely the ship which bears the flag of young Brutus; but young Brutus is too quick for them, and the unhappy Massilians run two of their biggest vessels against each other in their endeavor to pin that of the Cæsarean Admiral between them. The Massilian fleet is utterly dispersed. Five are sunk, four are taken; one gets off with Nasidius, who runs away, making no effort to fight; who has been sent there,—so Cæsar hints,—by Pompey, not to give assistance, but only to pretend to give assistance. One ship gets back into the harbor with the sad tidings; and the Massilians—despairing only for a moment at the first blush of the bad news—determine that their walls may still be defended. The town was very well supplied with such things as were needed for defence, the people being a provident people, well instructed and civilized, with means at their command. We are told of great poles twelve feet long, with sharp iron heads to them, which the besiegers could throw with such force from the engines on their walls as to drive them through four tiers of the wicked crates or stationary shields which the Cæsareans built up for their protection,—believing that no force could drive a weapon through them. As we read of this we cannot but think of Armstrong and Whitfield guns, and iron plates, and granite batteries, and earthworks. These terrible darts, thrown from "balistæ," are very sore upon the Cæsareans; they therefore contrive an immense tower, so high that it cannot be reached by any weapon, so built that no wood or material subject to fire shall be on the outside,—which they erect story by story, of very great strength. And as they raise this step by step, each story is secured against fire and against the enemy. The reader,—probably not an engineer himself,—is disposed to think as he struggles through this minute description of the erection which Cæsar gives, and endeavors to realize the way in which it is done, that Cæsar must himself have served specially as an engineer. But in truth he was not at this siege himself, and had nothing to do with the planning of the tower, and must in this instance at least have got a written description from his officer,—as he probably did before when he built the memorable bridge over the Rhine. And when the tower is finished, they make a long covered-way or shed,—musculum or muscle Cæsar calls it: and with this they form for themselves a passage from the big tower to a special point in the walls of the town. This muscle is so strong with its sloping roof that nothing thrown upon it will break or burn it. The Massilians try tubs of flaming pitch, and great fragments of rock; but these simply slip to the ground, and are pulled away with long poles and forks. And the Cæsareans, from the height of their great tower, have so terrible an advantage! The Massilians cannot defend their wall, and a breach is made, or almost made.

The Massilians can do no more. The very gods are against them. So they put on the habit of suppliants, and go forth to the conquerors. They will give their city to Cæsar. Cæsar is expected. Will Trebonius be so very good as to wait until Cæsar comes? If Trebonius should proceed with his work so that the soldiers should absolutely get into the town, then—Trebonius knows very well what would happen then. A little delay cannot hurt. Nothing shall be done till Cæsar comes. As it happens, Cæsar has already especially ordered that the city shall be spared; and a kind of truce is made, to endure till Cæsar shall come and take possession. Trebonius has a difficulty in keeping his soldiers from the plunder; but he does restrain them, and besiegers and besieged are at rest, and wait for Cæsar. But these Massilians are a crafty people. The Cæsarean soldiers, having agreed to wait, take it easily, and simply amuse themselves in these days of waiting. When they are quite off their guard, and a high wind favors the scheme, the Massilians rush out and succeed in burning the tower, and the muscle, and the rampart, and the sheds, and all the implements. Even though the tower was built with brick, it burns freely—so great is the wind. Then Trebonius goes to work, and does it all again. Because there is no more wood left round about the camp, he makes a rampart of a new kind—hitherto unheard of—with bricks. Doubtless the Cæsarean soldiers had first to make the bricks, and we can imagine what were their feelings in reference to the Massilians. But however that may be, they worked so well and so hard that the Massilians soon see that their late success is of no avail. Nothing is left to them. Neither perfidy nor valor can avail them, and now again they give themselves up. They are starved and suffering from pestilence, their fortifications are destroyed, they have no hope of aid from without—and now they give themselves up—intending no fraud. "*sese dedere sine fraude constituunt.*" Domitius, who is the Pompeian General, manages to escape in a ship. He starts with three ships, but the one in which he himself sails alone escapes the hands of "young" Brutus. Surely now will Marseilles be treated with worse treatment than that which fell on the Gaulish cities. But such is by no means Cæsar's will. Cæsar takes their public treasure and their ships, and reminding them that he spares them rather for their name and old character than for any merits of theirs shown towards him, leaves two legions among them, and goes to Rome. At Avaricum, when the Gauls had fought to defend their own liberties, he had destroyed everybody;—at Alesia he had decreed the death of every inhabitant when they had simply asked him leave to pass through his camp;—at Uxellodunum he had cut off the hands and poked out the eyes of Gauls who had dared to fight for their country. But the Gauls were barbarians whom it was necessary that Cæsar should pacify. The Massilians were Greeks, and a civilized people—and might be very useful.

Before coming on to Marseilles there had been a little more for Cæsar to do in Spain, where, as has been previously narrated, he had just compelled Afranius and Petreius to lay down their arms and disband their legions. Joined with them had been a third Pompeian General, one Varro—a truly distinguished man, though not, perhaps, a very great General—of whom Cæsar tells us that with his Roman policy he veered between Pompeian and Cæsarean tactics till, unfortunately for himself, he declared for Pompey and the wrong side, when he heard that Afranius was having his own way in the neighborhood of Lerida. But Varro is in the south of Spain, in Andalusia—or Bætica, as it was then called—and in this southern province of Spain it seems that Cæsar's cause was more popular than that of Pompey. Cæsar, at any rate, has but little difficulty with Varro. The Pompeian officer is deserted by his legions, and gives himself up very quickly. Cæsar does not care to tell us what he did with Varro, but we know that he treated his brother Roman with the utmost courtesy. Varro was a very learned man, and a friend of Cicero's, and one who wrote books, and was a credit to Rome as a man of letters if not as a General. We are told that he wrote 490 volumes, and that he lived to be eighty-eight—a fate very uncommon with Romans who meddled with public affairs in these days. Cæsar made everything smooth in the south of Spain, restoring the money and treasures which Varro had taken from the towns, and giving thanks to everybody. Then he went on over the Pyrenees to Marseilles, and made things smooth there.

But in the mean time things were not at all smooth in Africa. The name of Africa was at this time given to a small province belonging to the Republic, lying to the east of Numidia, in which Carthage had stood when Carthage was a city, containing that promontory which juts out toward Sicily, and having Utica as its Roman capital. It has been already said that when Cæsar determined to gain possession of certain provinces of the Republic before he followed Pompey across the Adriatic, he sent a Lieutenant with three legions into Sicily, desiring him to go on to Africa as soon as things should have been arranged in the island after the Cæsarean fashion. The Sicilian matter is not very troublesome, as Cato, the virtuous man, in whose hands the government of the island had been intrusted on behalf of the Republic, leaves it on the arrival of the Cæsarean legions, complaining bitterly of Pompey's conduct. Then Cæsar's Lieutenant goes over to Africa with two legions, as commanded, proposing to his army the expulsion of one Attius Varus, who had, according to Cæsar's story, taken irregular possession of the province, keeping it on behalf of Pompey, but not allowing the Governor appointed by the Republic so much as to put his foot on the shore. This Lieutenant was a great favorite of Cæsar, by name Curio, who had been elected Tribune of the people just when the Senate was making its attempt to recall Cæsar from his command in Gaul. In that emergency, Curio as Tribune had been of service to Cæsar, and Cæsar loved the young man. He was one of those who, though noble by birth, had flung themselves among the people, as Catiline had done and Clodius,—unsteady, turbulent, unscrupulous, vicious, needy, fond of pleasure, rapacious, but well educated, brave and clever. Cæsar himself had been such a man in his youth, and could easily forgive such faults in the character of one who, in addition to such virtues as have been named, possessed that farther and greater virtue of loving Cæsar. Cæsar expected great things from Curio, and trusted him thoroughly. Curio, with many ships and his two legions, lands in Africa, and prepares to win the province for his great friend. He does obtain some little advantage, so that he is called "Imperator" by his soldiers,—a name not given to a General till he has been victorious in the field; but it seems clear, from Cæsar's telling of the story, that Curio's own officers and own soldiers distrusted him, and were doubtful whether they would follow him, or would take possession of the ships and return to Sicily;—or would go over to Attius Varus, who had been their Commander in Italy before they had deserted from Pompey to Cæsar. A council of war is held, and there is much doubt. It is not only or chiefly of Attius Varus their Roman enemy, that they are afraid; but there is Juba in their neighborhood, the king of Numidia, who will certainly fight for Varus and against Curio. He is Pompey's declared friend, and equally declared as Cæsar's foe. He has, too, special grounds of quarrel against Curio himself; and if he comes in person with his army, bringing such an army as he can bring if he pleases, it will certainly go badly with Curio, should Curio be distant from his camp. Then Curio, not content with his council of war, and anxious that his soldiers should support him in his desire to fight, makes a speech to the legionaries. We must remember, of course, that Cæsar gives us the words of this speech, and that Cæsar must himself have put the words together.

It is begun in the third person. He,—that is Curio, —tells the men how useful they were to Cæsar at Corfinium, the town at which they went over from Pompey to Cæsar. But in the second sentence he breaks into the first person and puts the very words into Curio's mouth. "For you and your services," he says, "were copied by all the towns; nor is it without cause that Cæsar thinks kindly of you, and the Pompeians unkindly. For Pompey, having lost no battle, but driven by the result of your deed, fled from Italy. Me, whom Cæsar holds most dear, and Sicily and Africa without which he cannot hold Rome and Italy, Cæsar has intrusted to your honor. There are some who advise you to desert me,—for what can be more desirable to such men than that they at the same time should circumvent me, and fasten upon you a foul crime? . . . . But you,—have you not heard of the things done by Cæsar in Spain,—two armies beaten, two Generals conquered, two provinces gained, and all this done in forty days from that on which Cæsar first saw his enemy? Can those who, uninjured, were unable to stand against him, resist him now when they are conquered? And you, who followed Cæsar when victory on his side was uncertain, now that fortune has declared herself, will you go over to the conquered side when you are about to realize the reward of your zeal? . . . . But, perhaps though you love Cæsar, you distrust me. I will not say much of my own deserts towards you, —which are indeed less as yet than I had wished or you had expected." Then, having thus declared that he will not speak of himself, he does venture to say a few words on the subject. "But why should I pass over my own work, and the result that has been as yet achieved, and my own fortune in war? Is it displeasing to you that I brought over the whole army, safe, without losing a ship? That, as I came, at my first onslaught, I should have dispersed the fleet of the enemy? That, in two days, I should have been twice victorious with my cavalry; that I should have cut out two hundred transports from the enemy's harbor; that I should have so harassed the enemy that neither by land nor sea could they get food to supply their wants? Will it please you to repudiate such fortune and such guidance, and to connect yourself with the disgrace at Corfinium, the flight from Italy," namely, Pompey's flight to Dyrrachium, "the surrender of Spain, and the evils of this African war? I indeed have wished to be called Cæsar's soldier, and you have called me your Imperator. If it repents you of having done so, I give you back the compliment. Give me back my own name, lest it seem that in scorn you have called me by that title of honor." This is very spirited: and the merely rhetorical assertion by Cæsar that Curio thus spoke to his soldiers is in itself interesting, as showing us the way in which the legionaries were treated by their Commanders, and in which the greatest General, of that or of any age, thought it natural that a leader should address his troops. It is of value, also, as showing the difficulty of keeping any legion true to either side in a civil war, in which, on either side, the men must fight for a Commander they had learned to respect, and against a Commander they respected, the Commander in each case being a Roman Imperator. Curio, too, as we know, was a man who on such an occasion would use words. But that he used the words here put into his mouth, or any words like them, is very improbable. Cæsar was anxious to make the best apology he could for the gallant young friend who had perished in his cause, and has shown his love by making the man he loved memorable to all posterity.

But before the dark hour comes upon him the young man has a gleam of success, which had he really spoken the words put into his mouth by Cæsar, would have seemed to justify them. He attacks the army of his fellow-Roman, Varus, and beats it, driving it back into Utica. He then resolves to besiege the town, and Cæsar implies that he would have been successful through the Cæsarean sympathies of the townsmen, had it not been for the approach of the terrible Juba. Then comes a rumor which reaches Curio, and which reaches Varus too inside the town, that the Numidian King is hurrying to the scene with all his forces. He has finished another affair that he had on hand, and can now look to his Roman friends,—and to his Roman enemies. Juba craftily sends forward his Præfect, or Lieutenant, Sabura, with a small force of cavalry, and Curio is led to imagine that Juba has not come, and that Sabura has been sent with scanty aid to the relief of Varus. Surely he can give a good account of Sabura and that small body of Numidian horsemen. We see from the very first that Curio is doomed. Cæsar, in a few touching words, makes his apology. "The young man's youth had much to do with it, and his high spirit; his former success too, and his own faith in his own good fortune." There is no word of reproach. Curio makes another speech to his soldiers. "Hasten to your prey," he says, "hasten to your glory!" They do hasten,—after such a fashion that when the foremost of them reached Sabura's troops, the hindermost of them are scattered far back on the road. They are cut to pieces by Juba. Curio is invited by one of his officers to escape back to his tent. But Cæsar tells us that Curio in that last moment replied that having lost the army with which Cæsar had trusted him, he would never again look Cæsar in the face. That he did say some such words as these, and that they were repeated by that officer to Cæsar, is probable enough. "So fighting he is slain:"—and there is an end of the man whom Cæsar loved.

What then happened was very sad for a Roman army. Many hurry down to the ships at the sea; but there is so much terror, so much confusion, and things are so badly done, that but very few get over to Sicily. The remainder endeavor to give themselves up to Varus; after doing which, could they have done it, their position would not have been very bad. A Roman surrendering to a Roman would, at the worst, but find that he was compelled to change his party. But Juba comes up and claims them as his prey, and Varus does not dare to oppose the barbarian king. Juba kills the most of them, but sends a few, whom he thinks may serve his purpose and add to his glory, back to his own kingdom. In doing which Juba behaved no worse than Cæsar habitually behaved in Gaul; but Cæsar always writes as though not only a Roman must regard a Roman as more than a man, but as though also all others must so regard Romans. And by making such assertions in their own behalf, Romans were so regarded. We are then told that the barbarian King of Numidia rode into Utica triumphant, with Roman senators in his train; and the names of two special Roman Senators Cæsar sends down to posterity as having been among that base number. As far as we can spare them, they shall be spared.

Cæsar begins the last book of his last Commentary by telling us that this was the year in which he (Cæsar) was by the law permitted to name a Consul. He names Publius Servilius to act in conjunction with himself. The meaning of this is, that, as Cæsar had been created Dictator, Pompey having taken with him into Illyria the Consuls of the previous year. Cæsar was now the only magistrate under whose authority a Consul could be elected. No doubt he did choose the man, but the election was supposed to have been made in accordance with the form of the Republic. He remained at Rome as Dictator for eleven days, during which he made various laws, of which the chief object was to lessen the insecurity caused by the disruption of the ordinary course of things; and then he went down to Brindisi on the track of Pompey. He had twelve legions with him, but he was badly off for ships in which to transport them; and he owns that the health of the men is bad, an autumn in the south of Italy having been severe on men accustomed to the healthy climate of Gaul and the north of Spain. Pompey, he tells us, had had a whole year to prepare his army,—a whole year, without warfare, and had collected men and ships and money, and all that support which assent gives, from Asia and the Cyclades, from Corcyra, Athens, Bithynia, Cilicia, Phœnicia, Egypt, and the free states of Achaia. He had with him nine Roman legions, and is expecting two more with his father-in-law Scipio out of Syria. He has three thousand archers from Crete, from Sparta, and from Pontus; he has twelve hundred slingers, and he has seven thousand cavalry from Galatia, Cappadocia, and Thrace. A valorous Prince from Macedonia had brought him two hundred men, all mounted. Five hundred of Galatian and German cavalry, who had been left to overawe Ptolemy in Egypt, are brought to Pompey by the filial care of young Cnæus. He too had armed eight hundred of their own family retainers, and had brought them armed. Antiochus of Commagena sends him two hundred mounted archers,—mercenaries, however, not sent without promise of high payment. Dardani,—men from the land of old Troy, Bessi, from the banks of the Hebrus, Thessalians and Macedonians, have all been crowded together under Pompey's standard. We feel that Cæsar's mouth waters as he recounts them. But we feel also that he is preparing for the triumphant record in which he is about to tell us that all these swarms did he scatter to the winds of heaven with the handful of Roman legionaries which he at last succeeded in landing on the shores of Illyria. Pompey has also collected from all parts "frumenti vim maximam"—"a great power of corn indeed," as an Irishman would say, translating the words literally. And he has covered the seas with his ships, so as to hinder Cæsar from coming out of Italy. He has eight Vice-admirals to command his various fleets,—all of whom Cæsar names; and over them all as Admiral-in-Chief, is Bibulus, who was joint-consul with Cæsar before Cæsar went to Gaul, and who was so harassed during his Consulship by the Cæsareans that he shut himself up in his house, and allowed Cæsar to rule as sole Consul. Now he is about to take his revenge; but the vengeance of such an one as Bibulus cannot reach Cæsar.

Cæsar having led his legions to Brindisi, makes them a speech which almost beats in impudence anything that he ever said or did. He tells them that as they have now nearly finished all his work for him, they have only yet to lay low the Republic with Pompey the Great, and all the forces of the Republic—to which, however, have to be added King Ptolemy in Egypt, King Pharnaces in Asia, and King Juba in Numidia; they had better leave behind them at Brindisi all their little property, the spoils of former wars, so that they may pack the tighter in the boats in which he means to send them across to Illyria, if only they can escape the mercies of ex-Consul Admiral Bibulus. There is no suggestion that at any future time they will recover their property. For their future hopes they are to trust entirely to Cæsar's generosity. With one shout they declare their readiness to obey him. He takes over seven legions, escaping the dangers of those "rocks of evil fame," the Acroceraunia of which Horace tells us,—and escaping Bibulus also, who seems to have shut himself up in his ship as he did before in his house during the Consulship. Cæsar seems to have made the passage with the conviction that had he fallen into the hands of Bibulus everything would have been lost. And with ordinary precaution and diligence on the part of Bibulus such would have been eventually the result. Yet he makes the attempt—trusting to the Fortune of Cæsar and he succeeds. He lands at a place which he calls Palæste on the coast of Epirus, considerably to the south of Dyrrachium, in Illyria. At Dyrrachium Pompey had landed the year before, and there is now stored that wealth of provision of which Cæsar has spoken. But Bibulus at last determines to be active, and he does manage to fall upon the empty vessels which Cæsar sends back to fetch the remainder of his army. "Having come upon thirty of them, he falls upon them with all the wrath occasioned by his own want of circumspection and grief, and burns them. And in the same fire he kills the sailors and the masters of the vessels—hoping to deter others." Cæsar tells us, "by the severity of the punishment." After that we are not sorry to hear that he potters about on the seas very busy, but still incapable, and that he dies, as it seems, of a broken heart. He does indeed, catch one ship afterwards—not laden with soldiers, but coming on a private venture, with children, servants, and suchlike, dependants and followers of Cæsar's camp. All these, including the children, Bibulus slaughters, down to the smallest child. We have, however, to remember that the story is told by Cæsar, and that Cæsar did not love Bibulus.

Marc Antony has been left at Brindisi in command of the legions which Cæsar could not bring across at his first trip for want of sufficient ship-room, and is pressed very much by Cæsar to make the passage. There are attempts at treaties made, but as we read the account we feel that Cæsar is only obtaining the delay which is necessary to him till he shall have been joined by Antony. We are told how by this time the camps of Cæsar and Pompey have been brought so near together that they are separated only by the River Apsus—for Cæsar had moved northwards towards Pompey's stronghold. And the soldiers talked together across the stream: "nor, the while, was any weapon thrown—by compact between those who talked." Then Cæsar sends Vatinius, as his ambassador, down to the river to talk of peace; and Vatinius demands with a loud voice "whether it should not be allowed to citizens to send legates to citizens, to treat of peace—a thing that has been allowed even to deserters from the wilds of the Pyrenees and to robbers—especially with so excellent an object as to hinder citizens from fighting with citizens." This seems so reasonable, that a day is named, and Labienus—who has deserted from Cæsar and become Pompeian—comes to treat on one side of the river, and Vatinius on the other. But—so Cæsar tells the story himself—the Cæsarean soldiers throw their weapons at their old General. They probably cannot endure the voice or sight of one whom they regard as a renegade. Labienus escapes under the protection of those who are with him—but he is full of wrath against Cæsar. "After this," says he, "let us cease to speak of treaties, for there can be no peace for us till Cæsar's head has been brought to us." But the colloquies over the little stream no doubt answered Cæsar's purpose.

Cæsar is very anxious to get his legions over from Italy, and even scolds Antony for not bringing them. There is a story—which he does not tell himself—that he put himself into a small boat, intending to cross over to Brindisi in a storm, to hurry matters, and that he encouraged the awestruck master of the boat by reminding him that he would carry "Cæsar and his fortunes." The story goes on to say that the sailors attempted the trip, but were driven back by the tempest. At last there springs up a south wind, and Antony ventures with his flotilla, although the warships of Pompey still hold the sea, and guard the Illyrian coast. But Cæsar's General is successful, and the second half of the Cæsarean army is carried northward by favoring breezes towards the shore in the very sight of Pompey and his soldiers at Dyrrachium. Two ships, however, lag behind, and fall into the hands of one Otacilius, an officer belonging to Pompey. The two ships, one full of recruits and the other of veterans, agree to surrender, Otacilius having sworn that he will not hurt the men. "Here you may see," says Cæsar, "how much safety to men there is in presence of mind." The recruits do as they have undertaken, and give themselves up; whereupon Otacilius, altogether disregarding his oath, like a true Roman, kills every man of them. But the veterans, disregarding their word also, and knowing no doubt to a fraction the worth of the word of Otacilius, run their ship ashore in the night, and, with much fighting, get safe to Antony. Cæsar implies that the recruits even would have known better had they not been sea-sick; but that even bilge-water and bad weather combined had failed to touch the ancient courage of the veteran legionaries. They were still good men—"item conflictati et tempestatis et sentinæ vitiis."

We are then told how Metellus Scipio, coming out of Syria with his legions into Macedonia almost succeeds in robbing the temple of Diana of Ephesus on his way. He gets together a body of Senators, who are to give evidence that he counts the money fairly as he takes it out of the temple. But letters come from Pompey just as he is in the act, and he does not dare to delay his journey even to complete so pleasant a transaction. He comes to meet Pompey and to share his command at the great battle that must soon be fought. We hear, too, how Cæsar sends his Lieutenants into Thessaly and Ætolia and Macedonia, to try what friends he has there, to take cities, and to get food. He is now in a land which has seemed specially to belong to Pompey; but even here they have heard of Cæsar, and the Greeks are simply anxious to be friends with the strongest Roman of the day. They have to judge which will win, and to adhere to him. For the poor Greeks there is much difficulty in forming a judgment. Presently we shall see the way in which Cæsar gives a lesson on that subject to the citizens of Gomphi. In the mean time he joins his own forces to those lately brought by Antony out of Italy, and resolves that he will force Pompey to a fight.

We may divide the remainder of his last book of the second Commentary into two episodes,—the first being the story of what occurred within the lines at Petra, and the second the account of the crowning battle of Pharsalia. In the first Pompey was the victor,—but the victory, great as it was, has won from the world very little notice. In the second, as all the world knows, Cæsar was triumphant and henceforward dominant. And yet the affair at Petra should have made a Pharsalia unnecessary, and indeed impossible. Two reasons have conspired to make Pompey's complete success at Petra unimportant in the world's esteem. This Commentary was written not by Pompey, but by Cæsar; and, then, unfortunately for Pompey, Pharsalia was allowed to follow Petra. It is not very easy to unravel Cæsar's story of the doings of the two armies at Petra. Nor, were this ever so easy a task, would our limits or the purport of this volume allow us to attempt to give that narrative in full to our readers. Cæsar had managed to join the legions which he had himself brought from Italy with those which had crossed afterwards with Antony, and was now anxious for a battle. His men, though fewer in number than they who followed Pompey, were fit for fighting, and knew all the work of soldiering. Pompey's men were for the most part beginners;—but they were learning, and every week added to their experience was a week in Pompey's favor. With hope of forcing a battle, Cæsar managed to get his army between Dyrrachium, in which were kept all Pompey's stores and wealth of war, and the army of his opponent, so that Pompey, as regarded any approach by land was shut off from Dyrrachium. But the sea was open to him. His fleet was everywhere on the coast, while Cæsar had not a ship that could dare to show its bow upon the waters.

There was a steep rocky promontory some few miles north of Dyrrachium, from whence there was easy access to the sea, called Petra, or the rock. At this point Pompey could touch the sea, but between Petra and Dyrrachium Cæsar held the country. Here, on this rock, taking in for the use of his army a certain somewhat wide amount of pasturage at the foot of the rock, Pompey placed his army, and made intrenchments all round from sea to sea, fortifying himself as all Roman Generals knew how to do, with a bank and ditch and twenty-four turrets and earthworks that would make the place absolutely impregnable. The length of his lines was fifteen Roman miles,— more than thirteen English miles,— so that within his works he might have as much space as possible to give him grass for his horses. So placed, he had all the world at his back to feed him. Not only could he get at that wealth of stores which he had amassed at Dyrrachium, and which were safe from Cæsar, but the coasts of Greece, and Asia, and Egypt were open to his ships. Two things only were wanting to him,—sufficient grass for his horses, and water. The Illyrian country at his back was one so unproductive, being rough and mountainous, that the inhabitants themselves were in ordinary times fed upon imported corn. And Pompey, foreseeing something of what might happen, had taken care to empty the store-houses and to leave the town behind him destitute and impoverished. Nevertheless Cæsar, having got the body of his enemy, as it were, imprisoned at Petra, was determined to keep his prisoner fast. So round and in front of Pompey's lines, he also made other lines from sea to sea. He began by erecting turrets and placing small detachments on the little hills outside Pompey's lines, so as to prevent his enemy from getting the grass. Then he joined these towers by lines, and in this way surrounded the other lines, — thinking that so Pompey would not be able to send out his horsemen for forage; and again, that the horses inside at Petra might gradually be starved; and again "that the reputation,"— "auctoritatem,"—" which in the estimation of foreign nations belonged chiefly to Pompey in this war, would be lessened when the story should have been told over the world that Pompey had been besieged by Cæsar, and did not dare to fight."

We are, perhaps, too much disposed to think — reading our history cursorily —that Cæsar at this time was everybody, and that Pompey was hardly worthy to be his foe. Such passages in the Commentary as that above translated—they are not many, but a few suffice—show that this idea is erroneous. Up to this period in their joint courses Pompey had been the greater man: Cæsar had done very much, but Pompey had done more—and now he had on his side almost all that was wealthy and respectable in Rome. He led the Conservative party, and was still confident that he had only to bide his time, and that Cæsar must fall before him. Cæsar and Cæsareans were to him as the spirits of the Revolution were in France to Louis XVI., to Charles X., and to Louis-Philippe, before they had made their powers credible and formidable; as the Reform Bill and Catholic Emancipation were to such men as George IV. and Lord Eldon, while yet they could be opposed and postponed. It was impossible to Pompey that the sweepings of Rome, even with Cæsar and Cæsar's army to help them, should at least prevail over himself and over the Roman Senate. "He was said at that time," we are again translating Cæsar's words, "to have declared with boasts among his own people, that he would not himself deny that as a general he should be considered worthless if Cæsar's legions should now extricate themselves from the position in which they had rashly entangled themselves without very great loss"—"*maximo detrimento*"—loss that would amount wellnigh to destruction. And he was all but right in what he said. There was a great deal of fighting for the plots of grass and different bits of vantage-ground—fighting which must have taken place almost between the two lines. But Cæsar suffered under this disadvantage, that his works, being much the longest, required the greatest number of men to erect them and prolong them and keep them in order; whereas Pompey, who in this respect had the least to do, having the inner line, was provided with much the greater number of men to do it. Cæsar's men, being veterans, had always the advantage in the actual fighting; but in the mean time Pompey's untried solders were obtaining that experience which was so much needed by them. Nevertheless Pompey suffered very much. They could not get water on the rock, and when he attempted to sink wells, Cæsar so perverted the water-courses that the wells gave no water. Cæsar tells us that he even dammed up the streams, making little lakes to hold it, so that it should not trickle down in its underground courses to the comfort of his enemies; but we should have thought that any reservoirs so made must soon have overflown themselves, and have been useless for the intended purpose. In the mean time Cæsar's men had no bread but what was made of a certain wild cabbage—"chara"—which grew there, which they kneaded up with milk, and lived upon it cheerfully, though it was not very palatable. To show the Pompeians the sort of fare with which real veterans could be content to break their fasts, they threw loaves of this composition across the lines, for they were close together and could talk to each other, and the Pompeians did not hesitate to twit their enemies with their want of provisions. But the Cæsareans had plenty of water—and plenty of meat; and they assure Cæsar that they would rather eat the bark off the trees than allow the Pompeians to escape them.

But there was always this for Cæsar to fear—that Pompey should land a detachment behind his lines and attack him at the back. To hinder this Cæsar made another intrenchment, with ditch and bank, running at right angles from the shore, and was intending to join this to his main work by a transverse line of fortifications running along that short portion of the coast which lay between his first lines and the second, when there came upon him the disaster which nearly destroyed him. While he was digging his trenches and building his turrets the fighting was so frequent that, as Cæsar tells us, on one day there were six battles. Pompey lost two thousand legionaries, while Cæsar lost no more than twenty; but every Cæsarean engaged in a certain turret was wounded; and four officers lost their eyes. Cæsar estimates that thirty thousand arrows were thrown upon the men defending this tower, and tells us of one Scæva, an officer, who had two hundred and thirty holes made by these arrows in his own shield. We can only surmise that it must have been a very big shield, and that there must have been much trouble in counting the holes. Cæsar, however, was so much pleased that he gave Scæva a large sum of money—something over £500, and, allowing him to skip over six intermediate ranks, made him at once first centurion—or Primipilus of the legion. We remember no other record of such quick promotion—in prose. There is, indeed, the well-known case of a common sailor who did a gallant action and was made First-Lieutenant on the spot; but that is told in verse, and the common sailor was a lady.

Two perfidious Gauls to whom Cæsar had been very kind, but whom he had been obliged to check on account of certain gross peculations of which they had been guilty, though, as he tells us, he had not time to punish them, went over to Pompey, and told Pompey all the secrets of Cæsar's ditches, and forts, and mounds—finished and unfinished. Before that, Cæsar assures us, not a single man of his had gone over to the enemy, though many of the enemy had come to him. But these perfidious Gauls did a world of mischief. Pompey, hearing how far Cæsar was from having his works along the sea-shore finished, got together a huge fleet of boats, and succeeded at night in throwing a large body of his men ashore between Cæsar's two lines, thus dividing Cæsar's two forces, and coming upon them in their weakest point. Cæsar admits that there was a panic in his lines, and that the slaughter of his men was very great. It seems that the very size of his own works produced the ruin which befell them, for the different parts of them were divided one from another, so that the men in one position could not succor those in another. The affair ended in the total route of the Cæsarean army. Cæsar actually fled, and had Pompey followed him we must suppose that then there must be an end of Cæsar. He acknowledges that in the two battles fought on that day he lost 960 legionaries, 32 officers, and 32 standards. And then Cæsar tells us a story of Labienus, who had been his most trusted Lieutenant in the Gallic wars, but who had now gone over to Pompey, not choosing to fight against the Republic. Labienus demanded of Pompey the Cæsarean captives, and caused them all to be slaughtered, asking them with scorn whether veterans such as they were accustomed to run away. Cæsar is very angry with Labienus; but Labienus might have defended himself by saying that the slaughter of prisoners of war was a custom he had learned in Gaul. As for those words of scorn, Cæsar could hardly have heard them with his own ears, and we can understand that he should take delight in saying hard things of Labienus.

Pompey was at once proclaimed Imperator. And Pompey used the name, though the victory had, alas! been gained over his own fellow-countrymen. "So great was the effect of all this on the spirits and confidence of the Pompeians, that they thought no more of the carrying on of the war, but only of the victory they had gained." And then Cæsar throws scorn upon the Pompeians, making his own apology in the same words. "They did not care to remember that the small number of our soldiers was the cause of their triumph, or that the unevenness of the ground and narrowness of the defiles had anything to do with it; or the occupation of our lines, and the panic of our men between their double fortifications, or our army cut into two parts, so that one part could not help the other. Nor did they add to this the fact that our men, pressed as they were, could not engage themselves in a fair conflict, and that they indeed suffered more from their own numbers, and from the narrowness of the ravines, than from the enemy. Nor were the ordinary chances of war brought to mind,—how small matters, such as some unfounded suspicion, a sudden panic, a remembered superstition, may create great misfortune; nor how often the fault of a General, or the mistake of an officer may bring injury upon an army. But they spread abroad the report of the victory of that day throughout all the world, sending forth letters and tales as though they had conquered solely by their own valor, nor was it possible that there should after this be a reverse of their circumstances." Such was the affair of Petra, by which the relative position in the world-history of Cæsar and Pompey was very nearly made the reverse of what it is.

Cæsar now acknowledges that he is driven to change the whole plan of his campaign. He addresses a speech to his men, and explains to them that this defeat, like that of Gergovia, may lead to their future success. The victory at Alesia had sprung from the defeat of Gergovia, because the Gauls had been induced to fight; and from the reverses endured within the lines of Petra might come the same fortune;—for surely now the army of Pompey would not fear a battle. Some few officers he punishes and degrades. His own words respecting his army after their defeat are very touching. "So great a grief had come from this disaster upon the whole army, and so strong a desire of repairing its disgrace, that no one now desired the place of Tribune or Centurion in his legion; and all, by way of self-imposed punishment, subjected themselves to increased toil; and every man burned with a desire to fight. Some from the higher ranks were so stirred by Cæsar's speech, that they thought that they should stand their ground where they were and fight where they stood." But Cæsar was too good a General for that. He moves on towards the south-east, and in retreating gets the better of Pompey, who follows him with only half a heart. After a short while Pompey gives up the pursuit. His father-in-law, Scipio, has brought a great army from the east, and is in Thessaly. As we read this we cannot fail to remember how short a time since it was that Cæsar himself was Pompey's father-in-law, and that Pompey was Cæsar's friend because, with too uxorious a love, he clung to Julia, his young wife. Pompey now goes eastward to unite his army to that of Scipio, and Cæsar, making his way into Thessaly by a more southern route, joins certain forces under his Lieutenant Calvinus, who had been watching Scipio, and who barely escaped falling into Pompey's hands before he could reach Cæsar. But wherever fortune or chance could interfere, the Gods were always kind to Cæsar.

Then Cæsar tells us of his treatment of two towns in Thessaly, Gomphi, and Metropolis. Unluckily for the poor Gomphians. Cæsar reaches Gomphi first. Now the fame of Pompey's victory at Petra had been spread abroad; and the Gomphians, who, to give them their due,—would have been just as willing to favor Cæsar as Pompey, and who only wanted to be on the winning side that they might hold their little own in safety, believed that things were going badly with Cæsar. They therefore shut their gates against Cæsar, and sent off messengers to Pompey. They can hold their town against Cæsar for a little while, but Pompey must come quickly to their aid. Pompey comes by no means quick enough, and the Gomphians' capacity to hold their own is very short-lived. At about three o'clock in the afternoon Cæsar begins to besiege the town, and before sunset he has taken it, and given it to be sacked by his soldiers. The men of Metropolis were also going to shut their gates, but luckily they hear just in time what had happened at Gomphi, and open them instead. Whereupon Cæsar showers protection upon Metropolis; and all the other towns of Thessaly, hearing what had been done, also learn what Cæsar's favor means.

Pompey, having joined his army to that of Scipio, shares all his honors with his father-in-law. When we hear this we know that Pompey's position was not comfortable, and that he was under constraint. He was a man who would share his honor with no one unless driven to do so. And indeed his command at present was not a pleasant one. It was much for a Roman commander to have with him the Roman Senate, but the Senators so placed would be apt to be less obedient than trained soldiers. They even accuse him of keeping them in Thessaly because he likes to lord it over such followers. But they were, nevertheless, all certain that Cæsar was about to be destroyed; and, even in Pompey's camp, they quarrel over the rewards of victory which they think that they will enjoy at Rome when their oligarchy shall have been re-established by Pompey's arms.

Before the great day arrives Labienus again appears on the scene: and Cæsar puts into his mouth a speech which he of course intends us to compare with the result of the coming battle. "Do not think, O Pompey, that this is the army which conquers Gaul and Germany,"—where Labienus himself was second in command under Cæsar. "I was present at all those battles, and speak of a thing which I know. A very small party of that army remains. Many have perished, as a matter of course in so many battles. The autumn pestilence killed many in Italy. Many have gone home. Many have been left on the other shore. Have you not heard from our own friends who remained behind sick, that these cohorts of Cæsar's were made up at Brindisi?"—made up but the other day, Labienus implies. "This army, indeed has been renewed from levies in the two Gauls; but all that it had of strength perished in those two battles at Dyrrachium:" in the contests, that is, within the lines of Petra. Upon this Labienus swears that he will not sleep under canvas again until he sleeps as victor over Cæsar: and Pompey swears the same, and everybody swears. Then they all go away full of the coming victory. We daresay there was a great deal of false confidence: but as for the words which Cæsar puts into the mouth of Labienus, we know well how much cause Cæsar had to dislike Labienus, and we doubt whether they were ever spoken. At length the battle-field is chosen, near the town of Pharsalus, on the banks of the river Enipeus in Thessaly. The battle has acquired world-wide fame as that of Pharsalia, which we have been taught to regard as the name of the plain on which it was fought. Neither of these names occur in the Commentary, nor does that of the river: and the actual spot on which the great contest took place seems to be a matter of doubt even now. The ground is Turkish soil,—near to the mountains which separate modern Greece from Turkey and is not well adapted for the researches of historical travelers. Cæsar had been keeping his men on the march close to Pompey, till Pompey found that he could no longer abstain from fighting. Then came Labienus with his vaunts, and his oath,—and at length the day and the field were chosen. Cæsar at any rate was ready. At this time Cæsar was fifty-two years old, and Pompey was five years his elder.

Cæsar tells us that Pompey had 110 cohorts, or eleven legions. Had the legions been full, Pompey's army would have contained 66,000 legionaries: but Cæsar states their number at 45,000 or something over two-thirds of the full number. He does not forget to tell us once again that among these eleven were the two legions which he had given up in obedience to the demand of the Senate. Pompey himself, with these two very legions, placed himself on the left away from the river; and there also were all his auxiliaries,—not counted with the legionaries,—slingers, archers, and cavalry. Scipio commanded in the centre with the legions he had brought out of Syria. So Cæsar tells us. We learn from other sources that Lentulus commanded Pompey's right wing, lying on the river—and Domitius, whom we remember as trying to hold Marseilles against young Brutus and Trebonius, the left. Cæsar had 80 cohorts, or eight legions, which should have numbered 48,000 men had his legions been full—but, as he tells us, he led but 22,000 legionaries, so that his ranks were deficient by more than a half. As was his custom, he had his tenth legion to the right, away from the river. The ninth, terribly thinned by what had befallen it within the lines at Petra, joined to the eleventh, lay next the river, forming part of Cæsar's left wing. Antony commanded the left wing, Domitius Calvinus, whom Cæsar sometimes calls by one name and sometimes by the other, the centre,—and Sulla the right. Cæsar placed himself to the right, with his tenth legion, opposite to Pompey. As far as we can learn, there was but little in the nature of the ground to aid either of them:—and so the fight began.

There is not much complication, and perhaps no great interest, in the account of the actual battle as it is given by Cæsar. Cæsar makes a speech to his army, which was, as we have already learned, and as he tells us now, the accustomed thing to do. No falser speech was ever made by man, if he spoke the words which he himself reports. He first of all reminds them how they themselves are witnesses that he has done his best to insure peace;—and then he calls to their memory certain mock treaties as to peace; in which, when seekingly delay, he had pretended to engage himself and his enemy. He had never wasted, he told them, the blood of his soldiers, nor did he desire to deprive the Republic of either army—"alterutro exercitu"—of Pompey's army or of his own. They were both Roman, and far be it from him to destroy aught belonging to the Republic. We must acknowledge that Cæsar was always chary of Roman life and Roman blood. He would spare it when it could be spared; but he could spill it like water when the spilling of it was necessary to his end. He was very politic; but as for tenderness, —neither he nor any Roman knew what it was. Then there is a story of one Crastinus, who declares that whether dead or alive he will please Cæsar. He throws the first weapon against the enemy and does please Cæsar. But he has to please by his death, for he is killed in his effort. Pompey orders that his first rank shall not leave its order to advance, but shall receive the shock of Cæsar's attack. Cæsar points out to us that he is wrong in this, because the very excitement of a first attack gives increased energy and strength to the men. Cæsar's legionaries are told to attack, and they rush over the space intervening between the first ranks to do so. But they are so well trained that they pause and catch their breath before they throw their weapons. Then they throw their piles and draw their swords, and the ranks of the two armies are close pitted against each other. But Pompey had thought that he could win the battle, almost without calling on his legionaries for any exertion, by the simple strategic movement of his numerous cavalry and auxiliaries. He outnumbered Cæsar altogether, but in these arms he could overwhelm him with a cloud of horsemen and of archers. But Cæsar also had known of these clouds. He fought now as always with a triple rank of legionaries,—but behind his third rank,—or rather somewhat to their right shoulder,—he had drawn up a choice body of men picked from his third line, —a fourth line as it were,—whose business it was to stand against Pompey's clouds when the attempt should be made by these clouds upon their right flank. Cæsar's small body of cavalry did give way before the Pompeian clouds, and the horsemen and the archers and the slingers swept round upon Cæsar's flank. But they swept round upon destruction. Cæsar gave the word to that fourth line of picked men. "Illi—they," says Cæsar, "ran forward with the greatest rapidity, and with their standards in advance attacked the cavalry of Pompey with such violence that none of them could stand their ground;—so that all not only were forced from the ground, but being at once driven in panic, they sought the shelter of the highest mountains near them. And when they were thus removed, all the archers and the slingers, desolate and unarmed, without any one to take care of them, were killed in heaps." Such is Cæsar's account of Pompey's great attack of cavalry which was to win the battle without giving trouble to the legions.

Cæsar acknowledges that Pompey's legionaries drew their swords bravely and began their share of the fighting well. Then at once he tells us of the failure on the part of the cavalry and of the slaughter of the poor auxiliary slingers, and in the very next sentence give us to understand that the battle was won. Though Pompey's legions were so much more numerous than those of Cæsar, we were told that Cæsar's third line attacked the Pompeian legionaries when they were "defessi"—worn out. The few cohorts of picked men who in such marvelous manner had dispersed Pompey's clouds, following on their success, turned the flank of Pompey's legions and carried the day. That it was all as Cæsar says there can be little doubt. That he won the battle there can, we presume, be no doubt. Pompey at once flew to his camp and endeavored to defend it. But such defense was impossible, and Pompey was driven to seek succor in flight. He found a horse and a few companions, and did not stop till he was on the sea-shore. Then he got on board a provision-vessel, and was heard to complain that he had been betrayed by those very men from whose hands he had expected victory. We are told with much picturesque effect how Cæsar's men, hungry, accustomed to endurance, patient in all their want, found Pompey's camp prepared for victory, and decked in luxurious preparation for the senatorial victors. Couches were strewn, and plate was put out, and tables prepared, and the tents of these happy ones were adorned with fresh ivy. The senatorial happy ones have but a bad time of it, either perishing in their flight, or escaping into the desert solitudes of the mountains. Cæsar follows up his conquest, and on the day after the battle compels the great body of the fugitives to surrender at discretion. He surrounds them on the top of a hill and shuts them out from water, and they do surrender at discretion. With stretched-out hands, prone upon the earth, these late conquerors, the cream of the Roman power, who had so lately sworn to conquer ere they slept, weeping, beg for mercy. Cæsar, having said a few words to them of his clemency, gave them their lives. He recommends them to the care of his own men, and desires that they may neither be slaughtered nor robbed. Cæsar says he lost only 200 soldiers in that battle— and among them 30 officers, all brave men. That gallant Crastinus was among the 30. Of Pompey's army 15,000 had been killed, and 24,000 had surrendered! 180 standards and 9 eagles were taken and brought to Cæsar. The numbers seem to us to be almost incredible, whether we look at those given to us in regard to the conqueror or the conquered. Cæsar's account, however, of that day's work has hitherto been taken as authoratative, and it is too late now to question it. After this fashion was the battle of Pharsalia won, and the so-called Roman Republic brought to an end.

But Cæsar by no means thought that this work was done;—nor indeed was it nearly done. It was now clearly his first duty to pursue Pompey,—whom, should he escape, the outside provinces and distant allies of the Republic would soon supply with another army. "Cæsar thought that Pompey was to be pursued to the neglecting of all other things." In the mean time Pompey, who seems to have been panic-struck by his misfortune, fled with a few friends down the Ægean Sea, picked his young wife up at an island as he went, and made his way to Egypt. The story of his murder by those who had the young King of Egypt in their keeping is well-known and need not detain us. Cæsar tells it very shortly. Pompey sends to young Ptolemy for succor and assistance, trusting to past friendship between himself and the young King's father. Ptolemy is in the hands of eunuchs, adventurers, and cut-throat soldiers, and has no voice of his own in the matter. But these ruffians think it well to have Pompey out of the way, and therefore they murder him. Achillas, a royal satrap, and Septimius, a Roman soldier, go out to Pompey's vessel, as messengers from the King, and induce them to come down into their boat. Then, in the very sight of his wife, he is slaughtered, and his head is carried away as proof of the deed. Such was the end of Pompey, for whom no fortune had seemed to be too great, till Cæsar came upon the scene. We are told by the Roman poet, Lucan, who took the battle of Pharsalia as his difficult theme, that Cæsar could bear no superior, and Pompey no equal. The poet probably wished to make the latter the more magnanimous by the comparison. To us, as we examine the character of the two Generals, Cæsar seems at least as jealous of power as his son-in-law, and certainly was the more successful of the two in excluding all others from a share in the power which he coveted. Pompey in the triumvirate admitted his junior to more, as he must have felt it, than equal power: Cæsar in the triumvirate simply made a stepping-stone of the great man who was his elder. Pompey at Thessaly was forced to divide at least the name of his power with Scipio, his last father-in-law: but Cæsar never gave a shred of his mantle to be worn by another soldier.

In speaking, however, of the character of Pompey, and in comparing it with that of his greater rival, it may probably be said of him that in all his contests, both military and political, he was governed by a love of old Rome, and of the Republic as the greatest national institution which the world has ever known, and by a feeling which we call patriotism, and of which Cæsar was,—perhaps, we may say, too great to be capable. Pompey desired to lead, but to lead the beloved Republic. Cæsar, caring nothing for the things of old, with no reverence for the past, utterly destitute of that tenderness for our former footsteps which makes so many of us cling with passionate fondness to convicted errors, desired to create out of the dust of the Republic,—which fate and his genius allowed him to recast as he would,—something which should be better and truer than the Republic.

The last seven chapters of the third book of this Commentary form a commencement of the record of the Alexandrine war,—which, beyond those seven chapters, Cæsar himself did not write. That he should have written any Commentary amidst the necessary toils of war, and the perhaps more pressing emergencies of his political condition, is one of the marvels of human power. He tells us now, that having delayed but a few days in Asia, he followed Pompey first to Cyprus and then to Egypt, taking with him as his entire army three thousand two hundred men. "The rest, worn out with wounds, and battles, and toil, and the greatness of the journey, could not follow him." But he directed that legions should be made up for him from the remnants of Pompey's broken army, and, with a godlike trust in the obedience of absent vassals, he went on to Egypt. He tells us that he was kept in Alexandria by Etesian winds. But we know also that Cleopatra came to him at Alexandria, requiring his services in her contest for the crown of Egypt; and knowing at what price she bought them, we doubt the persistent malignity of the Etesian winds. Had Cleopatra been a swarthy Nubian, as some have portrayed her, Cæsar, we think, would have left Alexandria though the Etesian winds had blown in his very teeth. All winds filled Cæsar's sails. Cæsar gets possession of Cleopatra's brother Ptolemy, who, in accordance with their father's will, was to have reigned in conjunction with his sister, and the Alexandrians rise against him in great force. He slays Photinus, the servant of King Ptolemy, has his own ambassador slain, and burns the royal fleet of Egypt,—burning with it, unfortunately, the greater part of the royal library. "These things were the beginning of the Alexandrine war." These are the last words of Cæsar's last Commentary. See *Roman Wars*.

ROMANS.—Before the establishment of the mess at the Horse Guards, which was formerly paid out of the King's privy purse, and subsequently charged in the extraordinaries of the army, the Captain of the Guard at St. James's kept a table for the subalterns attached to that duty. In order to enable the Captains to support these expenses, a certain number of men were allowed to work in the metropolis, on condition that they left their pay in the hands of their Officers; these men were called *Romans*.

ROMAN WALL.—Traces are found in Great Britain of four great walls built by the Roman Conquerors. Two were built by Agricola, the first in A. D. 79, and the second in A. D. 81, extending from the Frith of Forth to the Frith of Clyde. As this proved insufficient to keep back the northern barbarians, Hadrian in A. D. 120 finished the most famous of all the walls, from the Solway to Newcastle on Tyne. This was 68 English miles in length. In A. D. 200 Severus built another wall a few yards above that of Hadrian, which was guarded by 10,000 men.

ROMAN WARS.—In the infancy of Rome, she had many wars but few conquests—in her maturity she had few wars and many conquests. When the power of Carthage failed, Rome no longer had a rival: her wars, or rather invasions, after that event, were generally of her own seeking; and they were many. Rome was no sooner able to say, "Carthage must be destroyed," than, in her heart, she also said, *the empire of Alexander shall be mine*. First Macedonia felt her grasp, and Perseus was hurled from the throne of Philip and Alexander, at which time she graciously gave the Greeks their liberty, *i. e.* gave them law.

Attalus, King of Pergamus, dying about this time, left his kingdom to the Romans, by will; or, in other words, seeing the world sink beneath their power, he preferred giving them a bloodless victory, and cloaked an ignoble dereliction of right under the specious name of a voluntary donation. Antiochus, the great King of Assyria, was destined next to fall before them. He was at this period the most powerful and opulent prince of all Alexander's successors; and had he accepted the advice and aid of Hannibal, there would have been at least a chance for his escaping the all-grasping power of Rome. But he, fearing lest, if anything should be done, Hannibal would have all the credit, was careful to go directly contrary to the advice of that General. The Romans defeated him almost without loss of blood—stripping him of great part of his dominions—triumphed over him—extorted from him an immense tribute, and left him only enough to grace the triumph of another campaign. Two other great cities shared the fate of Carthage, and nearly at the same time: Corinth, one of the noblest cities of Greece, was utterly destroyed by Mummius, the Consul, for offering some indignity to the Roman embassadors—and Numantia, the capital of Spain. This city after sustaining a siege of fourteen years, was reduced by Scipio. The inhabitants, being unable to hold out any longer, fired the city over their own heads, and all perished in the flames; and Spain became a Roman province.

The corruption of the senate, and the sedition and fall of the Gracchi, together with various disturbances next arise to view in tracing the history of Rome. Then follow the reduction of Numidia, and the civil wars in the republic, excited by the ambition of Marius and Sylla, which terminated in the perpetual dictatorship of the latter. But it will not comport with our present design to enter into a detail of these particular events. Rome was perhaps never more powerful or happy than in the days of Scipio Africanus, or about the times of the Punic wars. She then experienced great misfortunes and calamities; but those untoward events, instead of weakening or exhausting her, called forth, nay, even created new energies. From the invasion of Hannibal, she rose invincible: and while that consummate warrior held his ground in Italy, she sent armies into Spain, Africa, Greece and Macedon. A great part of those immense regions which Alexander subdued, soon shared the fate of the empire of Carthage; and in those days, with the Romans, to proclaim war was to insure a triumph—and to invade was to conquer.

When we look for a period in the Roman history, in which there is the greatest union of power, wisdom, virtue and happiness, it will doubtless be found not far from the times of which we are now speaking. The Romans, in earlier times of the republic, were more virtuous and patriotic than now—but then they were weak; in the Augustan age they were certainly more enlightened, scientific and polished—but then they were less brave; or if not less brave, their virtue was forever gone, and with it, the foundation of their prosperity and happiness. The conquest of Africa, Asia, and Greece at once poured into the coffers of Rome immense, incalculable riches. On this almost boundless tide of prosperity a set of men were soon seen floating, of a very different character from Cincinnatus, Fabricius and Regulus. To the most desperate bravery they united unbounded ambition; and to the strongest expression of regard to their country they united a total want of principle. The wealth of the world like a mighty river, poured into Rome; and many individuals acquired fortunes which transcended royal magnificence.

The elevation of Rome to such an astonishing height of power and splendor, drew to her men of parts, of taste, of ambition and enterprise—and in short, men of every description, and almost every nation. The descendants of the ancient Romans soon became few in comparison with the immense multitude, who by some means or other, acquired citizenship, or obtained a residence in Italy; and Rome herself experienced as great a change as the nations she conquered: for while she drew the arts, elegance and science from Greece, she drew wealth, luxury, effeminacy, and corruption from Asia and Africa, and she drew a swarm of hungry fortune hunters from every corner of the earth, who penetrated her inmost recesses—outnumbered and overwhelmed her ancient people—in short, conquered their conquerors, corrupted their morals, and put a final period to their liberties.

The civil wars of Rome which soon follow the period of which we have been speaking, unfold to the reader a spectacle equally dreadful and disgusting. Many persons who had witnessed the destruction of Carthage were still alive, and saw all Italy deluged in blood by Marius and Sylla. From the destruction of Carthage to the perpetual dictatorship of Sylla, was a little rising of seventy years. During the latter part of this period, Lucius Sylla, envying the power and glory of Caius Marius, involved the republic in a most bloody, disgraceful, and destructive war. After various turns which their affairs took in the progress of this eventful struggle—after they had destroyed half a million of men, including the best part of the Roman people—had humbled Rome and Italy—had shed the noblest blood, and prostrated the dignity of the republic, Sylla, an execrable monster of cruelty, tyranny and ambition, was able to triumph over virtue, liberty and justice. He seated himself quietly in the exercise of despotic power, and became perpetual dictator. Rome never saw another moment of freedom.

The Romans, in the times of Scipio, may be compared with the Greeks in the time of Themistocles, and the triumph of Greece over Persia, with that of Rome over Carthage. In both cases, the conquerors were corrupted by wealth, and inebriated by luxury. We might go further and say, that the Peloponnesian war, which succeeded the elevation of Greece, and laid the foundation of her ruin, resembled the civil wars of Rome, begun by Marius and Sylla—carried on by Cæsar and Pompey, and terminated by Augustus. But the firmness of the Roman character—the nature of their civil policy, and the immense extent of their conquests, enabled them still to be powerful, in spite of all their corruptions; and had they been otherwise, there seemed to be no nation near them who could have derived advantage from their weakness. They seem to have been raised up and endowed with universal dominion, that they might evidence to the world how far a nation can be happy, and how long she can exist without virtue or freedom.

The ambition of the demagogues as well as of the despots and tyrants of Rome, in one essential article, led them to promote the true and just policy of the empire: that was to attach the provinces as strongly as possible to the interest of Rome—to dissolve them down to one common mass—to preserve their extensive territories entire—to cement them together by various alliances, and to preserve the empire undivided. The strength of empires consists in their union. The Greeks wanting this, soon failed; and, in our own times, Poland, which ought, from her numerous advantages, to have been one of the most powerful kingdoms in the world, has exhibited a deplorable spectacle of weakness and misery, by means of her internal divisions. Our own country had well nigh been swallowed in the same gulf.

The Roman community, launched at once on such a sea of luxury, wealth, and glory, was variously affected. While all were struggling for eminence and power, it fortunately happened that the reins of government fell into strong and energetic hands. Of this description, generally speaking, were most of the first competitors, and of the triumvirates. The softening power of luxury—the sudden inundation of Grecian elegance and refinement, and the elevation of conscious greatness and empire, combined with her native gravity in forming the genius of Rome. About this period, it began to bud; soon after this was its fairest bloom and richest maturity. If the genius of Rome was of a heavier mould than that of Greece, it possessed a more commanding gravity; if it had less fire, it was more tranquil, majestic, and solemn; and more hearts will vibrate with pleasure to the plaintive and elegant notes of the Roman, than to the electric fulminations of the Grecian muse.

In the year 680 from the building of the city, the republic was freed from the tyranny of Sylla, by the death of that odious tyrant. But two men, of far more extensive views and refined ambition than either Marius or Sylla, were already prepared to run the same race. Cneus Pompey, had, by various arts, as well as by great abilities, become the most popular man in Rome, and was considered as the greatest commander in the Republic. Crassus possessed that authority and influence which great eloquence and immense wealth, combining with all the wiles of ambition, could procure him. He was the richest man in Rome. While Pompey, who warmly espoused the Marian faction, strove to gain the favor of the people by abrogating many of the tyrannical laws of Sylla, Crassus employed his amazing wealth in donations, distributions of corn among the poor, in public feasts and entertainments; and it is said that he supported, at his own private expense, the greatest part of the citizens for several months—expenditures sufficient to have exhausted the treasures of the greatest princes. In the progress of their contest for power, their animosities broke forth on every occasion, in opposition more or less direct, and by means more or less violent.

At this period, while the destinies of Rome seemed to hang in doubtful suspense, three characters appeared of very different complexions, but equally extraordinary, equally to be remembered, but with very different sensations, in posterity;—Catiline, Cicero, and Cæsar. One of these men procured for himself immortal fame by his atrocious villainy, one by his unrivalled eloquence, and one by his ambition, bravery, and good fortune. Julius Cæsar may be regarded as the greatest of the Roman commanders. In him the military genius of Rome displayed its utmost strength and perfection; but, as yet, he was not known in that group of great characters and personages, who, now inflamed with ambition, were preparing to carve and divide the world among them. Lucius Catiline is allowed by all writers to have possessed every quality of a great man but integrity and virtue; instead of which he held every principle, and practised every vice which could form a most infamous, atrocious and abandoned villain. Possessed of a body and mind equally strong and vigorous, he was bold, enterprising, and industrious. He hesitated at no cruelty to gratify his revenge—he abstained from no crime which could subserve his pleasures—he valued no labor or peril to gratify his ambition. Catiline perceiving himself not among the most favored rivals who were courting the mistress of the world, determined on getting her into his possession by violence. His end was the same as theirs, but his means were more unwarrantable. He planned and organized one of the deepest, most extensive and daring conspiracies recorded in history. The leading objects of his conspiracy were, to put out of the way by one general massacre, all who would be likely to oppose his measures—to pillage the city of Rome—to seize all public treasures, arsenals and stores to establish a despotic government—to revolutionize the whole republic, and to accomplish all these measures by an armed force.

This sanguinary plot was detected and crushed by Cicero, the great and justly celebrated orator of Rome. The accomplices of Catiline were seized and put to death; and Catiline himself, who had assembled an army of twelve thousand men, was encountered, defeated and slain. But if Rome escaped this threatening gulf, it was that she might fall into a snare, apparently less dreadful, but equally strong and conclusive as to her fate. Her days of virtue and glory were past; henceforth she was to be ruled with a rod of iron. The dissensions of Pompey and Crassus were quieted by the mediation of Cæsar, who stepped in between them, outwitted them both, and became the head of the first triumvirate. Having amicably agreed to govern in copartnership, Pompey chose Spain, Crassus chose the rich and luxurious provinces of Asia, and to Cæsar was allotted the powerful and warlike nation of Gaul, as yet unconquered. What was the result? Pompey basked for a moment in the splendors of Rome, and his fame was trumpeted by the eloquence of Cicero. Crassus was slain by the Parthians, endeavoring to enlarge his territories, and Cæsar conquered the Gauls in *a thousand battles*. Pompey could not bear an equal, nor Cæsar a superior. They were mutually jealous—they differed—they prepared for war. The Senate and nobility of Rome, and pride and strength of Italy sided with Pompey: Cæsar relies wholly on those veteran legions with whom he had subdued the fierce and martial tribes of Gaul and Germany. No civil war ever equalled this. It was a melancholy sight to see Rome given up to tyranny and blood—to see that august and venerable republic for ever abandoned to her evil genius. These were not the feeble bickerings of petty controversy; Marius and Sylla, the leaders of the former civil broils, bore little comparison with Cæsar at the head of his legions, or with the great Pompey, who could almost raise armies out of the earth by the *stamp of his foot*.

This eventful struggle was at length closed by the battle of Pharsalia, rendered truly famous by the grand object for which they fought—the greatness of the force employed on either side, and the transcendent reputation of both commanders. The Roman Empire was the prize; and both the armies and the Generals were the best the world could afford. Pompey was utterly defeated, and many of his army, won over by the magnanimous clemency and generosity of Cæsar, were content to change sides. The conduct of Pompey in this battle, which was to decide his fate, has ever been considered as strange and unaccountable. So far from displaying that courage, intrepidity, and fortitude, and those powers of command which he was supposed to possess, that, from the very first onset, he appeared like a man frightened out of his senses; he scarcely attempted to rally his men—was among the foremost that fled, and never made another effort to retrieve his cause. From facts so glaring, we are almost induced to believe that much of Pompey's greatness, as a soldier and commander, consisted in the elegant drawings of Cicero, and other partial writers. The true test of bravery, skill, and fortitude, is to see them displayed when they are most necessary—to see them shine in danger, surmount difficulty, and triumph over adversity. Yet no one can doubt that Pompey was a man of great and splendid talents: but who could equal Cæsar?—A man supereminent in the whole range of spiritual endowments. Nature seemed to scant him in nothing. Among philosophers, mathematicians, poets, and orators, he could shine. He could plan and execute—he could negotiate or fight—he could gain and improve an advantage. For seven years in his Gallic wars, his life was a continual series of fatigues and dear-bought victories: and no General, but one as great as Cæsar, could have encountered him without apprehension and dismay.

The battle of Pharsalia was fought 52 years before Christ, and 702 from the building of the city. Pompey fled an unhappy exile into Egypt, and was there miserably murdered by the command of Ptolemy. Thus the reins of government fell into the hands of Cæsar, and he was left undisputed master of the world. The clemency of Cæsar on this occasion was as illustrious as his victories had been. He entered into no measures against many persons, who, under professions of neutrality, had evidently sided with Pompey. He did nothing which bore any resemblance to the horrid proscriptions of Marius and Sylla. He endeavored, in most instances, to forget and forgive. But the reign and triumph of Julius Cæsar was short. He soon fell a sacrifice to that spirit of freedom and independence which had raised his country to her exalted rank: for though the demons of discord, ambition, and party rage, had now for a long period, aimed all their shafts at good and virtuous men—though torrents of the richest blood had flowed incessantly for many years, yet some men were still left whose constancy and virtue ever stemmed the strong current of the times. Cato and Cicero were still alive, whose stern virtues and commanding eloquence continued to remind the Romans of their better days. From the battle of Pharsalia to the death of Cæsar was eight years. During this period he went on and prospered. By a rapid series of journeys and expeditions he saw, awed and subjugated all places and all opposition. His arm pervaded, his vigilance detected, his spirit animated, his generosity won, and his power crushed in all directions. His great and active genius seemed universally to bear down all before him; but in reality not all: a plot at length was laid, as it were in his own bosom, which hurled him in a moment from the high summit whither he had climbed.

Brutus and Cassius, at the head of about sixty Senators, entered into a conspiracy to take him off by assassination. Their object was to arrest the progress of despotic power, to restore the authority of the senate, and the ancient forms of the republic; an object laudable in itself, but, alas, how far from being practicable! Their plot was deeply laid, but seems to have been carried into effect not without a wonderful concurrence of accident, or rather of providence. Whilst Cæsar was on his way to the senate house, where he was to perish, a slave, it is said, who had discovered the conspiracy, pressed forward in the crowd to apprise him of his danger, but could not get to him for the press. Another person put into his hands a paper, which would have saved him, containing an account of the conspiracy; this he handed to his secretary without breaking the seal. After he was seated in the senate house, the conspirators approached and despatched him with their daggers without resistance, and retired to the capitol, where they put themselves in a state of defence. Thus fell the first and doubtless the greatest of the Cæsars, in the 56th year of his age, and in the 8th of his sole administration. No Roman ever achieved more arduous enterprises than he. He rose to supreme power, in opposition to men of great abilities and of much greater resources than himself. Whatever standing he acquired, he maintained, and his enemies could only destroy him by treachery, under the mask of friendship. Rome did not owe to Cæsar the loss of her liberties; they were lost before he was born. He was allured to seize the dazzling prize, which to all observers, had evidently become the sport of fortune, and was liable to be grasped by him who was boldest and most lucky. Had Pompey prevailed over Cæsar, it is highly doubtful whether Rome would have experienced a happier destiny.

The fall of Cæsar seemed only to accelerate the establishment of imperial government. Octavius, the grand nephew of Cæsar, and heir, by will, to his fortunes and name, was soon at the head of a new triumvirate, viz. himself, Mark Antony, and Lepidus. This new triumvirate, proclaiming themselves the avengers of Cæsar, now hastened to make war upon the conspirators, whose army was headed by Brutus and Cassius. Had the Roman people desired their ancient liberty, which they certainly would had they understood the import of the word, or had they entertained any just notions of freedom, they now enjoyed an opportunity of regaining it: but so far from that, the triumvirate were able to excite the popular indignation against the conspirators, and in fact, gained the people over to their cause. The standard of liberty was deserted, and the wretched infatuated people were now employed in rivetting those chains which were never more to be broken. The conspirators were crushed with little trouble; and in shedding the blood of the last patriots of Rome, the sublime Cicero fell a victim to the merciless rage of Antony, and the base and cruel policy of Octavius. It soon appeared that the triumvirs had combined with no other view than as a present expedient, which was to be laid aside when occasion should offer. Accordingly Lepidus was very quickly rejected, and as he was neither a soldier nor a statesman, he had no means of redress. Antony and Octavius presently differed, and once more marshalled the forces of that mighty people under their hostile standards. Their quarrel was decided at the battle of Actium. A short time after which, Antony expired in Egypt, and left Octavius without a competitor.

In the 30th year before Christ, and 724th from the building of Rome, commenced the imperial reign of Octavius, under the titles, of Emperor and Augustus. Rome now became an empire in the more strict and proper sense of the word; and notwithstanding the degeneracy of the Roman people, it continued for several centuries to be the most powerful empire in the ancient world. The commotions and wars—the luxury and wealth—the corruptions and loss of public virtue among the Romans, did not extinguish but rather called forth and perfected their genius for literature. The sciences were assiduously cultivated, and men of learning received the warmest patronage and the amplest encouragement from those great and opulent men whose wealth was immense, and whose traffic was in states and kingdoms; indeed, many of those great men were themselves the favorites of the muses. They studied the liberal sciences and elegant arts with a diligence scarcely known in modern times. Scipio Africanus, according to the testimony of Cicero, was as eminent for mental improvement, as he was in the art of war. Cato was a man of great learning and wisdom; and those great men who composed the two triumvirates, especially the first, were highly accomplished in the liberal sciences.

When we consider that Cicero was a professional man—that for a course of years, many of the most important causes in the vast republic were ably managed by him—that he was a statesman and a great leader in the politics of his time—that he was, at times, a civil magistrate, a soldier, and a governor, and patron of provinces, we may truly be astonished at the extent and success of his studies. His voluminous writings which have come down to us, and which form the most perfect standard of classic excellence, leave us in doubt which to set foremost, whether the strength of his understanding, or the powers of his imagination—or which we shall admire most, his genius or industry. It is no partial admiration by which those writings are preserved: the united voice of all enlightened nations have declared their merit, and judged them worthy of immortality. The same may be said of the writings of Virgil, and Horace, and many others. But the approbation of men of taste and learning, in all nations has set the literary productions of the Augustan age above all panegyric. They will be read and admired so long as works of genius and taste are held in estimation. The Roman empire now appeared in its utmost splendor. Though less virtuous and happy, and probably less powerful than in former periods, yet the concentrated wealth of the world, the external pomp of so vast a monarchy, threw round her a dazzling glory which the most distant nations beheld with admiration and dread. Embassadors from remote kingdoms daily arrived to do homage, to court alliance, or solicit protection.

Augustus held the reins of government: there was no competitor—no rival. The people long fatigued with war, were very glad to enjoy peace, though under the reign of a despot. There was no Brutus nor Cassius to conspire or to assassinate. Cato was no more; and Cicero, one of the last luminaries of Rome, had been murdered, and his head and hands cut off and fixed upon the tribunal, where the thunders of his eloquence had so often struck terror to the hearts of tyrants. The spirit which animated the Romans in the days of Fabricius was gone for ever; liberty had taken her flight from the earth, or had retired to the sequestered bower of the savage, while gorgeous pride lifted her head to heaven, and trampled on innocence, equity, and law. Augustus was an artful, insidious tyrant: whilst one of the triumvirate, he had been careful to destroy all the virtuous men who had escaped the bloody proscriptions, the civil wars, and the violent commotions which were before his time. When his power was confirmed, he endeavored to fascinate the people—to lull them into security—to inebriate them with luxury—to dazzle them with his pomp and glory, and by all possible means to extinguish in them the true Roman spirit, and so to qualify and sweeten slavery itself, as to cause them to drink it down with a pleasing relish: he succeeded; for never was a people so changed in temper, habit, mode of thinking, and national character. But detraction itself cannot deny that Augustus was a General, a Statesman, and a very great man. Though void of the magnanimous spirit of Cincinnatus, Brutus, and Regulus, yet he affected to revere the character of the ancient Romans, and seemed desirous that a semblance of freedom should still mark the character of his countrymen. When he saw himself in the undisturbed possession of empire, the severities of his administration relaxed, and he held the reins of government with lenity, dignity and wisdom. Few monarchs have enjoyed a longer or more prosperous reign. His genius was less warlike than that of Julius Cæsar; yet in the course of his reign, he had various opportunities of showing himself capable of commanding armies and of directing very extensive military operations. But his greatness was of the tranquil and pacific kind, and he showed little ambition to enlarge his dominions. The reign of Augustus was active, energetic, and long. It was his boast that he found Rome built of brick, but that he left it built of marble.

The Roman empire, during a period of 210 years from the accession of Augustus to that of Commodus, contained the middle and southern parts of Europe, the northern parts of Africa, and the western parts of Asia. In the directions and advice of Augustus to his successor, it was warmly recommended that the empire should not be enlarged: accordingly, the weak and effeminate Emperors had no inclination nor ability to do it, and the valiant and warlike generally found business enough in defending what they already had; while the wise and prudent were sensibly impressed with the propriety of the advice of Augustus. The empire was, indeed, of vast extent; and if we cast our eyes upon a map, we shall directly see that it comprehended, as an elegant historian remarks, "the fairest part of the earth, and the most civilized portion of mankind." During this period, however, very considerable additions were made to the empire, and we believe, more or less in the three quarters of the globe. In Europe, the Gallic and German provinces were enlarged, the island of Great Britain was subdued, and several large countries on this side and beyond the Danube, as Illyrium, Dacia, Pannonia, &c. The Emperor Trajan, in order to prosecute the war with the Dacians, erected a stupendous bridge across the Danube; the ruins of which remain to this day, and afford a sublime specimen of ancient architecture.

The cruelty, depravity, folly, and enormous vices of the Emperors generally form a striking feature in this period. They seem to have been utterly lost to all sense of justice, honor or duty. Had they followed the examples of Julius or Augustus Cæsar, the Romans would scarcely have had reason to regret the establishment of a form of government which rescued them from deplorable wars and wasting revolutions, urged on by the rage of various powerful parties succeeding one another. Indeed, it is surprising that the illustrious examples of those great men should be deserted immediately, and so soon forgotten; and it can be accounted for in no other way than by supposing that the reins of government fell into the weakest and vilest of hands. When we consider the advantages the first Emperors of Rome possessed, it can scarcely be doubted that many of them were the lowest, the most detestable and abandoned villains that ever swayed a sceptre. The Kings of the Ottoman Turks, though barbarous and bloody tyrants, were almost without a stain in comparison with those "harpyfooted furies." The Henrys and Edwards of England; the Louises of France; the Gothic, and Chinese monarchs were sages, philosophers, philanthropists, and saints, in comparison with them; nor can we read the history of Rome without wondering how it was possible for that once powerful and magnanimous people to be so sunk and depraved as to endure the tyranny of such monsters, instead of hurling them with indignant scorn from the throne which they so deeply disgraced.

If the fate of Poland, in our own times, stands as a beacon exhibiting a dreadful testimony to the nations of the earth of the effects of bad government; we may certainly derive a still stronger testimony from this period of the Roman history. The wars of Marius and Sylla, of Cæsar and Pompey, and of Augustus and Antony, had demonstrated the power of individuals to enslave the State. Those wars had almost exterminated the ancient Romans—they had extinguished almost all the great and eminent families, and quite all the great men who dared to speak and act like Romans. At the same time an immense multitude of foreigners from all parts of the world poured into Rome; and the army, which always governed Rome, was composed of a mercenary rapacious crew, as void of public spirit as of all sense of justice and honor. An empire governed by a Prince as profligate and abandoned as weak and ignorant, and who was merely the tool of a mutinous, ill-disciplined, and vicious soldiery, must certainly experience the worst of governments; and must feel their worst effects: accordingly, the lustre of Rome faded—her power decayed—her virtue and happiness were for ever lost, and she was abandoned to every evil and calamity.

From various internal causes, the strength of the Roman empire declined greatly during the two first centuries of the Christian Era; she was not only absolutely but comparatively weaker. Many of the Asiatic provinces seemed only to observe a nominal subjection; and the Parthians, especially in that quarter, gained strength, rose and triumphed, and set Rome at defiance. The nations of Gaul and Germany grew strong, and often showed signs of revolt, and even indications that they were one day to trample upon the ashes of their conquerors.

The Romans soon gave melancholy proofs of the decay of learning, as well as of civility and politeness. We have spoken of the deplorable fate of Cicero. Augustus, under the infamous pretence of appeasing the resentment of Mark Antony, had murdered and mangled the great man. The crafty tyrant well knew how necessary it was for him to silence that eloquence which must have shaken his throne, and to exterminate that virtue which must have thrown continual embarrassments in the way of his ambitious schemes. Mæcenas, the great friend of Virgil and Horace, still lived; but he only lived as a flatterer, to form new modes of adulation, and to act the cringing parasite. In the course of the reign of the twelve Cæsars, the Roman horizon, which had been once illuminated with one immense constellation of poets, orators, philosophers, statesmen, heroes, and sages, was left in dreary darkness. And if we descend to the reign of Commodus, we shall see few lights on that once splendid horizon, but such as most resembled the horrid glare of tartarean fires. Yet the names of Seneca, Lucian, Pliny, Josephus, Quintilian, Tacitus, Juvenal, Plutarch, Justin, and Galen, were scattered down this tract of time; long after which Longinus flourished; and Marcus Aurelius, the Emperor, was a great philosopher, and an ornament of the republic of letters.

The nature and form of the Roman legion, a military establishment and grand instrument of the Roman power, by which Rome conquered and governed the world had been improved through every period of the republic, and greatly so by Julius Cæsar, as well as by some of his successors. The main strength of the legion consisted in a body of infantry, divided into ten cohorts and fifty-five companies, which companies were more or less full. Each cohort was commanded by a Prefect or Tribune, and each company by a Centurion. The first cohort, which always claimed the post of honor and carried the eagle, contained 1,105 soldiers, the most approved for bravery and fidelity. The remaining cohorts consisted each of 555; and the infantry of a legion, in its most improved state, amounted to 6,100 men. Their arms, which were uniform, consisted of a helmet with a lofty crest, a breastplate or coat of mail, greaves on their legs, and on their left arm a concave buckler, of an oval form, four feet in length and two and a half in breadth. The buckler was formed of light wood, covered with bull's hide and strengthened with plates of brass. The *pilum*, a long and heavy spear, was the most effective of the Roman weapons. With this they usually conquered. It was about six feet long, and terminated in a triangular point of steel eighteen inches in length. This dreadful javelin, when "launched from the vigor of a Roman arm," often pierced helmets, breast plates, and bucklers; nor was there any cavalry that chose to venture within its reach. When the pilum was thrown, which was commonly within the distance of ten or even six yards, the soldier drew his sword and closed with the enemy. The sword was a two-edged, short, well-tempered blade, fitted to strike or push, the latter of which the Romans were instructed to prefer.

The legion, in battle array, stood eight deep, preserving the distance of three feet between both the ranks and files; so that each one had a sufficient space to move and wield his arms in; and this loose order gave great celerity to their movements. It is remarked, perhaps justly, by Mr. Gibbon, that the strength of the phalanx was unable to contend with the activity of the legion. But could the phalanx of Alexander have contended with the legion of Julius Cæsar, each under the eye and animated by the spirit of those great commanders, a different conclusion perhaps might be drawn. A body of cavalry, consisting of ten troops or squadrons, was an essential appendage of each legion. The first troop of horse was the companion of the first cohort and consisted of 132 men. The other nine consisted each of 66 men, and were attached to the remaining nine cohorts. The cavalry of a complete legion amounted to 726 men. Their defensive arms were, a helmet, a very oblong shield, light boots, and a coat of mail. Their effective weapons were a javelin and a long broadsword. Thus the regular infantry and cavalry of a legion amounted to 6,826 men; besides which, several light armed troops, called auxiliaries, where attached to it, which, together with all the various attendants for baggage, &c, swelled each legion to upwards of 12,000 men. To every legion were assigned ten engines of the larger size, and fifty-five of the smaller, for throwing large stones and heavy darts. The force of these engines was such as to produce astonishing effects on walls and towers, and they are thought by some writers of note to have been little inferior in utility to cannon. The camp of two complete legions usually occupied an exact square of nearly 700 yards on each side. This spot was levelled by the pioneers, and the tents were then pitched in the form of regular, broad streets—the prætorium or General's quarters in the center. The whole square was then surrounded by a rampart 12 feet high, compactly formed of wood and earth, and also inclosed by a ditch 12 feet broad and deep. When this camp was to be left, it is incredible how soon the legions would be in motion. Their tents being struck and packed, each legionary loaded himself with his arms, kitchen furniture and provisions, sometimes for many days; and, with this weight, which says Mr. Gibbon, would oppress the delicacy of a modern soldier, they would march, by a regular step, 20 miles in six hours.

The military discipline of the Romans was exceedingly strict. They were accustomed to various athletic exercises; and their armor in running and leaping, was scarcely considered as an incumbrance. Such were some of the military arrangements of the Romans; and, in order to form some idea of their armed force, it may be observed, that the peace establishment of Adrian and his successors consisted of thirty of these formidable legions, which were usually stationed on the banks of large rivers, and along the frontiers of their extensive dominions. The author just cited says, that under the Emperors, the legions were more or less permanently stationed, as follows, viz. *three* legions in Britain—*sixteen* on the Rhine and Danube, where it was early discovered that most force was necessary—*eight* on the Euphrates—and in Egypt, Africa, and Spain, a single legion was sufficient for each. Besides all these, a powerful armed force was always stationed in Italy, to watch over the safety of the capital, and of the Emperor. These were called city cohorts and prætorian guards; and we shall see hereafter, that these troops were principally instrumental in the ruin of the empire.

From the fall of the Roman empire, a period of darkness ensued, equally dreadful for its length and for the number and greatness of its calamities upon mankind. To trace the history of those times, is like making a progress through chaos, amidst upper, nether, and surrounding darkness. We will first notice the fortunes of Constantinople, commonly called the Eastern, and in late periods of history, the Greek empire. The successors of Constantine, whom, in this article, it will be impossible for us even to name, were more fortunate in the east than in the west. The numberless swarms of barbarians, which, in these times, poured down from the north of Europe, generally directed their course more westwardly and inundated France, Spain, Italy, and even Africa. The empire of Constantinople was various in its extent; sometimes its territories were very extensive, and at others were limited almost to the city walls. But this city was destined to enjoy a great and almost peculiar felicity. It stood unrifled and unimpaired through all the storms and revolutions of the dark ages. It was never taken by the barbarians of the north, nor of the east. It was even fortunate enough to escape the rage of civil war, and to survive for many ages to triumph over the vices of its degenerate inhabitants; till, at length, it was taken by Mahomet II., Emperor of the Turks, in the year 1453,—977 years after the conquest of Rome by the Goths. During this long period, the reader will find few things in the history of Constantinople worthy of very particular notice. That empire neither abounded in heroes, philosophers, poets, orators, nor historians. Yet the preservation of that one city to so late a period, was certainly an importan link in the chain of events which restored the arts and sciences. The writers of the Middle Ages, and especially the Crusaders, speak in the highest terms of the greatness and splendor of Constantinople. Her final subjugation to the Turks appears to have been a just judgment of Providence upon her, since, though bearing the Christian name, she almost uniformly carried a hostile front to all Christian powers—made more wars upon them, and exercised more animosity towards them, than she did towards Pagans and Mahometans. If we except Constantinople, the whole of Europe, from the fall of Rome to the establishment of Charlemagne, resembled a troubled ocean. The most splendid cities, the most populous countries, and the most delightful regions of the earth, were harassed and overwhelmed with ruin and desolation. We naturally first turn our eyes toward Italy, whose wretched inhabitants were the severest sufferers of all. The historians of those times say that their sufferings exceeded all conception—that neither pens nor pencils can describe the barbarity, the rage, and the violence of their savage conquerors. All their effects were converted into plunder; their men of every age and character were put to the sword or dragged into slavery; their women subjected to the most brutal violence, and their cities and villages wrapped in flames.

We can give the reader no juster idea of the miseries of Rome, than by noticing to him, that during this period, that devoted city was besieged and taken by storm five times in the space of twenty years. Those northern invaders, after having conquered and in a measure destroyed the unwarlike inhabitants of the Roman provinces, fell with a fury upon one another, and several gloomy centuries were wasted away in the horrors of the most bloody and desolating war. The Mediterranean Sea did not secure the northern shores of Africa from those terrible invasions. An immense horde of Vandals found their way thither and settled in those fruitful countries. But their settlement, so far from taking a regular, consistent and pacific form, remained a perpetual scourge, and accomplished the utter ruin of those once opulent regions. Mankind in those unhappy times, seemed utterly lost to all mental improvement as well as to all sense of humanity. For several ages the whole human race scarcely produced one ornament, or could boast of one illustrious character to illumine the universal gloom, or to cast a partial beam of light through the intellectual chaos; so far from it, that those days were spent in destroying the noblest works of art and genius. A diligent search was made for the most valuable productions of antiquity, not to preserve and treasure up, but to demolish, to burn, and to destroy. Nor did barbarians alone pursue the work of destruction; the superstitions of the apostate Christian Church, in too many instances, lent their aid to that infernal work. In this cursory survey, it would be impossible to notice the slight shades of difference in the situation of the numerous provinces of the Roman empire. And as these times produced no historians, it would be arrogance to attempt to tell the reader what was going on,generally speaking,in the eastern parts of the world. We could say little more than that the empire of China stood firm in its strength, having already flourished for many ages. India and Persia have been subject to changes, divisions and revolutions from time immemorial—especially the former; and the Greek writers are, perhaps, the only historians who ever wrote correctly the Persian history. It was but partially known before, and has been far less so, since the Augustan age. The north of Europe was only known by the incredible swarms of barbarians which issued from it, and overwhelmed the civilized world. Of the history of Arabia we shall soon have occasion to speak; and concerning the immense interior of Asia, commonly called Tartary, the best of modern geographers are yet almost wholly ignorant, as also of the middle regions of Africa. The Island of Great Britain has been known in history since the time of its conquest by Julius Cæsar. The Britons made a formidable resistance to his arms, and were never but partially conquered. When the Roman empire fell, that island shared in the general calamities. The British called over to their aid the Saxons, a nation from Germany, to assist them against the fury of the Picts and Scots, by whom they were invaded. The Saxons, led by Hengist and Horsa,two powerful chieftains readily obeyed the call, and, according to the fashion of the age, came over in such numbers, as not only to repel the Picts and Scots,but to conquer and enslave the Britons themselves. They therefore settled in the southern part of the island, and at length erected themselves into seven petty but independent kingdoms, commonly called the Saxon heptarchy. These were at length united into one government by Egbert, who, about the year 800, reigned over them all and founded the English monarchy. This brings the English history to the close of the period which was to be the subject of the present article. Arabia forms the southwest corner of Asia. It is a tract of country considerably more than a thousand miles square, and is peninsulated by the Persian Gulf on the east, and the Red Sea on the west of it. This great country is supposed to have been peopled originally by the family of Ishmael the son of Abraham. Of Ishmael it was foretold, that he should be an archer,and that his hand should be against every man, and every man's hand against him. This prediction seems to have been fully accomplished in his posterity. The Arabs have ever been excellent horsemen and archers, formidable with the bow and the lance,and they have been wild men, and have dwelt in the desert. A singular circumstance in their history is, that they have never been conquered or subjugated by any nation, although it has been attempted successively by the Chaldeans, the Persians, the Romans, and in late ages, by the Turks. In the beginning of the seventh century,a fire broke out in Arabia,which for a while, threatened to involve in its flames all Europe and Asia. It is remarked by an able historian, as a wonderful synchronism, that the very same year in which the Roman pontiff was proclaimed universal bishop, Mahomet, the grand impostor, forged the Alcoran in a cave of Mecca. The usurpations of the Romish church were complete—the beast was at its full growth, and was then ready to begin his reign. It would thence seem probable, that the beast and the false prophet began and will end their career nearly together.

It is a matter of doubt, whether the great exploits and astonishing elevation of some men, are to be set down to the account of their extraordinary natural endowments, or to a favorable coincidence of events in the world around them. Mahomet, from an obscure parentage, birth and education,rose to a height, and with a rapidity, almost without a parallel. From the occupation of a tradesman he retired to a cave in Mecca, where he pretended he had frequent interviews with an angel, by whose assistance and direction he wrote the Koran on the plate bones of camels. He at length issued from the cave, and began to publish his mission to the people of Mecca. A storm was soon raised against him there, and he fled from Mecca to Medina, in Arabia. This flight the Mahometans call the *hegira*, and regard it as their grand epoch, as we do the birth of Christ. The followers of Mahomet soon became numerous—he subdued or rather revolutionized his native country, and, in a short time, all the neighboring countries. His religion spread with his arms, and was embraced wherever he conquered.

The Saracens, as Mahomet's followers were called, after his death still pursued their conquests; and, in a very short time, all the west of Asia, the north of Africa, and the south of Europe were overrun by this dreadful inundation; which, if possible, was more sanguinary and exterminating than that of the Goths and Vandals. A final stop however, was put to the progress of the Saracens in Europe by Charles Martel, who defeated them with great slaughter near the Pyrenees killing, it is said 370,000 of them in one day. This battle was fought in the year 734.

Mahomet declared himself to be the prophet of God, sent into the world to enlighten and reform mankind; and that he was clothed with greater light and powers than either Moses or Christ. His doctrines and morality were drawn from such sources as would best suit the prejudices, and obtain currency among the nations whom he conquered. They were extracted from the Jewish and Christian Scriptures—from oriental traditions—from the legendary trash of the rabbies, and indeed, from the inventive genius of Mahomet himself, whose knowledge of mankind enabled him to foresee how they might easiest be led and governed. He taught the unity of God, and the universality of his providence, or rather, in the strictest sense, the doctrines of the fatalist.

His scheme of morality allowed the full indulgence of the passions, being exactly suited to the most depraved mind; and he so managed the affairs of a future state, that they could have no influence in favor of virtue or in opposition to vice.

It was not without reason, that he relied on the natural disposition of men for the ultimate success of his doctrines, but his main arguments, for their propagation, were fire and sword.

The kingdoms of Europe in general, as to their extent and boundaries, seem to have been parcelled out by accident, or more properly by nature. Spain is marked out by oceans and mountains—France by oceans, mountains, and rivers—Germany and Italy in like manner. As early as the period under consideration, some remote vestages may be discovered of the present European establishments. Early in the sixth century, Clovis laid the foundation of the French monarchy; at which time the rage of emigration by nations had generally subsided, either because the wilds of Europe had poured forth all their daring spirits, or because a general repletion of the southern provinces had rendered a kind of reflux necessary. No part of Europe had oftener been traversed and ransacked than France; but as they found less plunder there, they generally pushed forward to other countries. The Franks at length made a settlement there, after having driven out and destroyed several Gothic nations, who had previously dispossessed the Romans and ancient Gauls. From the Franks the country is supposed to have obtained the name of France. The Franks, after maintaining long and bloody wars with subsequent invaders for several ages, at length found themselves united by a more regular form of government under Clovis, who is reckoned the founder of the first dynasty of French monarchs.

During the period now before us, the face of Europe was changed,as we have already stated, by the Gothic and Saracen eruptions. The first care of these barbarous invaders was to destroy and forever to obliterate the inhabitants, the institutions, the manners and customs of the countries which they subdued. A far more difficult task than this was to maintain their acquisitions against subsequent invaders: for the north of Europe, like an immense storehouse of nations, poured forth innumerable hordes, in rapid succession. These were equally hostile to each other, and knew nothing but to make war—to kill and ravage wherever they came. Whether it was owing, however, to the softening influence of mild climates, combined with the scattered rays of science, humanity, and order which had escaped the overwhelming flood of darkness; or whether to the imperceptible influence of various unknown causes upon individuals—the people in the south and west of Europe, instead of sinking into a savage state, began, in the sixth century, to assume a regular form of government, which, though bad in itself, yet, under the influence of a natural course of causes ultimately led on to the present state of Europe. The northern barbarians entertained a high sense of freedom, and each of them considered himself as entitled to a liberal share of whatever his tribe should conquer. Each great chieftain, therefore, granted out and divided the conquered lands to the high officers next himself, and they subdivided the same among their followers or vassals; under this express condition, that each man should do military service a certain part of his time to his immediate lord, and that each lord or great vassal of the court should also do military service to the Grand Chieftain or King. This division of property which prevailed in every part of Europe, was grounded wholly on military policy: it became, in fact, the only organized system of defense for several centuries, and has obtained the name of the *feudal system*. This system of property, government, and war, although it must be regarded as a happy change from a direful plunge of the human species into anarchy, and all the degradations of a savage state, yet was radically defective and certainly conduced to protract the ages of darkness. Still, however, it left room for the slow operation of causes which would naturally correct, improve, and elevate the human mind; and which would at length originate other causes, far more efficient and rapid in rending the veil of darkness, and once more ushering the nations into the light of science and civility. Those who would see this subject handled with great elegance and perspicuity, may find it in the first volume of Dr. Robertson's History of Charles V. We shall here only observe that the exorbitant power of the middle order was the grand defect of the feudal system. The great lords held the power of life and death over their own subjects; and also the right of making war in their own defense. Of course, if with such an extent of prerogative, they confederated, they always outweighed the King—if they were at war with each other, which was often the case, the King had no control over them, because it was impossible for him to raise or command an army without their assistance. On the one hand, therefore, the hands of the monarch were tied; and, the other, the lowest order were little better than abject slaves to their immediate governors. The feudal governments were at no great remove from the very worst of oligarchies. The want of power in the prince, and the force of the nation so divided, rendering them weak against invasion. This weakness was increased by the jealousies and turbulence of the great lords, who frequently occasioned civil wars, and at length reduced them to a state of anarchy, from which they could only be recovered and re-united by union, and a strong sense of common danger.

In the midst of the fluctuating waves of war, revolution, and anarchy, the powerful genius of Charlemagne erected a new empire in Europe; which, for a moment bid fair to cut short the reign of darkness, and re-establish those institutions which improve and adorn society. His dominion comprehended the fairest parts of Europe; France, Germany and Italy. This event took place in the beginning of the ninth century. But as nothing can be more uninteresting than the sterile histories of the wars and revolutions of the dark ages, so, even what is known of the battles, the sieges, the victories, the conquests, the elevation, and the grandeur of Charlemagne, will be little more improving to the reader of history, than to tell him that Charlemagne was a soldier of fortune—that he fought bravely, and was generally victorious; in a word, that he established a huge empire, consisting of a heterogeneous mass of crude materials—incongruous, disjointed members, and which he governed for several years not by any regular plan of civil policy, which the nations were then as incapable of receiving as of organizing, but by a strong military arm, which he wielded with dexterity and success; and that, when he expired, his empire fell into pieces. In justice, however, to this great monarch, it must be noticed that he was far from resembling the fierce, cruel, and barbarous chieftains of the Goths or Saracens. Instead of deserving the title of Attila, *the scourge of God, and the terror of men*, he is justly celebrated for cultivating the arts of peace—for encouraging men of learning and wisdom, and for promoting various important civil institutions. Perhaps, but for him, Europe had still remained under the cloud of Gothic ignorance. He merits an honorable rank among those great and powerful minds, which evinced the possibility of checking the strong current of the times; and, could he have lived and reigned for a century, he might have raised Europe from her degraded state. But time, and a long series of events, could only mature those seeds of order and virtue, which under his administration began to vegetate, but which, in a manner, disappeared with him, and left the world in still palpable darkness.

During the 283 years following the reign of Commodus, and up to the extinction of the Western Empire under Augustulus, there is little else to contemplate but the most deadly disorders, the most agonizing struggles, and the deepest and most ostensible decay. But an empire containing a hundred and twenty millions of people—founded in power, wealth and policy—strengthened by every auxiliary of human greatness—triumphing over all enemies, and elevated almost beyond the reach of invasion, could only perish by the gradual progress of internal disorder. The misfortunes of Rome sprung from her own bosom, and it can scarcely be said that she had enemies, till she had formed and trained them to the arts of war. In the 180th year of the Christian era, Commodus ascended the throne. No reign was more inauspicious than his, nor is the memory of any prince more deeply covered with infamy. He formed a perfect contrast to his illustrious father, Marcus Aurelius. It would be impossible in this compend to draw a character more black, detestable and depraved than that of Commodus. A detail of his vices would occupy more space than we can allow to the whole subject of this article. We can say but little more than that, during his reign, the administration of government was totally abandoned, and the numerous props of a falling empire, which had existed a century before this, were now no more. At the seat of government there was nothing but luxury, riot and murder. In the provinces, extreme disorder, rapacity, misery and revolt prevailed. On the frontiers, the burning of cities and the blood of thousands marked the footsteps of invasion. In Italy, disaffection, conspiracy, jealousy, terror, detestation, revenge, fury and despair, surrounded the throne—filled the capital—inspired every heart, and painted destruction on every face. In the army there was licentiousness, outrage, mutiny and desertion. The soldiers, in multitudes, forsook their standards, and in numberless and fierce banditti, infested the highways. The redress of wrongs and the recovery of rights expired with civil justice; and while the empire felt those strong but vain struggles, which were occasioned by the reaction of her natural force, her union, power, and military reputation vanished, and left her an immense chaos of discordant principles. An illustrious parentage gave high expectations of Commodus, but his conduct soon banished all hopes. He exhibited cruelties at which even Nero would have shuddered, and he was even more effeminate than Sardanapalus. It seems a pity, for the honor of humanity, that the name of so infamous a monster should have been preserved. His feeble and licentious reign produced calamities to his country, after his vices had destroyed him, and he was no more. He was no sooner taken off by a conspiracy, conducted by his favorite mistress, than the choice of the army and senate clothed with the imperial purple, Helvetius Pertinax. He was above 60 years of age had served under the illustrious Antonines—and was always noted equally for bravery and wisdom. He had risen from a private soldier, through all the grades of military honor to that of prætorian prefect. With modesty and reluctance he assumed the diadem, which he was destined to wear and to grace only long enough to demonstrate his merit, and to enroll his name amongst the most excellent of the Roman Emperors.

If the degenerate Romans discovered their mistake, in elevating to the throne a man whose administration was utterly repugnant to their wishes, he much sooner discovered his, in thinking it possible to renovate the empire, now going rapidly into an irrecoverable decline. The Roman armies, which under the Scipios had subdued Africa and Asia—which under Cæsar had extended the empire beyond the Danube, and which under Trajan had conquered beyond the Euphrates, were now the scorn and ridicule of the barbarians. Through a total want of discipline, all subordination was lost—all military spirit; nothing remained but discord, sedition and outrage. Pertinax commenced an administration vigorous, systematic and comprehensive. The empire, through her wide regions felt his power, and saw and revered the equity that marked all his movements. It was soon perceived that Pertinax would aim to suppress those irregularities and restore the discipline of the army to its ancient severity—that he would revive the institutions of civil justice, and retrieve the fallen dignity of the Roman name. But alas! his noble intentions and excellent schemes could not be effectuated by mortal prowess; the nation was too far gone—too deeply sunk in vice and luxury. The palace, the court, and the capital were filled and surrounded with a swarm of execrable villains, whom the vices of Commodus had rendered necessary—whom his weakness had emboldened, and the corruption of the times had furnished in abundance. His first care was to displace these—to exalt men to power who were worthy to rule, and to restrain and punish the insolence of the prætorian guards.

He had just entered on this salutary but arduous work, when he was informed, one day, that a mutiny was raising in the army. He had only time to walk to the gate of his palace, when he perceived a large body of soldiers rapidly advancing with angry clamors and menacing imprecations. As they drew near, he stood his ground and with a firm dignity demanded their business. Without making any reply, a Scythian soldier struck him dead at a blow. His head was severed from his body and carried on a pole to the camp; where immediately after the empire was offered at public sale to the highest bidder. It was bid off by a sordid wretch, who assumed the purple, but who, in a few days, suffered all the severities of the fate of Pertinax, without any of the pity and regret which will follow the memory of that great man to the latest posterity. It is a matter of regret that so little is known of Pertinax, that so few circumstances have escaped oblivion, which would more clearly elucidate his private character; and especially, that so short a time was allowed him for displaying the energy of command, the wisdom of legislation, and the greatness of man. Historians, however, unite in allowing him to rank with the most worthy men who ever governed Rome. His energy was guided by justice—his authority was tempered with sweetness, and all his supereminent qualities combined to form a character truly great and amiable. Were it safe, however at this distance of time, one might conjecture that he was too severe and hasty in his first essays of reformation. Had he, by some politic and impenetrable movement contrived to separate and remove to a distance his licentious soldiery, till he could have levied and disciplined an army to his mind, perhaps he might have enjoyed a longer and more fortunate reign. But what power can renovate a nation totally effeminate and corrupt! Pertinax, by his abilities and address, ascended from the lowest to the highest rank among men. His reverses were so numerous, great and sudden, that historians have given him the peculiar appellation of the *tennis ball of fortune.*

From the death of Pertinax till that of Augustulus, the last of the Roman Emperors of the West, was 282 years, during which time no less than fifty-six Emperors swayed the sceptre in succession. Their names it is not necessary to record; and for an account of their vices (for little more is recorded of them), the reader must be referred to the history of the decline of the Roman empire; on which part of history, Gibbon is the ablest and most elegant writer in our language. The artful and insidious endeavors of that writer to subvert Christianity, and to substitute, no one knows what, in its place, are obvious to every reader; yet his merit as a writer cannot be questioned; and although his opposition to Christianity betrayed him into many gross absurdities suited to the complexion of his prejudices, yet his history of the decline and fall of the Roman empire is one of the noblest of historical productions. So much has been already said concerning the decline of the Roman empire that the reader may be surprised when he understands that it stood upwards of two centuries after this period. But that empire could only die a lingering death. West of it lay the Atlantic Ocean, south lay Africa, which, since the fall of Carthage, was without power, east lay Asia, dissolved in luxury, always ready to be conquered, as soon as attacked, and enslaved as soon as invaded; and so far from subduing Rome that they were even too effeminate to maintain a form of government over themselves.

The barbarous nations which lay north of the empire were indeed numerous and warlike; but they could not subdue the Romans, till they had learned of them the art of war. And the power of Rome, under the Emperors, lay chiefly in the nothern provinces, where it was most needed. As we have already said, sixteen or twenty legions generally lay bordering on the Rhine and Danube. The barbarians, in these times, were generally poorly clothed and fed, and had few arms, as well as little knowledge of the art of war. Their invasions were like those of a hungry lion, whom fierce appetite impels to rush on the point of the spear, in order to seize its prey; and their chief difficulty was want of union. Their tribes were composed of warlike, fierce, impetuous spirits; but they were unsettled, barbarous, roving, independent, and jealous of the power of their chiefs, as well as tenacious of the honor of their tribes. Yet the nations composing the northern hive could not but experience a gradual improvement. Their proximity to a great and enlightened people, with whom they were at perpetual war—their strength of body—their intellectual vigor, and their ambition to acquire those arts which had so long rendered the Romans invincible, must, in time, have produced their natural and unavoidable effects. In the barbarian armies and countries there must have been a multitude of Romans; numbers having fled from justice, or induced to rove, from disgust at their own capricious and tyrannical government, would naturally seek an asylum in the wilds of Europe, and among a more free and equitable people. Numbers being detained there would, at length yield to necessity, and voluntarily remain in a land, whither they had been dragged as captives, assimilating by degrees to its customs and habits.

The Gauls and Germans, from the period now before us, composed the strength of the Roman armies; and great numbers of these nations, whom we shall indiscriminately call the Goths, and Vandals, and Huns, were now admitted into the Roman service, either as legionaries or auxiliaries. Some of them were promoted to the highest stations, both civil and military, and even wore the imperial diadem and purple. Many of these, either never had, or else lost all attachment to Rome; and rejoining their countrymen, carried and diffused among them the arts of war, and advantages of disciplined valor. From the reign of Commodus to the extinction of the Western Empire, history presents one uniform scene of disorder, vice and misery. We have almost constantly before our eyes, a great empire going rapidly to destruction under the influence of bad government. A very few of the Emperors, however, during this dreary period, were both able statesmen and commanders. Had it been their fortune to have reigned in happier times, and over a more virtuous people, their administrations would have done more important service to mankind. But their best measures and greatest exertions, seemed only to have the effect of medicines given to the sick after his disease has become incurable; they might a little procrastinate, but could not prevent the moment of dissolution. About the year of Christ 267, the Emperor Valerian was taken prisoner by the Persians, when no less than thirty persons in various parts of the empire assumed the imperial purple, with the titles of Cæsar and Augustus; and each of them endeavored to support his claims and titles by the sword. There can be no stronger proof than this of the extreme wretchedness of those times. All was tumult, war, distrust, cruelty and the most bloody revolutions. But there are two circumstances in the period of history now before us, which merit the particular attention of the reader, viz. the establishment of the Christian Religion throughout the empire, by means of the conversion of the Emperor Constantine, surnamed the Great; and his removal of the seat of government from Rome to the ancient city of Byzantium, which he rebuilt and called Constantinople, or the *City of Constantine.* We have already noticed the rapid spread of the Christian Religion. In the days of Constantine it had penetrated almost every part of the empire. No sooner, therefore, did that prince declare in favor of it, than it became the religion of the court, the capital, and soon of the empire itself. This was truly an amazing change, and forms one of the most memorable æras in ecclesiastical history; a meek and humble religion unknown to the world, or if known, despised and persecuted, set on foot by a few obscure persons in Judea, and propagated only by the force of rational conviction, spread and prevailed against all opposition overturned the altars and silenced the oracles of the heathen; and at last, through hosts of prejudices fortified by antiquity, and sanctioned by universal custom, made its way to the throne of the Cæsars. It was like a "stone cut out of a mountain without hands, becoming a great mountain and filling the whole earth." There are various accounts given, and various opinions formed, concerning the conversion of Constantine. Whether his mind was swayed by the power of truth, or by temporal, political and interested motives, is not easy to determine. It is related and believed by some that his conversion was miraculous. They say that he saw in the heavens the sign of the cross, with this inscription in radiant letters, *By this conquer*, and that upon this he immediately embraced Christianity. His life and conduct were by no means eminent for christian virtue, nor was he wholly free from crimes of the deepest die.

From this period the Christian Church was loaded with honor, wealth and power; nor did her virtues ever sustain a severer trial. The chief dignitaries of the empire could scarcely do less than imitate their master, and Christianity soon became a necessary qualification for public office. The church now no longer appeared in her ancient simplicity and purity; lords and princes were among her converts, and she was dressed in robes of state. Her ceremonies were increased—her forms of worship were loaded with pomp and splendor—her doctrines were intermingled with the senseless jargon of a philosophy equally absurd and vain; and the way seemed prepared, not only for the decay of Christian doctrine and morality, but of every science which distinguishes civilized from savage nations. After various wars and competitions, Constantine, in the year of Christ, 320, became sole master of the Roman empire. He certainly did whatever could be done, by an accomplished General and statesman, towards restoring the empire to its ancient glory. But, alas! he did not reign over the ancient Romans. His people had been often defeated, humbled, enslaved, and trampled in the dust. The true Roman spirit was long since utterly extinguished; and, as we had occasion to observe, Italy itself was filled with a mighty heterogeneous mass of population, of no fixed character. His strong genius for a moment sustained, but could not ultimately save, the falling fabric. The ambition of Constantine gave a more fatal blow to the Roman empire than even the vices of Commodus. To secure to himself a glory equal with that of Romulus, he formed the resolution of changing the seat of empire. The place upon which he pitched as a new capital, and which should immortalize his name was indeed well chosen. The ancient city of Byzantium enjoyed the finest port in the world, on the straits of Bosphorus, which communicate with those inland seas, whose shores are formed by the most opulent and delightful countries in Europe and Asia. Thither Constantine caused the wealth of the empire to be conveyed, and directly a new and splendid city arose which was able to rival ancient Rome. That proud capital, so long the mistress of empire suddenly became but a satellite, and was forsaken by honor, wealth, and glory; since the Emperor, and all who were devoted to his interest, used every possible means to exalt the new seat of empire.

This wound was deadly and incurable. It proved fatal not only to one city, but to the western empire. Rome was utterly abandoned by Constantine, nor was it much alleviated under his successors, among whom a permanent division of the empire taking place, Rome and Italy fell under the government of a series of weak, miserable, short-lived tyrants who rose by conspiracy and fell by murder in rapid succession; till, in the 476th year of the Christian Era, Augustulus, the last of the Roman Emperors, was conquered and dethroned by Odoacer, King of the Heruli, who, at the head of an immense army of barbarians, overran all Italy, and put a period to the western empire. Thus ended Rome, after having stood 1229 years: and when we consider the length of her duration, her character, and the nature and extent of her resources, we shall not hesitate to pronounce her the most powerful and important city which ever existed, and as standing at the head of the first rank of cities. But if this remark is true of Rome in the times of which we are now speaking, it will serve to awaken our admiration, when we consider that Rome survived even this shock; and, as though destined to bear rule, from being the head of a powerful empire, she soon became the head of an ecclesiastical institution not less powerful; she spread her wings over all Europe.

Rompu.

ROMPU.— In Heraldry, a term applied to a chevron when the upper part is taken off, and remains above it in the field.

RONCONE. The name given by some authors to the *ranseur*, a kind of partizan.

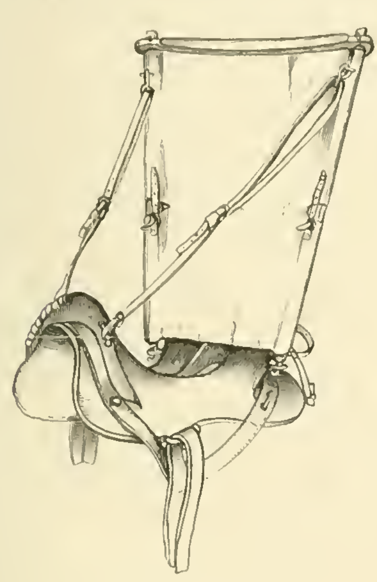
RONDACHE. In ancient warfare, a circular shield carried by foot-soldiers to protect the upper part of the person, having a slit in the upper part for seeing through, and another at the side for the point of the sword to pass through.

RONDEL. In fortification, a round tower, sometimes erected at the foot of a bastion.

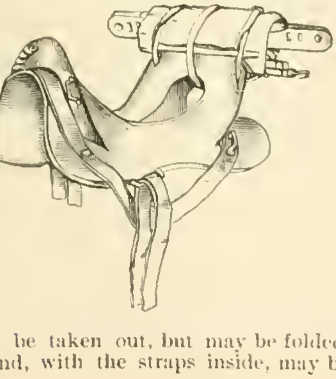
RONDELLE. A small round shield which was formerly used by light-armed infantry. It was about 1¼ feet in length. A *Rondellier* was an Archer or Pikeman who carried the *rondelle*.

RONFLEURS.— Frederick the Great applied this name to some 12-pounders of 22 calibers, weighing 32,00 pounds, which, before the battle of Leuthen, he had drawn from the neighboring fortress of Glogan. The charge for the gun was 5 pounds.

ROOKER AMBULANCE SADDLE.—An ordinary cavalry saddle, having an attachment consisting of two upright bars cut and hinged in the middle, a cross-bar at the top of the uprights to support the head, a canvas back, and two strong leather straps with buckles, so arranged as to support the apparatus



to be more or less inclined, to suit the rider. When the upright bars are placed in the canvas, they need



not again be taken out, but may be folded at the hinges, and, with the straps inside, may be rolled into a compact bundle and attached by the coat-straps to the cantle. The weight of the attachment is about 4½ pounds.

When intended to be used it may be thus adjusted: Unstrap it from the cantle and place the sick or wounded man in the saddle; insert the iron keys in the lower ends of the uprights in the eye-bolts, especially attached to the saddle for this purpose, on each side, near the base of the cantle; put on the cross-bar and key it; hook the straps to the eyelets in the upper parts of the uprights, having first buckled the lower ends of the straps into the staples in front of the pommel; then by the middle buckles elevate or depress the head, as may be required. An umbrella may be readily attached, though not an essential part of the apparatus. The form or arrangement of this contrivance is shown in the drawing. Although it possesses merit and would at times be of service, it has never been extensively used because of increasing the weight and number of articles a soldier has to carry.

ROPE.— Ropes are generally made of vegetable fibres, and differ only from twine in their much greater thickness. The fibre most commonly used is hemp; but large quantities of plantain fibre, called manila hemp, made from the leaf-stalks of *musa textilis*, are also employed, especially for the large ropes used for various purposes on board ships. Ropes consist of many thicknesses of yarn, which is spun by hand in various places called rope-walks. The spinner has a large bundle of the fibre loosely gathered around his waist, from which he pulls out a few fibres, and attaches them to a hook in the turning-wheel or whirl, which is stationary, and is worked by an assistant. Experience teaches him what number of fibres to draw out, and how to twist them so as to hold firmly on to the hook. He then walks slowly backward down the rope-ground, gradually drawing out or regulating the pulling out of the fibres so as to make an equal yarn, which receives the necessary twist from the whirl. When he has got to the end of tbe walk, another spinner takes the yarn from the hook of the whirl, and fixes it to a reel, which is then set in motion, and he attaches a second portion of hemp from his own supply to the hook, and proceeds down the walk as the previous one had done. In the meantime, the first spinner gradually walks up the ground, carefully guiding his length of yarn as it is wound on the reel. When he reaches the reel it stops, and he waits until the second spinner's length is completed. He then in his turn takes it off the hook, and twists it on to his own; and the reel being again started, receives the additional length from the second man, and so on until the full length required is made up. The next operation is called *warping*, and consists in stretching out the number of yarns required for a rope. These are all slightly twisted again separately, and stretched to an equal length. Then, if they are intended for tarred ropes, each yarn is drawn separately, either lengthwise or in a hank, through a kettle of hot tar. The superfluous tar is removed by drawing it through a hole lined with oakum. In the next process, called *laying*, two or more yarns are attached to hooks on a whirl, so that when it is turned they will be twisted together the contrary way of the original twist they received in the first spinning. When this is done it is called a strand. Then as many of these strands as are required for the rope are stretched at full length, and are attached at each end to whirls. One of the whirls has but one hook, to which all the strands are attached; the other has as many hooks as there are strands, one always being central, and a strand is attached to it. The whirls are then put in motion, but in opposite directions, and this causes the outer strands to be laid with great regularity and firmness around the central one. Such is the ordinary process of rope-making; but machines have been invented which produce ropes with such mathematical precision that the strength of the rope may be calculated with great exactness. Captain Huddart has the merit of effecting these improvements; and very few applications of mechanism are more beautiful in their details than those which he has worked out. They, however, do not alter the principle of the manufacture. Within the last few years a great improvement has been patented by Mr. Edward Sang of Edinburgh, and is now in profitable use in the large establishment of the Edinburgh and Leith Ropery Company. It consists of a machine which spins the yarn from material supplied as before by hand, but it does away with the long walk, and can be used in a small room.

Large ropes are either what is called *cable-laid* or *hawser-laid*. The former consists of three large strands, each made up of three smaller strands. A cable-laid rope of eight inches circumference is made up in this way of nine strands, each containing 37 original yarns, or altogether 333 yarns. A hawser-laid rope consists of only three strands, each containing a sufficient number of yarns to make up the required thickness. The numerous lives and the vast property depending on the efficiency of the ropes employed in shipping have caused a great amount of ingenuity and care to be brought to bear on the manufacture. One very great improvement of modern times has been the introduction of wire ropes, which are now extensively used in rigging ships, and for other purposes. They are generally made of iron wire, sometimes but not always galvanized. The twisting is effected in the same way as that in which the strands of a hempen rope are laid together.

The following table shows the weight which manila rope in daily use will sustain, simply and when rove in tackles. Hemp rope is about one-third stronger. Due allowance has been made for loss of strength by wear and tear. Look for the weight to be raised, or the next larger, in the column headed with the number of sheaves in the purchase of tackle. The circumference of the rope required will be found on the same line in the left-hand column.

Circumference in Inches.	Single.	Number of Sheaves in Purchase.				
		3	4	5	6	7
1....	540	1,080	1,350	1,485	1,620	1,755
1¼...	844	1,688	2,110	2,321	2,532	2,743
1½...	1,215	2,430	3,038	3,342	3,645	3,949
1¾...	1,654	3,308	4,135	4,559	4,962	5,376
2....	2,160	1,320	5,400	5,940	6,480	7,020
2¼...	2,734	5,468	5,835	6,519	8,202	8,886
2½...	3,375	6,750	8,438	9,282	10,125	10,969
2¾...	4,084	8,168	10,210	11,231	12 252	13,273
3....	4,860	9,720	12,150	13,365	14,580	15,795
3¼...	5,704	11,408	14,260	15,686	17 112	18,538
3½...	6,415	12,830	16,048	17,657	19,245	20,854
3¾...	7,594	15,188	18,985	20,884	22,782	24,681
4....	8,640	17,280	21,600	23,760	25,920	28,080
4¼...	9,753	19,516	24,393	26,831	29,259	31,697
4½...	10,935	21,870	27,338	30.072	32,795	35.529
4¾...	12,184	24,368	30,460	33,506	36,552	39,598
5....	13,500	27,000	33,750	37,125	40,500	43,875
5¼...	14,881	29,768	37,210	40,931	44,652	48,373
5½...	16,335	32,670	41,838	45,922	49,005	53,089
5¾...	17,954	35,908	41,885	49,373	53,862	58,350
6....	18,252	36,504	45,630	50,193	55,756	60,319
6¼...	19,805	39,610	49,513	54,465	59,415	64,367
6½...	21,421	42,812	53,553	58,908	64,263	69,618
6¾...	23,100	46,200	57,750	63,525	69,300	75,075
7....	24,843	49,786	62,208	68,418	74,529	80,740
8....	32,448	64,896	81,120	89,232	97,341	105,456

To ascertain the strain in pounds which a rope will bear without breaking, *multiply the square of the circumference by the tabular number*.

Description	Circumference.	White.		Tarred.	
		3-strand	4-strand	3-strand	4-strand
	Inches.				
Hemp......	2.5 to 6	1140	1330	850	1000
	6 to 8	1090	1260	825	940
Manila.....	2.5 to 6	810	950	....	....
	6 to 12	760	835	....	....

For ropes in *daily* use, the unit should be diminished *one-third* to meet the reduction in strength by wear and exposure. A safe general rule for all ropes is this: One-fourth the square of the circumference gives the breaking weight in tons of 2000 lbs. When using tackles, multiply the weight thus found by one-half the number of sheaves in the blocks. *Straps* are applied by passing them around the object, putting one bight through the other, and hooking to this; or, after putting it through, winding all the strap around the rope or spar, and hooking to both bights.

Ropes should be placed in the upper stories of buildings, coiled up and labeled; large ropes on skids, allowing free circulation of air; small ropes hung up to the joists, on pins or hooks. Ropes should not be coiled until perfectly dry; they should be uncoiled every year, and stretched out for several days in the dry season. Ropes long in store lose their strength. See *Blocks*, *Cordag*, and *Tackles*.

ROSARD SYSTEM OF FORTIFICATION.—In this system, the bastions and ravelins are retrenched, and the flanks are formed of good casemates, which secure the defense of the main ditch. The tenaillons and counter-guards, however, do not sufficiently cover the bastion and ravelin. The first covered-way has retrenched places of arms, and the second is defended by lunettes, which communicate with the place by means of galleries. The great defect of the system is the possibility of reaching the enceinte from the covered-way of the ravelin.

ROSE.—The heraldic rose is drawn in a conventional form, as in the drawing, and never with a stalk, except when expressly directed by the words of blazon. Being sometimes argent and sometimes gules, it cannot be designated proper: but when blazoned "barbed and seeded proper," it is meant that the barbs are to be green, and the seeds gold or yellow. The rose gules was the badge of the Plantagenets of the House of Lancaster, and the rose argent of that of York. The York rose was sometimes surrounded with rays as of the sun, termed *rose en soleil*. As a mark of cadency, the rose has been used as the difference of the seventh son.


Rose.

ROSE ENGINE.—A peculiar kind of turning lathe having special chucks for the production of those patterns of curved lines called by the French *rosettes*, from the slight resemblance which they bear to a full-blown rose, and hence the term *rose-engine*. The rose-engine lathe differs from the common lathe in this, that the center of the circle in which the work revolves is not a fixed point, but is made to oscillate with a slight motion while the work is revolving upon it, the tool being all the time stationary, and hence the figure will be "out of round," as the turners call it, or will deviate from the circular figure as much and as often as the motion is given to the center.

ROSETTES.—Two small bunches of ribbons, that were attached to the loops by which the gorget of an officer was suspended on his chest.

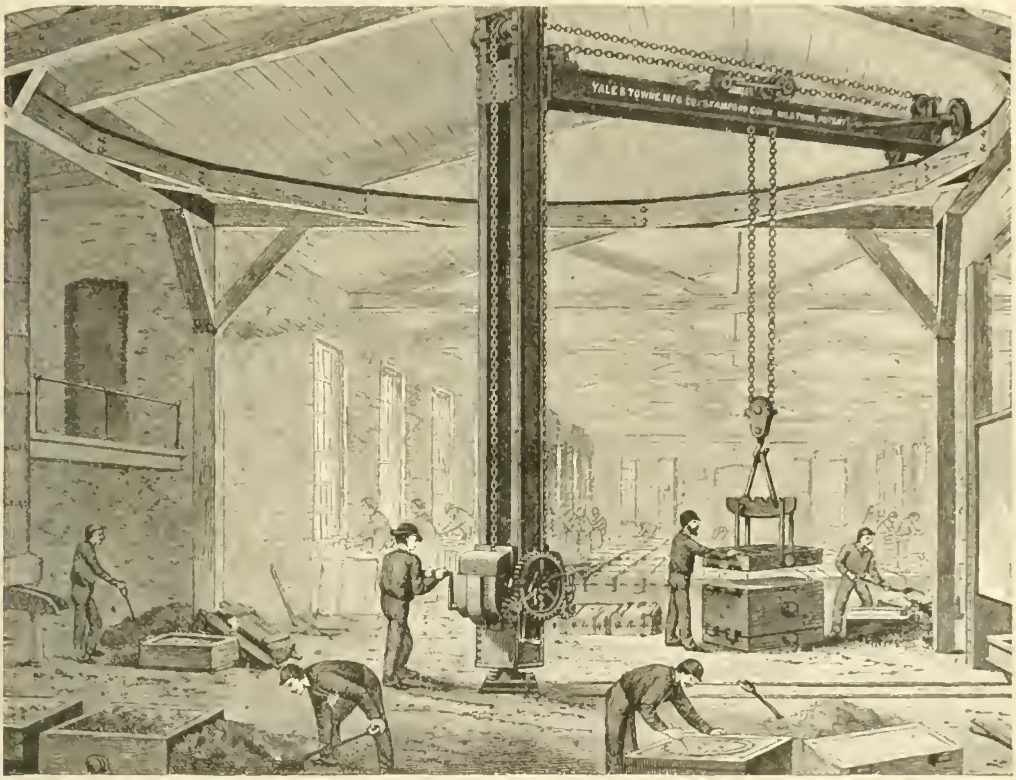
ROSIN. An exudation from trees belonging to the Coniferæ or fir tribe, and the residue left in the still, after the oil or spirit of turpentine has been distilled. It is very combustible, and is used in light-ball and carcass composition.

ROSS-SCHINDER.—A name given to foot-soldiers who were in the habit of using the *gisarme* or *glaive-gisarme* to hamstring the knights' horses.

ROSTER ROLLSTER. A fixed order preserved in military departments as the rotation in which individuals, companies, or larger bodies are called on to serve. In England, regiments proceed on foreign service according to the roster. In the United States, the following rules in regard to the roster apply to service both in garrison and in the field: All details of service should be by roster, but officers or enlisted men, when detailed, must serve whether roster be kept or not; having performed the service, they may appeal to superior authority if they deem themselves aggrieved. The duties performed by detail are of three classes: The *first class* comprises 1st, grand guards and outposts; 2d, interior guards, as of magazine, hospital, etc.; 3d, orderlies; 4th, police guards. The *second class* comprises—1st, detachments to protect laborers on military works, as field-works, communications, etc.; 2d, working parties on such works; 3d, detachments to protect fatigues. The *third class* comprises General Courts-Martial, and all fatigues, without arms, in or out of the camp. In the Cavalry, stable-guards form a separate roster, and count before fatigue.

The rosters are distinct for each class. Officers are named on them in the order of rank. The details are taken in succession in the order of the roster, beginning at the head. Lieutenants form one roster, and 1st and 2d Lieutenants are entered on it alternately. The senior 1st Lieutenant is the first on the roster; the senior 2d Lieutenant is the second, etc. The Captains form one roster, and are exempt from fatigues, except to superintend issues. A Captain commanding a battalion temporarily is exempt from detail, and duty falling to him passes. Lieutenant Colonels and Majors are on one roster. They may be detailed for duties of the first and second classes, when the importance of the guards and detachments requires it. Their roster is kept at division and brigade headquarters. In the company, sergeants, corporals, and privates form distinct rosters. Officers, non-commissioned officers, and soldiers take duties of the first class in the order stated, viz, the first, for the detail, takes the grand guards; the next, the interior guards; the last, the police guard; and the same rule in regard to the details and duties of the second class. In the details for the third class, the senior officer takes the largest party. The party first for detail takes the service out of camp.

When the officer whose tour it is, is not able to take it, or is not present at the hour of marching, the next after him takes it. When a guard has passed the chain of sentinels, or an interior guard has reached its post, the officer whose tour it was cannot then take it. He takes the tour of the officer who has taken his. When an officer is prevented by sickness from taking his tour, he becomes first for detail on being restored to duty, the general rule being that the officer longest off duty is the first for detail. These rules apply equally to non-commissioned officers and soldiers. Duties of the first and second classes are credited on the roster when the guards or detachments have passed the chain of sentinels, or an interior guard has reached its post; fatigue duties when the parties have passed the chain or begun the duties in camp. Every officer, non-commissioned officer, or soldier, on duty of the first class, or who is of the next detail for such duty, takes, when relieved, the duty of the second or third class that has fallen to him during that time, unless he has marched for detachment of more than twenty-four hours.



Rotary Bridge Crane.

ROSTHORN GUN METAL.—An alloy composed of

55.04 parts copper; 42.36 zinc; 1.77 iron; and 0.83 tin; or, according to another analysis, 57.63 copper; 40.22 tin; 1.86 iron; and 0.15 tin.

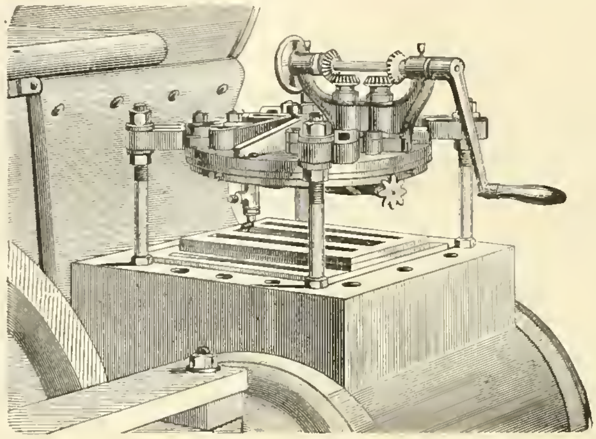
ROTARY BRIDGE CRANE.—A novel form of rotary crane possessing many advantages for certain kinds of work in foundries. It consists of a mast and jib, as in an ordinary jib crane, but is provided with a circular overhead track carrying the outer end of the jib, or the rotary bridge, so that the latter may easily have a much greater length than the jib of an ordinary jib crane, and so that all diagonal braces are dispensed with and the entire space under the bridge left unobstructed. Cranes of this construction are built of capacities from 3 to 12 tons for operation by hand, and of any desired capacity for operation by power.

The engraving on page 781 shows the manner of its arrangement. The frame consists of wrought-iron channel beams, the mast and the bridge each being composed of two such channel irons. The operating mechanism, for the operation by hand, is contained wholly within the two housings at the foot of the mast, and its construction and action are identical with those of the jib crane, to which a reference is made for further particulars. The same mechanism is also utilized for hoisting and lowering at several speeds, and for causing travel of the trolley in either direction upon the bridge. Rotation is effected by simply pushing or pulling the suspended load, except in cranes of large size, which are provided with a power mechanism for this purpose. The construction of the upper bearing of the crane, by which the head of the mast is carried, is such as to avoid any severe lateral strains upon the roof, the weight being carried, at one end of the bridge, by the mast, and at the other by the circular track which is supported from the ground by suitable posts.

This type of crane affords all the conveniences ot the ordinary jib crane, while avoiding the limitation in the vertical movement of the load imposed by the diagonal braces of the latter. It also avoids the severe lateral strains upon the building which result from the use of jib cranes, and thus dispenses with the heavy walls or bracing necessary, where jib cranes are employed, to afford the proper support of the upper end of the mast of such cranes. The posts supporting the circular track can easily be so placed as to cause little if any obstruction upon the floor, or, if the roof be stiff enough, the track may be hung directly from it without resorting to special posts. The bridge, being supported at both ends, can conveniently have much greater span than the jib of a jib crane, the outer end of which is necessarily overhung. With rotary bridge cranes of ordinary capacity a span of 50 feet is entirely feasible, and in this way the crane can be made to cover a circular floor 100 feet in diameter.

Cranes of this type can be adapted to heavy and light work of all kinds, especially in foundries, erecting shops, etc. When arranged for operation by power their capacity can be indefinitely extended. They are particularly applicable to existing buildings the shape of which does not adapt them to the application of traveling-cranes, and in which the construction does not adequately provide for the strains which would result from the use of the jib cranes. See *Bridge Crane*, *Cranes*, and *Jib Crane*.

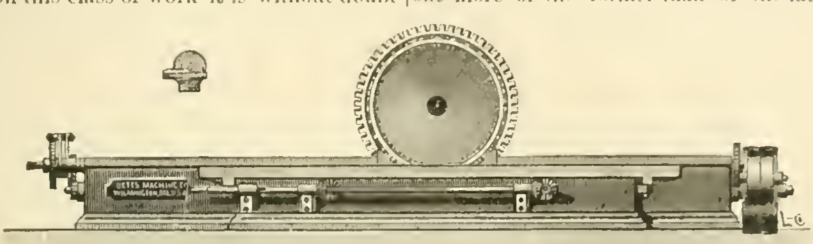
ROTARY PLANING-MACHINE.—This time and labor-saving machine, so constantly employed in the armory, is a comparatively recent invention. Its construction, and method of attachment and operation, are easily understood after an examination of the drawing herewith, representing the machine as made by Messrs. Manning, Maxwell & Moore, New York. The machine is especially adapted to facing



off valve seats, etc. It has two horizontal discs, the upper secured by radial arms, adjusted to suit the position of the studs in the valve seat; the lower, carrying the cutter and its slide, revolves freely against the upper, and is held in its place by a king bolt passing through its center. This lower plate is also secured by a circular gib upon its circumference, which admits of taking up the wear. It is an annular gear, having teeth cut on its inner periphery, from which it receives its rotary motion by means of its connection with the bevel gear and crank. The crank may be replaced by a pulley if power be convenient. The double bevel shaft acts like a back gear and admits of a change of speed. Either bevel is thrown into gear at pleasure by the movement of a pin in a slot operated by the hand wheel. If the outer bevel is in action, it gears directly into the lower plate; if the inner bevel, it is slow geared to the outer, and that to the plate. The revolving lower plate is fitted with a V slide and the tool post, and is fed by a screw and star wheel, arranged to give a large variation in the feed, from roughing to finishing, etc. The cutter is conveniently fed down by the operation of a nut on the cutter spindle acting against the tool post. The radial arms which secure this machine to the studs are so finished with slots as to give a wide range of adjustment. The nuts and their bearings, in the washers which jam the radial arms, are curved to admit of their being firmly secured without springing the machine, even though the studs should be a little out of line. In case the stud holes in a small valve seat should come inside the plates, four other radial arms are furnished with the machine, fitted with a T slot, and with a hole at the other end corresponding to the hole for the old stud, thus affording facilities for extreme cases.

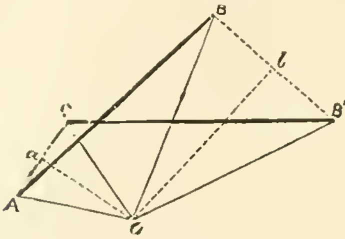
The points claimed for this tool are the great saving in time and labor over old methods; also a saving in files, and the fact that the job may be done accurately, as the plates may be set true with the unworn parts of the valve seat, and, consequently, the new face will be likewise true. It is readily seen that the work done is exactly in line with the travel of the valve stem, thereby preventing the yoke from slipping up and down the valve, as well as all extra friction on the valve stem. No more material need be removed than is absolutely necessary to true up, thus saving the seat. The work is done by a continuous cut, and the loss of time from the return motion of the ordinary planer avoided. There is also no breaking out of the edges. The saving claimed by the makers over the old methods is from 75 to 80 per cent., and 100 per cent. in files, as none need be used. After the seat is planed, the machine can be lifted off and placed on a table which is supplied with stationary adjusting columns and chuck for holding the valve, when the *valve* is planed. In many instances, when the work is done in round houses, the table is essential to a more perfect and satisfactory job. It is estimated that an ordinary locomotive valve seat can be thoroughly trued up in two hours. These machines are strong and well fitted up, are easily handled, and will be found an excellent tool in every respect. They are principally made in three sizes, 18, 22, and 26 inches.

The following drawing represents a machine specially designed for facing plain surfaces, in iron work, where large numbers of pieces of the same kind are used; on this class of work it is without doubt superior to any reciprocating planer that can be made; in many cases the finished work can be removed and replaced by new work while the machine is still facing at the opposite end. There are 28 cutters, in the 25-inch. machine shown, secured in a heavy plate wheel, banded with wrought iron, and driven by worm and worm-wheel; this plate wheel has a heavy steel spindle, and is carried in a traveling head on the bed plate, the work remaining stationary. It has an automatic variable feed, and the head is moved back by an independent countershaft. This machine will face a surface 25 inches high and 11 feet long. The 18-inch machine has 22 cutters, and will face a surface 18 inches high and 8 feet long. The 32-inch machine has 36 cutters, and will face a surface 32 inches high and 14 feet long. The weights of the machines are 12500, 8000, and 19225 pounds respectively.



ROTATION.—There is, perhaps, no elementary idea which has been the subject of so much popular misconception as that of rotation. This is probably due to the vagueness of the definitions commonly given. All motion that we can observe is *relative;* for instance, any fixed object on the earth's surface has a certain motion *relative* to the earth's axis, in consequence of the diurnal rotation; the earth itself has a certain motion *relative* to the sun, in consequence of its annual revolution; the sun has a certain motion *relative* to the so-called fixed stars; and it is possible that the whole stellar system may have a motion *relative* to something in space beyond its boundaries. Now, the motion of an object on the earth's surface differs according to the way it is measured: a passenger sitting in a railway carriage is *at rest* if his motion *relative* to the carriage be considered; he has the same motion as the carriage if it be measured *relative* to the rails; and if the carriage were running from East to West along a parallel of latitude, so as to complete the circuit in 24 hours, he would be at rest relative to the earth's axis. If, therefore, we wish to talk of *absolute* motion, it must be measured *relative* to FIXED points or directions; and in the violation of this obvious condition lies the error most commonly met with. Thus, to show that the earth rotates about its axis, we may observe its motion relatively to the line joining it with the moon; and we observe that the moon comes to the meridian at intervals of (roughly) 25 hours. Does the earth rotate in 25 hours? We know that it does not, and the error consists in treating as an *absolute* rotation, a rotation measured relative to a line—that joining the earth and moon—which is itself turning. If we take the intervals of the sun's crossing the meridian, we find 24 hours—a much closer approximation; but still not exact, because our line of reference—that joining the earth and sun—is slowly turning. Would we have an absolute measure, we must choose a *fixed* line, or one so nearly fixed that its motion will be absolutely insensible. Such is the line joining any fixed star with the earth, and the time of the earth's *absolute* rotation about its axis is $23^h\ 56^m\ 4.09^s$—the interval between culminations of the same fixed star. The difference between absolute and relative rotation in any planet gives rise to the difference between the *sidereal* and the *solar* day; and the planet's year contains just *one* more of the former than of the latter. Now, suppose for a moment that the earth were to revolve only $\frac{1}{366}$ part as fast as it now does, there would be *one sidereal* day in the year, and there would be *no* solar day at all—in other words, there would be *no* rotation of the earth with reference to the line joining it with the sun; that is, the earth would turn always the same side to the sun; yet it would be *absolutely* rotating about its axis once in a year. This is the case which we observe in the moon's motion relative to the earth, and we see at once that the moon must rotate *absolutely*—that is, with reference to fixed directions in space—in the exact time in which she completes one revolution about the earth. Those who say the moon does not rotate on her axis make precisely the same mistake as those who fancied that the earth is immovable, and that moon, sun, and stars revolve about it every day. There is a physical cause for this peculiarity in the moon's motion, which leads to very important consequences with reference to the future of the solar system.

Several elementary theorems regarding rotation may now be enunciated; but the proofs, though very simple, will be given merely in outline. Any displacement *whatever* given to a plane figure in its own plane—as to a sheet of paper lying on a table—is equivalent to a single rotation about a definite axis. Let A, B be any two points of the figure, and let them be displaced to A′, B′ respectively. Join AA′, BB′, and bisect them in *a* and *b* by perpendiculars meeting in O. Then, it is easy to show that (1.) OA′ = OA, OB′ = OB, and therefore O is the *same* point of the plane figure in its first and second positions. (2.) AOA′ = BOB′; and this is therefore the angle through which the whole has turned about the point O. If AA′ and BB′ are parallel, this construction fails; but in this case, if AB and A′B′ do *not* intersect, the motion is simply one of translation: if they do intersect, the point of intersection is the axis. Any number of successive rotations about different points constitute, of course, a displacement,



and are therefore reducible to one rotation. Two equal and opposite rotations about different points give rise to a mere translation. The first two of these propositions are true of figures on a sphere as well as on a plane surface; for the figure above has only to be drawn with great circles instead of straight lines, and the proof applies letter for letter. Only, here, the first case of exception cannot occur, because two great circles *must* intersect. Hence it follows that if the center of a sphere be fixed, any displacement whatever is equivalent to a rotation about some axis; that is, after any motion whatever of a rigid body, one point of which is fixed, there is always *one* line of particles which remains undisturbed. Hence rotations about any number of axes passing through the same fixed point may be compounded into one; and, generally, any motion whatever of a rigid body may be decomposed into two, one of which is a motion of translation of some chosen point, and the other rotation about some axis through that point. Thus, in the case of the moon, we have a motion of translation of its center in its orbit, and one of rotation about its axis; or we may combine them into a single rotation in the period of a lunar month about a fixed axis passing through the earth's center. Again, any displacement of a plane figure in its plane, or of a spherical figure on a sphere, may be produced by the rolling of a curve fixed in the figure upon another fixed on the plane or sphere. Hence, the most general motion of a body with reference to one point, consists in the rolling of a cone fixed in the body upon another fixed in space, their vertices being at the chosen point. To this, when the cones in question are right circular cones, belong the *precession* and *nutation* of the earth and of a top, the evolutions of an ill-thrown quoit, etc. See *Rotation of Projectiles*.

ROTATION OF PROJECTILES.—The principal cause of the deviation of a projectile is its rotation combined with the resistance of the air. It is proposed, in the first place, to show how rotation may be produced, and in the second, to show how rotation combined with the resistance of the air, produces deviation.

If the projectile be spherical and homogeneous, rotation is produced by the bounding or balloting of the ball in the bore, arising from the windage. In this case the axis of rotation is horizontal, and passes through the center of the ball; the direction of rotation depends on the side of the projectile which strikes the surface of the bore last; if it strike on the upper side, the front surface of the projectile will move upward; if on the lower side, this surface will move downward. The velocity of rotation from this cause depends on the windage, or depth of the indentations in the bore, the charge being the same. It has been found to be, for ordinary windage, about 30 feet for a 24 pdr. shell fired with $2\frac{1}{4}$ lbs. of powder.

If from the structure of the ball, or from some defect of manufacture, the center of gravity do not coincide with the center of figure, rotation generally takes place around the center of gravity. This arises from the fact that the resultant of the charge acts at the center of figure, while inertia, or resistance to motion, acts at the center of gravity, and is perpendicular to a plane containing the resultant of the charge and the centers of figure and gravity. For the same charge, the velocity of rotation is proportional to the lever arm, or perpendicular, let fall from the center of gravity to the resultant of the charge. Knowing the position of the center of gravity of the ball in the bore, it is easy to foretell the direction and velocity of rotation. In general terms, the front surface of the projectile moves toward the side of the bore on which the center of gravity is situated, and the velocity of rotation is greatest when the line joining the centers of gravity and figure is perpendicular to the axis of the bore.

The effect of rotation in producing deviation of projectiles may be studied under two heads: 1st. When the projectile is spherical and concentric. 2d. When it is spherical and eccentric.

The simplest case is that of a homogeneous spherical projectile, rotating around a vertical axis passing through the center of gravity.

Let *A B C D*, in Fig. 1, represent the great circle cut out of the sphere perpendicular to the axis of

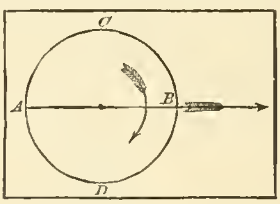


Fig. 1.

rotation, and suppose rotation to take place in the direction *A C B*, and the motion of translation in the direction *A B*; it is evident that each point of the circle moves in the direction *A B*, with a velocity which is equal to the velocity of translation, plus or minus the component of its velocity of rotation in the direction of the axis *A B*, which is equal to the projection of the arc over which the point moves in a unit of time on the line *A B*. The points *C* and *D* have the greatest velocity in the direction of this line, *A B*, and the points *A* and *B* the least. All the points in the semi-circle *A C B* rotate in a forward direction, and the components of their velocities of rotation must be added to that of translation; while the points in the semi-circle *B D A* move backward in rotation, and the components of their velocities must be subtracted from it. A body moving in the air draws with it a film of the particles which surround it, and these particles set in motion the adjacent particles, and so on from one layer to another: the number of particles set in motion and their reaction on the surface of the projectile, depend on the velocity of the moving surface; now it has been shown that the surface *A C B* moves with a greater velocity than the opposite side, the reaction, or pressure upon it, must be greater than upon the latter, and the projectile will be urged in the direction *C D*.

In Fig. 2, let *A C B D* represent the great circle cut out of an eccentric projectile perpendicular to

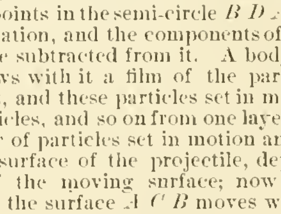


Fig. 2.

the axis of rotation, and containing the center of figure O, and the center of gravity O'. Suppose the motions of rotation and translation to take place as in the preceding case, it follows that the same cause will operate in this, as in the preceding case, to deviate the projectile in the direction *C D*; but there is another and more powerful cause operating to deviate the projectile in the same direction, and that is, the greater pressure on the side *A C B* arising from the greater surface offered to the air in consequence of the eccentricity. These phenomena may be easily illustrated by the very simple and ingenious apparatus devised by Prof. Magnus, of Berlin. Let *C*, in Fig. 3, represent a light brass cylinder, delicately suspended in a ring, and made to revolve very rapidly around its vertical axis, by means of a

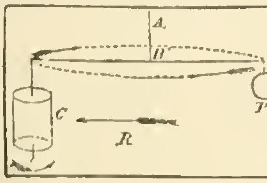


Fig. 3.

string, after the manner of a top; let this ring be suspended at the extremity of a wooden lever *B*, which, in turn, is suspended by a delicate wire from the ceiling, so that it may rotate freely in a horizontal direction; let *P* be a counterpoise, and *R* the direction of a strong current of air blowing upon the cylinder from a fan-blower. It is invariably found, that the axis of the cylinder will move in the opposite direction from the side which is moving toward the current of air from the blower (see direction of the arrows); but if there be no rotation of the cylinder the axis will remain stationary.

The following conclusions are obvious:—If a projectile be spherical and concentric, rotation takes place from contact with the surface of the bore around a horizontal axis, and the effect will be to shorten or lengthen the range, as the motion of the front surface is downward or upward.

If the projectile be eccentric, the motion of the front surface is generally toward the side on which the center of gravity is situated, and the deviation takes place in this direction.

The extent of the deviation for the same charge, depends on the position of the center of gravity; the horizontal deviation being the greatest when the centers of gravity and figure are in a horizontal plane, and the line which joins them is at right angles to the axis of the piece; the vertical deviation will be the greatest when these centers are in a vertical plane, and when the line which joins them is at right angles to the axis of the piece. If the axis of rotation coincide with the tangent to the trajectory throughout the flight, all points of the surface have the same velocity in the direction of the motion of translation, and there will be no deviation. This explains why it is that a rifle-projectile will move through the air more accurately than a projectile from a smooth-bored gun. See *Deviation, Initial Velocity of Rotation, Rotation*, and *Velocity of Rotation*.

ROTTBERG SYSTEM OF FORTIFICATION. This enceinte consists of a belt of isolated forts and cavaliers, the rampart of which is casemated. A casemated wall, situated in the ditch at the salient of the bastion adjoining the cavalier, serves to flank that work. The exterior fronts of the forts are covered by a couvre-face formed of a double covered-way; the inner one serving as reduit is secured against enfilade by a casemated bonnet. The ditch, which is partially wet, receives its defense from the cavalier and the flanks of the bastions. The ravelin and its reduit are casemated; but the casemates of the gorge of the reduit are opened to the rear to be exposed to the view of the place, whilst the ditch before the faces is defended by a reverse gallery constructed at the salient of the ravelin. On the capitals of the forts are casemated fleches with a covered-way capable of maintaining a protracted defense. The loss of one fort does not entail the fall of the others.

ROTTEN-STONE. A mineral consisting chiefly of alumina, with about 10 per cent of carbonaceous matter, and a little silica. It is supposed to be formed by decomposition of shale. It is found in Derbyshire, England, in Wales, and near Albany, in the State of New York. It is brown; either grayish, reddish, or blackish. It is soft, and easily scraped to powder, and is well-known to soldiers, being much used for cleaning and polishing brass and other metals.

ROUGE CROIX.—One of the pursuivants attaching to the heraldic establishment of England, generally allowed to be the most ancient, though the period of institution is uncertain. The title is derived from the Red Cross of St. George, the Patron Saint of England.

ROUGE DRAGON.—The title of a pursuivancy founded by Henry VII. on the day before his coronation. The name is taken from the supposed Ensign of Cadwaladyr, the last King of the Britons, ancestor of that Monarch. The red dragon was also sometimes used by Henry VII. as a supporter.

ROUGHING.—A mode of treating horse-shoes during slippery weather, when ice is lying on the ground. The old mode of carrying out this operation is considered an inconvenient and exceedingly injurious plan. A new method of roughing is recommended be Mr.George Fleming, a Veterinary Surgeon of the Royal Engineers, which consists in the insertion of a small, pointed, square plug of steel, measuring from 1 to 3 inches (nearly always the former) at the heel, and, if desirable, at the toe also of each shoe, in a simple square hole punched at these points. The result is stated to be most satisfactory, horses being enabled, in the most frosty state of the roads, to do their work as in ordinary weather. The army horses at Chatham were so roughed during the winter of 1875, and nothing could have been more satisfactory.

The term *roughing* is also applied to the action of a rasp on a fuse, to make it bite in the fuse-hole.

ROUGH RIDER.—In the artillery or cavalry, an Instructor of equitation, and assistant to the Riding-master. One is allowed to each troop or battery.

ROULEAUX. Round bundles of fascines, which are tied together. They serve to cover men when the works are pushed close to a besieged town, or to mask the head of a work.

ROULETTE.—An instrument used in engraving, mechanical drawing, and plotting, for making dotted lines. It has a wheel and points, which, for use on paper, is dipped into India-ink, so that the points impress a series of black dots or marks as the instrument passes over the paper. Different patterns of dots are used for national, state, county, and township lines, canals, roads, railways, etc. See *Dotting-pen*.

ROUND.—In artillery, a "round of ammunition" comprehends the charge of powder, the projectile, and the priming or friction tube. *To fire one or more rounds* is to discharge each gun in succession from a battery or a portion of it, until the turn comes round for the first gun to fire again. Light artillery can come into action and fire one round in 28 seconds, timing from the order "Action front," to the discharge of the piece; and in 15 seconds if the first cartridge and shot be carried in a box on the gun axle-tree.

ROUND-BAR.—In ordnance, a metallic cylinder, which has been reduced from a larger cylinder by rolling friction.

ROUND BULLET.—The object of small-arms is to attain animate objects; their projectiles are, therefore, made of lead, and are generally known as *bullets*. They are both round and oblong; but in consequence of the great improvements that were made of late, in adapting the principle of the rifle to small-arms, the oblong ball is now very generally used in all military services, the round bullet being chiefly retained for use in case-shot.

Round bullets are denominated by the number contained in a pound; this method is often used to express the caliber of small-arms; as, for instance, the caliber of the old musket was 17 to the pound. and the rifle was 32. In 1856, these two calibers were replaced by one 24 to the pound, that of the new rifle-musket. The number is sometimes prefixed to the word *gauge* in which case the rifle-musket would be called a 24 *gauge gun*. This mode, however, is principally used to designate sporting-arms.

The oblong bullet is denominated by its diameter and weight; for instance, the new rifle-musket ball has a diameter of 0.58 in., and it weighs 540 grains. See *Bullet*, *Oblong Bullet*, and *Projectiles*.

ROUNDEL.—1. A disk of iron having a central aperture, through which an assembling-bolt passes. It serves to separate the stock and cheeks. 2. A shield used by the Norman soldiers. 3. A semi-circular bastion in early fortification as introduced by Albert Dürer. This bastion was about 300 feet in diameter and contained roomy casemates for the troops. Also written *Roundelle*.

ROUNDHEADS.—A name given by the adherents of Charles I., during the English civil war, to the Puritans, or friends of the Parliament, who distinguished themselves by having their hair closely cut, while the Cavaliers wore theirs in long ringlets.

Roundle.

ROUNDLE—ROUNDLET.—In Heraldry, a general name given to charges of a circular form, which, in English Heraldry, have more special names indicative of their tinctures the roundle or being, for example, called a *bezant*; and the roundle gules, a *torteaux*.

ROUND POWDER.—In case of emergency, and when powder cannot be procured from the mills, it may be made, in a simple and expeditious manner, as follows: Fix a powder-barrel on a shaft passing through its two heads, the barrel having ledges on the inside; to prevent leakage, cover it with a close canvas glued on, and put the hoops over the canvas. Put into the barrel 10 lbs. of sulphur in lumps, and 10 lbs. of charcoal, with 60 lbs. of zinc balls or of small shot (down to No. 4, 0.014 in. in diameter nearly); turn it, by hand or otherwise, 30 revolutions in a minute. To 10 lbs. of this mixture thus pulverized, add 30 lbs. of nitre, and work it two hours with the balls; water the 40 lbs. of composition with 2 quarts of water, mixing it equally with the hands, and granulate with the graining-sieve. The grains thus made, not being pressed, are too soft. To make them hard, put them into a barrel having 5 or 6 ledges projecting about 0.4 in. inside; give it at first 8 revolutions in a minute, increasing gradually to 20. The compression will be proportionate to the charge in the barrel, which should not, however, be more than half full; continue this operation until the density is such that a cubic foot of the powder shall weigh 855 oz., the mean density of round powder; strike on the staves of the barrel from time to time, to prevent the adhesion of the powder. Sift the grains and dry the powder as usual. That which is too fine or too coarse is returned to the pulverizing-barrel. This powder is round, and the grain is sufficiently hard on the surface, but the interior is soft, which makes it unfit for keeping, and may cause it to burn slowly. This defect may be remedied by making the grains at first very small, and by rolling them on a sheet or in a barrel, watering them from time to time, and adding pulverized composition in small proportions; in this way, the grains will be formed by successive layers; they are then separated according to size, glazed and dried. It appears from experiments that the *simple incorporation* of the materials makes a powder which gives nearly as high ranges with cannon as grained powder. The incorporated dust from the rolling-barrel may be used in case of necessity. See *Gunpowder*.

ROUND ROBIN.—A name given to a protest or remonstrance signed by a number of persons in a circular form, so that no one shall be obliged to head the list. The Round Robin originated in France, and the name is derived from the words *rond*, round, and *ruban*, a ribbon.

ROUNDS.—An Officer, or Non-commissioned Officer who, attended by one or more men, visits the sentinels on post, in order to ascertain whether they are vigilant. The design of rounds is not only to visit the guards, and keep the sentinels alert, but likewise to discover what passes in the outworks, and beyond them. See *Grand Rounds* and *Visiting Rounds*.

ROUND-WIRE.—In ordnance, a metallic cylinder which has been reduced from a larger cylinder by rubbing friction.

ROUT.—To put to *rout* is to defeat and throw into confusion. It is not a retreat in good order, but also implies dispersion.

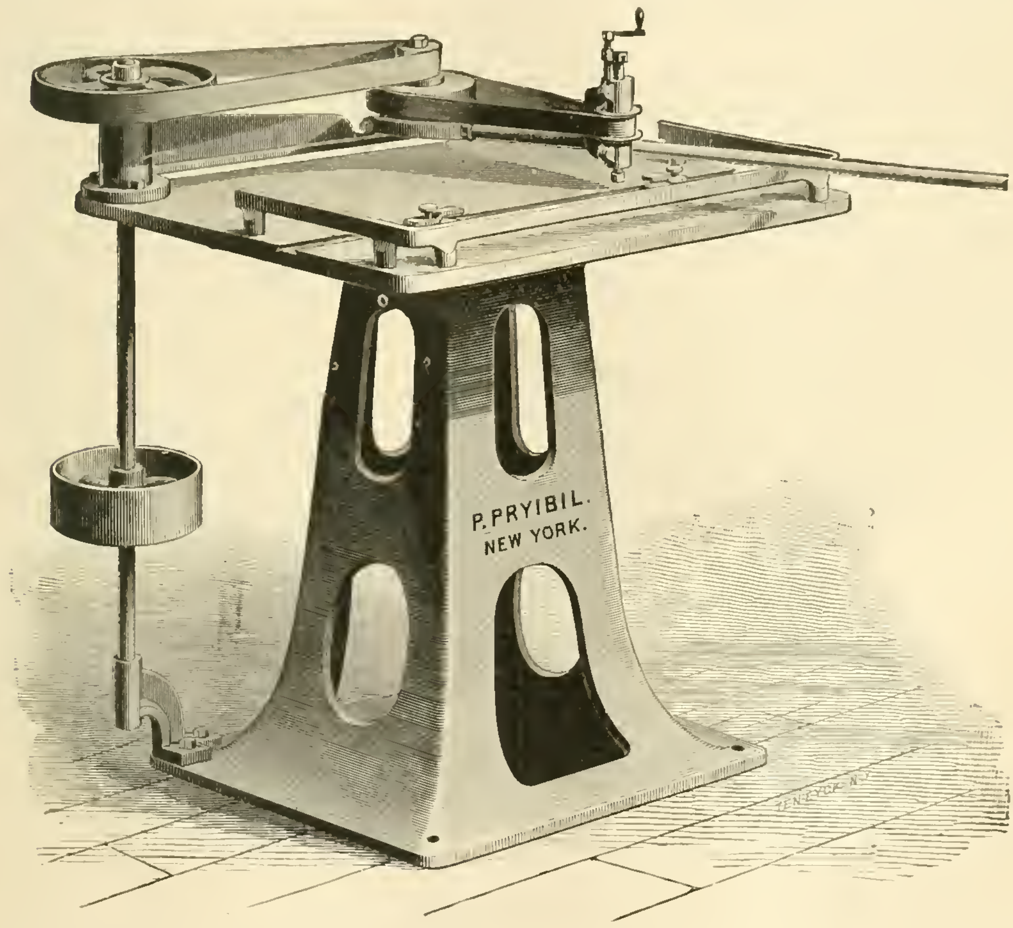
ROUTE.—An open road; the course of march of troops. Instruction for the march of detachments, specifying daily marches, the means of supply, are given from the headquarters of an army in the field, and are called marching *routes*.

ROUTE MARCHES.—Three marches are used in peace to conduct a body of troops from one station to another. They are used in war for the purpose of assembling the fractions of an army on its base of operations, of conducting troops through a district or country where there is no enemy, etc. The health, comfort and convenience of the troops are the principal things to be considered in arranging the details of their execution. When the body of troops to be moved is large it should be subdivided into smaller bodies, and these detachments are sent by different roads. Caution must be taken to prevent the crossing of the columns on the march, as one would then have to wait to allow the other to pass, and the delay caused to the waiting column would be irksome in the extreme. Since, in executing marches of this kind, there is no danger to be expected from an enemy, the precautions taken in the other kinds of marches to guard against attack may be omitted. Route marches are designated as *ordinary*, *forced* and *rail*, according to the manner in which they are made. The ordinary route march does not exceed 20 miles per day. Forced marches are extremely exhausting upon the troops and should not exceed 30 miles per day. They should only be resorted to in time of peace under pressing circumstances. They are much used in war, when a rapid concentration of troops is to be made, or when a strategical combination is to be effected. Railroads have become in recent years the great factor in rapid and cheap means of moving troops, and are of especial service when the time given to the troops to reach their destination is short, and the distance is great. The marches made by the several corps of the French army in 1805, by which this army was assembled upon the Rhine is an example in point. Napoleon issued his orders for the corps to move on three different routes, each of the seven corps being divided into three divisions, following each other on three successive days. The arrangements were perfect: all crossings of columns were avoided; the marches for each day were of proper length: the great natural routes were followed, and the detachments arrived in succession and without interference at their destination. See *Marches*.

ROUTE STEP.—A style of march, whereby the men carry their arms at will, keeping the muzzles elevated; they are not required to preserve silence, or to keep the step, but each man covers the file in his front. The column of fours is the habitual column of route. The route step is at the rate of from two miles and a half to three miles per hour. The column of fours being in march, to march in the *route step*, the Captain commands: 1. *Route step*, 2. MARCH. At the command *march*, the men carry their arms at will, keeping the muzzles elevated; they are not required to preserve silence, or to keep the step, but each man covers the file in his front. The ranks preserve the distance of thirty-two inches from each other. To resume the cadenced step, the Captain commands: 1. *Company*, 2. ATTENTION. At the second command, the arms are brought to the right shoulder, and the cadenced step is resumed. The company marching in line may also march in the route step, the rear rank falling back to thirty-two inches. The company in route step changes direction by the same commands as when in the cadenced step.

ROUTINE.—Capacity or the faculty of arranging; a certain method rather acquired by habit and practice than by study and rule. It signifies also a general custom or usage, established by habit, and followed mechanically.

machine for arsenal use. The spindle is of steel fitted to a steel tube with which it revolves, and in which it slides longitudinally. The wear is thus confined to the tube where it is easily taken up by means provided for the purpose, and the trouble experienced with machines where the spindle slides in the same bearings in which it revolves is wholly avoided. The spindle head is carried on a lever connected by a universal joint to a swinging arm. As this arm is strongly webbed and is provided with a long bearing on the outside of the sleeve forming the upper bearing for the vertical shaft at the corner of the machine, additional supports are dispensed with, and the table is left clear for the reception of large work. Through the agency of arm and lever the cutter can be easily brought to any part of the work. Both the spindle head and the stud carrying the intermediate pulley are movable, to enable them to be shifted to take up the slack of the belt. The spindle has a vertical adjustment of $1\frac{3}{8}$ inches, and the clamps are made double faced and reversible. Either a spring rest for keeping the cutter from the



ROUTING-MACHINE.—A shaping-machine which works by means of a router-cutter, adjustable itself and revolving above a bed with universal horizontal adjustment, so as to permit the cutter to follow along a traced line, and thus cut to a shape, or groove to a depth, the work upon the table. It is adapted for work in metal or stone; in the latter case, black diamonds are used. Paneling in relief or intaglio, raised or sunken carving, circular slotting, slotting, key-seating, beveling, and bordering may be done upon it.

The drawing shows a very convenient routing-machine for arsenal use. work until the lever is depressed, or a solid rest, as shown in the drawing, may be used, but the solid rest is safer and more convenient. The table will take on a plate 24×32 inches which can be completely routed without being shifted more than once. Six cutters, from $\frac{1}{16}$ to $\frac{1}{2}$ inch in diameter, and a tool box fitting the side of the body accompany each machine. An attachment for cutting straight lines is also used. The speed is 7,000 to 8,000 revolutions per minute.

ROWEL.—The pointed part of a riding spur, made in a circular form, with rays or points like a star.

ROYAL.—1 A small mortar which carries a shell whose diameter is 5.5 inches. It is mounted on a bed like other mortars. 2. In England, one of the soldiers of the first regiment of foot, called the *Royal*, and supposed to be the oldest regular corps in Europe.

ROYAL ARTILLERY INSTITUTION.—An establishment organized at Woolwich in the year 1838. The building was erected at government expense, and is supported partly by subscriptions from the officers of the regiment and partly by government. It contains a museum, lecture-room, laboratory, theatre, and printing press. Reports, *verbatim*, of all lectures which have been delivered are issued periodically to all its members. It is a repository for the sale of military books, stationery, etc.

ROYAL CORPS OF ENGINEERS.—A component portion of the Army of the British Empire. A similar Corps exists in all regular armies. It is the scientific and constructive branch, intrusted with the making and defending of all military *works*, and the attack and conquest of similar works belonging to an enemy. It is true that civilians are often employed to construct the buildings themselves, at a stated price; but the Military Engineers make the plans, and are responsible to the country for their efficiency. For a number of years past, contractors have been at work on fortifications at Portsmouth and in other parts of the kingdom, but on plans and under orders for which the Engineer Department of the Government is responsible.

The Royal Engineers of the United Kingdom form one Regiment or Corps. The officers, in time of peace, are scattered all over the world. There is no half-pay, except on *permanent* retirement; and no unemployed list. They have much wear and tear of earlier age than other officers. Their regular pay corresponds to the active pay of other officers of the same rank; but they exclusively receive in addition *extra* pay, amounting to one-half their ordinary pay when on duty at home, and equaling their ordinary pay when employed abroad or in the London district. There is an establishment of Engineers in each military command, to conduct and superintend all the military buildings and works. The entire force is under a particular Department of the War Office, that of the Inspector General of fortifications. Until the year 1763, the duties of Military Engineers were discharged by officers taken from the regular army. In that year, however, the Corps of Engineers was formed, greatly to the advantage of the military service. In 1783, it was made a *Royal* Corps, and a distinctive uniform adopted. Several companies of artificers were, in 1812, converted into sappers and miners, and placed under the Engineers.

The non-commissioned officers and privates of this valuable Corps are all workmen who have learned some mechanical trade; hence their skill in all constructive operations. The Ordnance Survey has been intrusted to the Corps. For many purposes the men are *lent*, they attend to special and peculiar work; and at such times their emolument is always increased. They often buy their discharge, in order to go into civil employments, when the prospects are very good. The men enlist for 12 years, with power to re-engage (if wanted) for nine more; but they can purchase their discharge at any time. They have to pay more for their discharge than other Corps in the army, having received more instruction at the national expense. Officers intended for the Engineers enter the Royal Military Academy as cadets by open competition, and pass out from time to time for commissions. When in the Corps, promotion is by seniority, the purchase system having never been introduced. The head-quarters are at Chatham, where there are Engineer Barracks. The Corps is grouped into battalions and companies. There are 432 officers of Royal Engineers serving in India, their subordinates being natives. See *Corps of Engineers*.

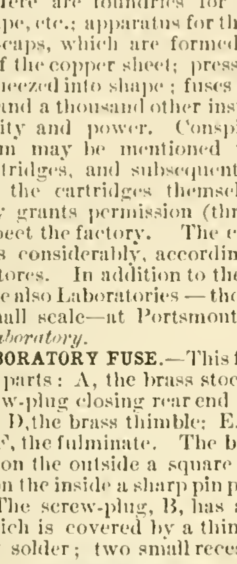
ROYAL ENGINEER INSTITUTION.—A similar Institution to that established by the royal artillery at Woolwich, but of older date (1813), and formed at Chatham. It contains a library of 12,000 volumes, and publishes yearly a volume of professional papers, with the view of conveying, to all members of the Institute, the knowledge and experience acquired by each officer of the corps. It publishes besides a small monthly paper, printed at the expense of the Institution.

ROYAL GUN FACTORIES.—Government establishments at Woolwich for the construction of great guns for the use of the British Army and Navy. For a very long period there had been at Woolwich a small factory for the manufacture of brass cannon, but guns of cast-iron were obtained from private foundries by contract. At last it was determined that Government should become in part its own gun-founder, and extensive work-shops were erected in 1855—6. The adoption of the Armstrong wrought-iron gun into general use in the service, in 1859, arrested the further making of cast-iron guns, and occasioned again a great expenditure in the erection of shops and costly machinery, which have since been adapted to other systems of wrought-iron ordnance adopted into the service under the name of "Woolwich." The factories may now fairly be regarded as among the most remarkable sights in the Kingdom. In each department, whatever the process, it is repeated over and over again, till long parallel lines of similar mills are seen, each busily fashioning a separate gun. Iron at red-heat is first wound round a solid core (representing the bore of the future gun), as tape might be round a pencil; and then by the action of successive blows from a steam-hammer (there is one of 100-tons), the strips are welded into a compact cylinder of wrought-iron of extreme density. This cylinder, after undergoing several heatings, and also poundings with the steam-hammer, is encompassed with wrought-iron rings of immense strength, which are shrunk on, and then transmitted to the boring mill. Here the proper caliber is imparted to it; in another department, the bore is rifled; in another, the outside of the gun is carefully turned; and in yet another, the whole is polished and browned. A gun is several weeks in its passage through these many processes. By the ingenuity of Sir William Armstrong, the Superintendent, and Dr. John Anderson, his able assistant, every part of the difficult manufacture has been reduced to a question of machinery. Many thousand guns have to this time been turned out complete of which upwards of 7,000 are now available for military and naval use. The cost of the guns as now made is, on an average, as follows: 12-pounder, £82; 20-pounder, £124; 40-pounder, £206; 70-pounder, £375; 35-ton gun, £2,156. The Royal Gun Factory at Woolwich was estimated to cost for 1878—9 the sum of £203,948, of which £5,242 were for management; £78,656 for the wages of artificers and laborers; £12,671 for buildings and machinery: and £104,190 for stores to be consumed in the manufacture of guns. Much of the machinery now used in the manufacture of guns was originally developed at the engineering and founding establishment of Sir William Armstrong & Co., at Elswick, which was for some time used as an auxiliary and supplement to the gun factory in Woolwich Arsenal, the guns being turned out at a contract price, payable after they had passed a rigid inspection. The connection between the Government and the Elswick firm ceased in 1863. See *Gun-making*.

ROYAL GUNPOWDER FACTORY.—The establishment at Waltham Abbey, in which much of the gunpowder required for the British Army and Navy is made. It is built on all the newest and most approved principles to insure safety, economy, and efficiency; but even here accidents occasionally happen in this dangerous manufacture, and roofs and sides, purposely left loose so as to offer but little resistance, are scattered to the winds. Between the different mills mud-banks are raised, and groves of trees thickly planted, to lessen the concussion, and, as far as possible, limit the catastrophe when one house is unfortunately exploded. A series of raised canals, at the same time, is ready to flood the whole place, or to afford a precarious shelter to the men employed, if time be available to make use of it. The charge for this factory for 1878-79 was £104,439, of which £20,692 were for management and wages, £19,696 for buildings, and £41,764 for raw material. There are about 200 workmen. When the gunpowder is made, it is sent down the Lea, to the magazines at Woolwich and Purfleet.

ROYAL LABORATORY.—An extensive military manufacturing department in Woolwich Arsenal. Although it has existed for many years, it was only in 1855 that the present very large establishment was organized. Here are foundries for the casting of shot, shell, grape, etc.; apparatus for the manufacture of percussion-caps, which are formed—hundreds at a time—out of the copper sheet; presses where rifle-bullets are squeezed into shape; fuses in all stages of manufacture and a thousand other instances of combined ingenuity and power. Conspicuous among the mechanism may be mentioned the making of paper for cartridges, and subsequently the making and filling of the cartridges themselves. Government liberally grants permission (through the War Office) to inspect the factory. The cost of the Laboratory varies considerably, according to the accumulation of stores. In addition to the Royal Laboratory, there are also Laboratories — though on a comparatively small scale—at Portsmouth and Devonport. See *Laboratory*.

ROYAL LABORATORY FUSE.—This fuse consists of the following parts: A, the brass stock or body; B, the brass screw-plug closing rear end of fuse; C, the lead plunger; D, the brass thimble; E, the brass safety-wire; and F, the fulminate. The body has a solid head, having on the outside a square recess for fuse wrench, and on the inside a sharp pin projecting from the center. The screw-plug, B, has a hole through its center which is covered by a thin disk of brass secured on by solder; two small recesses in the bot-



tom of the plug facilitate its insertion with a wrench. The lead plunger, C, has also a central hole through it, in the front end of which is placed the fulminate cap; the plunger has also two slight projections from its sides upon which rests the brass thimble, D. Running through holes in the heads of fuse body and thimble, and to one side of center and resting on top of the plunger, is the twisted safety-wire, E. In order to prevent the easy withdrawal of the safety-wire a small hole is bored into one side of fuse body and down to the hole through which the wire is inserted, and into this is poured melted lead. A strong cord facilitates the extraction of the wire before firing. Inserted in a loaded shell with the safety-wire removed, and meeting with a resisting object in flight, the plunger is thrown forward sheering off the shoulders; the fulminate striking the pin is ignited, the brass disk closing hole through screw plug is blown out, and the bursting-charge of shell ignited. See *Fuse*.

ROYAL MARINE ARTILLERY AND LIGHT INFANTRY.—I. A limited number of candidates will be nominated to compete for admission into the Royal Naval College, Greenwich, as probationary Lieutenants in the Royal Marines.

II. The examination will be conducted by the Civil Service Commissioners, and will be held once a year commencing on the second Wednesday in August.

III. No candidate will be eligible who is under 16½ or above 18 years of age on the 1st of October following the examination.

IV. Public notice will be given in May of each year of the number of vacancies, and of the number of candidates to be nominated to compete for them.

V. A candidate who qualifies, but is not successful in the competition, will be allowed to compete again at the next examination if not over age; but a candidate who fails to qualify will not be admitted to compete again; and no candidate will be allowed to compete more than twice.

VI. Every candidate will be required to be at least 5 feet 5 inches in height and to pass the medical examination according to the prescribed regulation, under the direction of the Medical Director General of the Navy. He must be in good health, and free from any physical defect of body, impediment of speech, defect of sight or hearing, and also from any predisposition to constitutional or hereditary disease, or weakness of any kind, and must be in all respects well developed, and active in proportion to his age. Any candidate rejected at the medical examination will, subject to the approval of the Board, be finally excluded from the Royal Marines.

VII. Each candidate, before the examination, will be required to produce the following certificates, viz.: (1) A registrar's certificate of birth, or declaration thereof made before a magistrate. (2) A certificate of good conduct for the two years previous from the masters of the schools at which he may have been educated; or, if educated at home, from his tutors, or the clergyman of the parish in which he has resided for that period. (3) A certificate of good health and physical development from the Medical Director General. (4) A certificate of height.

VIII. A candidate will be required to pass a preliminary examination in the following subjects, the maximum number of marks obtainable for each being as stated:—

	Marks.
1. Writing English from dictation correctly in a good legible hand No marks allowed.	
2. Arithmetic	300
3. Algebra (including quadratic equations and the three progressions)	500
4. Geometry (up to the standard of the sixth book of Euclid's Elements)	600
5. Plane trigonometry (including definitions, fundamental formulæ, and the solution of plane triangles)	600

IX. The further examination will be proceeded with immediately on the conclusion of the preliminary examination. Candidates who fail in the preliminary examination will be informed of their failure as soon as possible, and they will then be released from further attendance.

X. The subjects of the further examination and the maximum of marks obtainable for each subject will be as follows:

	Maximum Marks.
1. Applied mathematics (viz., elementary statics, dynamics, and hydrostatics)	1000
2. Physics (viz. sound, light, heat, magnetism, and electricity)	1000
3. Chemistry	600
4. Latin	1500
5. Greek	1000
6. English language and composition	1000
7. History, ancient and modern, with geography	1000
8. French	1000

9. German, Spanish, or Italian		1000
10. Drawing	Freehand	400
	Geometrical	400
		9900

XI. A candidate may be examined in as many of the above subjects as he chooses. A certain number, corresponding to a merely elementary knowledge, will be deducted from the marks gained by a candidate in each subject, except drawing and applied mathematics.

XII. To qualify, a candidate must pass to the satisfaction of the Civil Service Commissioners in the subjects specified in Par. VIII., and in two at least of the subjects of the further examination. He must also obtain such an aggregate of marks as shall indicate, in the judgment of the Commissioners, a competent amount of general proficiency.

XIII. The successful candidates will be appointed Lieutenants on probation. They will proceed to the Royal Naval College at Greenwich at the commencement of the season following the examination, viz. on the 1st of October.

XIV. At the end of the first session they will be examined, and commissions in the Light Infantry will be granted to all who shall pass a satisfactory examination. The dates of the commissions so granted will depend upon the number of marks obtained. Those who do not pass satisfactorily will be finally excluded from the Royal Marines.

XV. From those who pass highest at this examination, officers will be selected to qualify themselves to fill vacancies in the Royal Marine Artillery.

XVI. The officers thus selected will remain at the College a second session, at the end of which they will be examined, and, if they pass satisfactorily, will receive commissions in the Artillery.

XVII. Officers who fail to obtain commissions in the Artillery may retain their rank as Lieutenants in the Light Infantry.

XVIII. Artillery and infantry officers will be posted on the list of their respective corps in the order in which they pass their final examination at Greenwich.

XIX. Officers of the Royal Marines on probation will receive 5s. 3d. a day. Those who are permitted to remain a second session to qualify for the artillery will be allowed 1s. 6d. a day mess allowance during that session.

XX. Officers, on passing out, will join their respective divisions, and be instructed in their drill and military duties for service ashore and afloat.

XXI. Each successful candidate at the examination for entry must deposit the sum of £80 with the Accountant-General of the Navy before he can be appointed Lieutenant on probation for the Royal Marines, to provide for his equipment at the Royal Naval College and on joining his division.

XXII. The uniform for officers on probation will be a blue patrol jacket, blue working jacket, mess jacket, undress trowsers, sword, and forage cap.

ROYAL MARINES.—A body of men raised for service as soldiers, either on shore or on board ship, and placed under the control of the Board of Admiralty. The whole regiment is never afloat, only portions of it, the rest being stationed at some of the naval seaport towns. The Royal Marines were first raised in 1664, and have been considerably strengthened since the commencement of this century. They rank, when acting with the troops of the line, between the 49th and 50th regiments. The Royal Marines are a non-purchase corps, and the officers, as in the artillery and engineers, rise by seniority. The corps now possesses a marine force of artillery, consisting of 13 companies, which is a most effective and valuable body of men. The head-quarters of the Royal Marine Artillery are at Eastney, near Portsmouth. Many of the chief garrisons in the south of England have divisions of the Marines quartered in them, such as Woolwich, Chatham, Portsmouth, Plymouth. The strength of the corps amounts to 14,000 men and 287 officers. See *Marines*.

ROYAL MILITARY ACADEMY.—1. The Royal Military Academy at Woolwich is maintained for the purpose of affording a preparatory education to candidates for the Royal Artillery and Royal Engineers; this education will be chiefly technical, and will in no obligatory subject be carried beyond the point useful to both corps alike.

Regulations for Admission, etc.

2. Admission to the Royal Military Academy as cadets will be granted to the successful candidates at an open competitive examination. The examinations will be conducted by the Civil Service Commissioners, and held twice a year, December and July.

3. Notice will be given from time to time of the day and place of the examinations, and of the vacancies to be competed for at each examination.

4. The limits of age will be from sixteen to eighteen, the candidates being required to be within those limits on the 1st day of the January next following for the winter examination, and on the 1st of July for the summer examination.

5. Candidates for admission to the December or July examination must send to the Military Secretary, not less than one month before the 1st December or 1st July respectively, an application to be examined, accompanied by the following papers:—(*a*) An extract from the register of his birth, or in default, a declaration made by one of his parents or guardians before a magistrate, giving his exact age. (*b*) A certificate of good moral character, signed by a clergyman of the parish in which he has recently resided, or by the tutor or head of the school or college at which he has received his education for at least the two preceding years, or some other satisfactory proof of good moral character.

6. When a candidate who has once been examined applies to be examined again, he will only be required to forward a certificate as to moral character for the interval between the two examinations.

7. The number of trials allowed will not exceed three.

8. All candidates will be inspected by a Medical Board; and no candidate will be allowed to proceed to examination by the Civil Service Commissioners unless certified by the Board to be free from bodily defects or ailments, and in all respects, as to height and physical qualities, fit for her Majesty's service. Cases of exceptional shortness of stature will be referred to the War Office for special consideration.

9. A candidate will be required to satisfy the Civil Service Commissioners in the following subjects:—(1) Mathematics, viz. (*a*) arithmetic, and the use of common logarithms; (*b*) algebra, including equations, progressions, permutations and combinations, and the binomial theorem; (*c*) geometry, up to the standard of the sixth book of Euclid; (*d*) plane trigonometry, including the solution of triangles. (2) French, German or some other modern language, the examination being limited to translation from the language and grammatical questions. (3) Writing English correctly and in a good legible hand, from dictation, and English composition. (4) The elements of geometrical drawing, including the construction of plane scales and the use of simple mathematical instruments. (5) Geography. A thorough knowledge of each of the four branches of mathematics will be required. The Commissioners may, however, if they think fit, dispense with this preliminary examination, except as regards mathematics, English composition, and geometrical drawing, in the case of any candidate who has satisfied them on a previous occasion.

10. No marks will be allotted for the above preliminary examination excepting for mathematics (2000), for English composition (500), and for geometrical drawing (300).

11. The "further examination" will be proceeded with immediately on the conclusion of the "prelim-

inary examination." Candidates who fail in the preliminary examination will be informed of their failure as soon as possible, and they will then be released from further attendance.

12. The subjects of the further examination and the maximum number of marks obtainable for each subject will be as follows:

	Marks.
(1) Mathematics, viz. further questions and problems on the subjects of the qualifying examination, and the elements of the following subjects: theory of equations; analytical geometry; conic sections; solid geometry; differential and integral calculus; statics; and dynamics	4000
(2) English: English literature, limited to specified authors; and English history, limited to certain fixed periods; the authors and periods being notified beforehand	2000
(3) Classics, viz. Latin	2000
(3) Classics, viz. Greek	2000
(4) French, the examination to be partly colloquial	2000
(5) German, the examination to be partly colloquial	2000
(6) Any one of the following languages at the option of the candidate, viz. Italian, Russian, Spanish, or Hindostanee; the examination to be partly colloquial	2000
(7) Experimental sciences, viz. (a) chemistry and heat; or (b) electricity and magnetism	2000
(8) General and physical geography and geology	2000
(9) Drawing, free-hand	1000

Of these nine subjects, candidates will not be allowed to take up more than four, exclusive of drawing. In all the subjects, a very great importance will be attached to the accuracy in numerical results.

13. A certain number will be deducted from the marks gained by a candidate in each subject, except mathematics; and the remainders will be added to the marks gained by the candidate in the preliminary examination in mathematics, English composition, and geometrical drawing. The resulting total will determine the candidates place in the competitive list; the successful candidates being those who stand first on the list up to the number of vacancies competed for.

Optional Examination in Mathematics.—Detailed Syllabus.

14. Further questions and problems on the subjects of the qualifying examination. The theory of equations: first principles. Analytical geometry: problems on straight line and circle. Conic sections: elementary properties, with easy problems, both on the analytical and geometrical methods. Solid geometry: first principles, with easy exercises. Differential calculus. Differentiation of functions of one independent variable. Taylor's and Maclaurin's theorems: applications. Maxima and minima of functions of one independent variable. Method of infinitesimals: first principles, with easy applications. Tangents and normals to curves. Points of inflexion. Curvature of curves. Involutes and evolutes. Integral calculus. Elementary integrations. Integration considered as summation. Rectification and quadrature of plane curves. Statics: equilibrium of forces and couples in one plane. Friction: center of gravity; mechanical powers. Problems on elementary statics; the graphical or geometrical method of treating such problems should be studied as well as the analytical. No applications of the differential calculus to statics will be required. Dynamics: elementary principles; projectiles; motion of a heavy particle on a smooth curve; centrifugal force; simple pendulum. Problems and exercises. No applications of the differential calculus will be required.

Terms of Payment.

15. The terms of payment for cadets at the Royal Military Academy are regulated by the following articles of her Majesty's warrant of the 27th December, 1870, for the pay and promotion of the Army:

Payment for cadet. The payment to be contributed on behalf of a cadet shall be as follows, and shall be paid half-yearly in advance:—

	Annually. £
Queen's cadets (if any)	*Nil.*
For the son of an officer of the Army or Navy who has died in the service, and whose family is left in pecuniary distress (subject to the approval of the Secretary of State)	20
For the son of an officer below the rank of Colonel or Regimental Field Officer in the Army, and Captain or Commander in the Navy, or an Instructor at the Royal Military College or Staff College	40
For the son of a Colonel or Regimental Field-officer in the Army, or of a Captain or Commander in the Navy, or of a Professor at the Royal Military Academy, or Royal Military College, or Staff College	60
For the son of a General-officer who is not Colonel of a Regiment, or of a Vice or Rear-admiral	70
For the son of an Admiral or of a General-officer who is Colonel of a Regiment or in receipt of Indian Colonel's allowances	80
For the son of a private gentleman	125

Scale of payment, how computed.—In determining the rate of payment—

a. A General-officer on the half-pay of his last regimental commission shall pay in accordance with such regimental rank.

b. Officers who have sold their commissions shall be regarded as private gentlemen.

c. Officers on retired full or half-pay after 25 years' service, or officers of less than 25 years' service, if placed on half-pay by reduction of establishment, or on account of ill health, shall pay in accordance with their last substantive regimental rank. The cases of officers voluntarily retiring to half-pay before completing 25 years' service shall be specially considered.

d. Officers of the departments of the Army and Navy according to their relative rank, of the permanent staff of the militia, adjutants of the volunteer force, as well as Indian military and naval officers, shall be treated on the same terms as military or naval officers.

e. The sons of deceased officers shall be contributed for in accordance with the foregoing regulations in regard to the rank or classification of their fathers.

Sickness and rustication.—If a cadet be absent a whole term in consequence of sickness or rustication, a payment of £10 shall be required for the privilege of his name being kept on the rolls of the establishment, and for a vacancy being guaranteed at the commencement of the next term.

Orphans.—In the case of a cadet who is an orphan, whose annual contribution is only £20, the amount to be paid when absence extends over a whole term shall be determined by the Secretary of State.

Sickness.—If a cadet be absent from sickness during a portion of the term, his pay shall continue to be issued and credited to his account, but no refund of the contribution shall be permitted.

Rustication.—If a cadet be rusticated or removed during a term, his daily pay shall cease from the date on which he is sent away, and the contribution made for the half-year shall be forfeited.

Pay of cadet.—The pay of a cadet shall be 3s. a day. It is issued to cover the expenses of regimental clothing, messing, washing, and other contingencies. All other necessary expenses of this nature, as well as weekly pocket money, postage of letters, bootmakers' and tailors' bills for repairs, etc., which cannot be covered by his pay, shall be chargeable to his parent or guardian in addition to the regulated contribution.

Extra payments for cadets.—Each cadet on first joining shall be required to pay, in addition to the regulated contribution, a sum of £25 to cover the expenses of uniform, books, etc., and to bring with him the articles of clothing of which he will receive notice, and which must afterward be kept up at his own expense. He shall also be required to pay the regulated contribution in advance, for each half-year of the time during which he remains under instruction, and a deposit of £5 on account, for contingent expenses, which latter sum he shall be required to make up on returning to the Royal Military Academy after each vacation, to cover any expense that may be incurred on his account during the ensuing half-year.

Government and Organization.

16. The Field Marshal Commanding-in-Chief will be the President of the Royal Military Academy.

17. An independent inspection by a Board of Visitors, appointed by the Secretary of State for War, and reporting to him, will be made once a year. Such Visitors will not be a permanent body, but will not all be changed at the same time. The report of this Board will be presented to Parliament.

18. The Academy will be under the control of a Governor, a military man, selected with special reference to his qualifications for superintending both instruction and discipline, and appointed by and responsible to the Secretary of State for War, through the Field Marshal Commanding-in-Chief.

19. The Governor, by virtue of his office, will have local rank superior to that of any of the officers employed under him.

20. The tenure of the appointment is regulated by the following article of the royal warrant of the 27th December, 1870:—The appointment of Governor of the Royal Military Academy . . . . shall be for seven years, with power of re-appointment; but shall in all cases terminate after fourteen years, or at the age of sixty.

21. The Governor, with the approval of the Secretary of State for War, will have the power of appointing and removing the Professors and Instructors.

22. The organization will be on a military basis.

23. The Governor will be solely responsible for discipline and for the general superintendence of the studies,

24. He will be assisted in the arrangements of the studies by the Academy Board, composed of the Professors or Senior Instructors of the different branches. The head of each branch will have the general power of supervision and inspection over the studies of his department, with the duty of reporting on them to the Governor.

25. The Governor will from time to time assemble and confer with all the Professors and Instructors of each separate branch on matters relating to it.

26. The Governor will be assisted by a Staff-officer, not under the rank of Captain, who will be secretary and treasurer, and have charge of the records correspondence and accounts of the establishment, and make all local payments connected therewith, and receive the contributions for the cadets. This appointment will be for seven years, with power of re-appointment.

27. The cadets will form one company under a Captain, assisted by four Lieutenants, charged with the discipline out of studies and the drill, one of whom will be Adjutant and Quartermaster.

28. The Professors and Instructors may be either military men or civilians.

29. The Professors and Instructors will have certain limited powers of punishment, within and without the halls of study, at the discretion of the Governor, to whom they will report all punishments which they may inflict.

30. The Chaplain will be specially appointed by the Secretary of State, and will give instruction in classics.

31. The tenure of office of the Professors and Instructors is regulated by the following article of the royal warrant of 27th December 1870:—The Professors and Instructors at the Royal Military Academy shall be appointed for six years, with power of re-appointment. Their term of office shall not continue after the age of fifty-five, unless an extension be specially recommended by the Governor and approved by the Secretary of State.

32. No Professor or Instructor will be permitted to give private instruction to a cadet, either during the vacation or at any other time, or be allowed to prepare candidates for admission to the Academy.

33. The Governor will have the absolute power of rustication and removal, and also of sentencing a cadet for misconduct to lose places in the list of successful candidates for commissions; when expulsion is necessary, the case will be referred to the Secretary of State through the Field Marshal Commanding-in-Chief.

34. The name of any cadet expelled for misconduct will be recorded in the office of the Field Marshal Commanding-in-Chief, and will be made known to the First Lord of the Admiralty, and to the Secretary of State for India, in order to prevent his being admitted into her Majesty's naval, military, or Indian service.

35. A sword will be given at each final examination as a special reward for excellence in conduct.

36. The Governor will cause registers to be kept of all serious punishments awarded, and of the offences which have caused them.

37. He will inspect accounts of every description connected with the Academy, and certify those which require it.

Course of Instruction.

38. The length of the course of instruction will be two years and a half.

39. If any cadet fail to come up to the required standard at two examinations, or be found unable to qualify in his studies for a commission within three years, to be counted from the commencement of the term in which he first joins, or to acquire a sufficient proficiency in military exercises, he will be removed. No extension of the above period of three years will be granted on account of absence from any cause excepting illness. Cases of protracted absence on account of illness will be specially referred for decision to the Secretary of State for War through the Field Marshal Commanding-in-Chief.

40. The following subjects will form the course of obligatory studies:—(1) Mathematics, including a thorough knowledge of plane trigonometry; practical mechanics, with the application of mathematics to machinery. (2) Fortification, field and permanent; such a course as is suitable to cadets qualifying for the Artillery, and the requisite amount of geometrical drawing. (3) Artillery; such a course as is suitable to cadets qualifying for the Engineers. (4) Military drawing, with field sketching and reconnaissance. (5) Military history and geography. (6) French or German, at the student's choice. (7) Elementary chemistry and physics. (8) Drills and exercises.

41. In addition to the obligatory course, every cadet will be allowed, at his option, to take up certain voluntary subjects, viz.:—(1) Higher mathematics. (2) Higher portions of fortification. (3) Any of the following languages:—German or French, Italian, Russian, Spanish, or Hindostanee. (4) Free-hand, figure, and landscape drawing. (5) Higher chemistry. (6) Latin and (7) Greek; instructions in these subjects to be given by the Chaplain.

42. Marks will be assigned to the obligatory sub-

jects of instruction in the following proportions: Mathematics and mechanics, 7; fortification, 7; artillery, 5; military drawing and reconnaissance, 6; military history, etc., 3; one modern language, French or German, 2; elementary chemistry and physics, 2; drills and exercises manual, platoon, and company drill, ½; gymnastics, ½; riding and sword exercises, ½; artillery, 2; total 31½.

43. The voluntary subjects shall be valued as follows:—Higher mathematics, 5; higher fortification, 3; Latin, 2; Greek, 2; any of the following languages—French or German, Italian, Russian, Spanish, or Hindostanee, 2; freehand, figure, and landscape drawing, 2; higher chemistry, 2.

44. No obligatory subject shall gain a cadet any marks unless he obtain a minimum of one-half the marks in it.

45. No cadet will be ensured a commission unless he qualify by obtaining at least one-half marks in the obligatory course in mathematics and mechanics, fortification, and artillery, and one-half of the total aggregate of the marks allotted to all the obligatory subjects.

46. No voluntary subject shall gain a cadet any marks unless he obtain a minimum of at least one-third of the marks assigned to that portion of it in which he is examined. The marks gained in the voluntary subjects will be added to those obtained in the obligatory subjects to make a second total, according to which cadets shall be finally placed.

47. The periodical examinations will be entirely conducted by examiners independent of the Academy the whole of the marks except those reserved for note-books and drawing being allotted according to their results.

Staff of the Establishment.

48. The following will be the Staff of the establishment:—Governor, Secretary and Treasurer, Captain commanding company, 3 Lieutenants, Adjutant and Quartermaster, Medical Officer, Chaplain, 4 Professors and Instructors of mathematics and mechanics, 4 Professors and Instructors of fortification and geometrical drawing, 2 Professors and Instructors of artillery, 4 Professors and Instructors of military drawing, etc., and Professor and Instructor of military history and geography, 2 Professors and Instructors of French and German, 1 Professor and Instructor of figure and landscape drawing, and 1 Professor and Instructor of chemistry.

49. The pay and allowances of the officers are regulated by the following articles of her Majesty's warrant of the 27th December 1870:—The pay of the officers of the Royal Military Academy shall be as follows:

Governor, £1500 yearly, inclusive of all allowances except quarters, and in addition to his unattached pay as a General-officer or his pay as Colonel Commandant of royal artillery or royal engineers, in the event of his holding such rank; Secretary and Treasurer, not of lower rank than Captain, £400 yearly, inclusive of all allowances except quarters, and in addition to regimental pay; Captain of company, 12s. daily, and regimental pay (also forage allowance for one horse, quarters, fuel, and light, and 2 soldier servants); Lieutenants, each 4s. daily, and regimental pay (also quarters, fuel, and light, and 1 soldier servant); Adjutant and Quartermaster, 5s. daily, and regimental pay as Lieutenant (also quarters, fuel, and light, forage allowance for 1 horse, and 2 soldier servants); Surgeon, according to his rank in the Army Medical Department; Chaplain and Classical Instructor, £400 yearly, and quarters, fuel, and light; Professor of mathematics, if a civilian, £550 to £700 yearly, by a triennial increase of £50; Professor of mathematics, if an officer, £550 yearly, without increase; Instructors of mathematics, if civilians, £350 to £500 each yearly, by a triennial increase of £50; Instructors of mathematics, if officers, £450 yearly, without increase; Professor of fortification, £550 yearly; Instructors of fortification and geometrical drawing, each £450; Professor of artillery, £550; Instructors of artillery, £450; Professor of military drawing, £550; Instructors of military drawing, each, £450; Professor of military history, £500; Professor of French, £350; Professor of German, £350; Professor of landscape drawing, £350; and Professor of chemistry, £400.

The above scale of pay (and allowances) shall include all remuneration of every kind except any additional pay, beyond his ordinary regimental pay, to which an officer may be entitled by brevet rank or as a reward for distinguished service in the field, and no person hereafter to be appointed to any of the above appointments shall be entitled to pension or superannuation allowance for services in such appointment.

50. The appointments of Military Professors and Instructors are open to officers of all ranks.

51. No person whatever belonging to the Royal Military Academy is to receive a present from any cadet, or from the relations or friends of any cadet.

52. Commissions as Lieutenants in the royal artillery or royal engineers will be conferred upon candidates who qualify in accordance with Pars. 39 to 45.

53. The commissions of such Lieutenants as are recommended by the Governor of the Academy, and afterwards pass through their practical course at Woolwich and Chatham in a satisfactory manner, will be antedated 6 months.

ROYAL MILITARY ASYLUM.—An Educational Government Institution at Chelsea, near, but wholly distinct from, the Royal Hospital for pensioned soldiers. Its object is the suitable education for trade, etc., of 500 male children—generally orphans—of British soldiers. For these there are a model school and an infant school, and the boys have a complete military organization, with scarlet uniform, band, etc. As a result of their training, a large proportion of the pupils ultimately volunteer into the Army. The School was originally established in 1803 by the late Duke of York, whence it is still commonly known as the "Duke of York's School." Originally a similar school for soldiers' daughters was included but was not found to answer, and has been discontinued. Attached to the School is a training establishment for military schoolmasters, known as the Normal School. The total cost of the whole Institution is about £11,500 per annum.

ROYAL MILITARY COLLEGE AT SANDHURST.—

1. The Royal Military College is maintained for the purpose of affording a special military education to Sub-lieutenants of cavalry and infantry recently appointed, and to successful candidates in the competitive examinations for commissions.

2. The number of Sub-lieutenants admitted to the College will vary according to the requirements of the service.

3. The dates of admission will be the 10th of February and 10th of September in each year.

4. The College terms will be—(*a*) from the 10th of February to the 30th of July, with suspension of study during a fortnight at Easter; (*b*) from the 10th of September to the 15th of December. The intermediate periods will constitute the vacations.

5. The Commander-in-Chief will be the President of the Royal Military College.

6. The College will be under the command of a Governor, who will be solely responsible for discipline and for the general superintendence of the studies.

7. He will be assisted in the arrangement of the studies by a Board, composed of the Professors or Senior Instructors of the different branches. The head of each branch will have the general power of supervision and inspection over the studies in his department, with the duty of reporting on them to the Governor.

8. The Governor will be assisted by a Staff-officer, who will be responsible in his temporary absence for the charge of the establishment. This officer will

have the custody of the records and the correspondence of the College, and will give the Governor such assistance as he may require.

9. The Quartermaster will perform the duties of Acting Commissary.

10. The Sub-lieutenants, being commissioned officers, are under the Mutiny Act and Articles of War, and must conform to her Majesty's regulations in all respects. While resident at the College, they will be subject to such rules and regulations as are, or may be from time to time, established for the maintenance of good order and discipline.

11. The Governor will have the power of removing for a period not beyond the corresponding period in the next term any Sub-lieutenant guilty of insubordinate or ungentlemanlike conduct, or of repeated acts of irregularity, and will report the circumstances to his Royal Highness, the Field Marshal Commanding-in-Chief.

12. Sub-lieutenants reported for habitual inattention to their studies, or failing to pass satisfactorily through the probationary examination at the end of their first term, will be specially brought under the notice of his Royal Highness, with a view to their cases being considered as to the necessity of removal from the College.

13. In cases requiring more serious notice, a student if commissioned, will be liable, on the report of the Governor to his Royal Highness, to be removed from the service, or, if not commissioned, to be removed from the list of candidates awaiting their commissions.

14. Sub-lieutenants who misconduct themselves during their residence at the College will be liable to the forfeiture of the antedate to which they would otherwise be entitled in accordance with Par. 28. They will also, if temporarily removed from the College for misconduct, be liable, under the provisions of the royal warrant of the 15th of February, 1875, to the forfeiture of pay for such period as the Secretary of State may direct.

15. The Sub-lieutenants will be distributed in divisions of not less than 25, each division being under the immediate charge of one of the Professors or Instructors selected by the Governor.

16. The officers of divisions will be the channel of communication on all subjects between the Sub-lieutenants and the Governor. They will mess with their divisions, and will exercise a general superintendence over them, for which they will be responsible to the Governor.

17. During the hours of study the Sub-lieutenants will be under the charge of the Professors and Instructors, to whose orders they will be required to pay implicit obedience.

18. Sub-lieutenants will salute the Governor and Assistant to the Governor on all occasions, whether in or out of uniform, and the Professors and Instructors when on duty, on parade, or when under instruction.

19. The Sub-lieutenants will be required to appear at all times in uniform, except when on leave of absence, or otherwise exempted by the Governor.

20. The study undress may be worn at all times when Sub-lieutenants are under instruction, with the exception of riding or parade, when they will wear their undress uniform. The forage cap will be worn with the study undress.

21. The course of instruction for each Sub-lieutenant will last during two terms. The following will be the subjects of study:—(*a*) Queen's Regulations and Orders for the Army, regimental interior economy, accounts, and correspondence; (*b*) military law; (*c*) the elements of tactics; (*d*) field fortification, and the elements of permanent fortification; (*e*) military topography and reconnaissance; (*f*) infantry and field artillery drill, riding, and gymnastics.

22. At the end of the course the Sub-lieutenants will be required to pass an examination in the field and on paper, and those who pass the examination will be gazetted to regiments in which there may be vacancies for Sub-lieutenants, with a view to their completing the period of service required before they can be promoted to the rank of Lieutenant.

23. On the pass list of the examination prescribed in the foregoing paragraph, Sub-lieutenants will be placed in one of the three classes, according to their proficiency, as shown at the examination.

24. The examination will be qualifying, not competitive, and the candidates will be arranged alphabetically in each class.

25. The standard of qualifications for the respective classes will be decided upon from time to time by the Secretary of State for War, and announced to the Sub-lieutenants at the commencement of their course.

26. Marks will be allotted to the subjects in the following proportions:—Queen's Regulations, etc., $1\frac{1}{2}$; military law, 2; elements of tactics, 3; fortification, 3; military topography and reconnaissance, 3.

27. In tactics, fortification, and military topography and reconnaissance, one-fourth of the marks will be reserved for notes and drawings done during the course.

28. In accordance with the power vested in the Secretary of State by Art. 3 of the royal warrant of the 30th October, 1871, he has decided that the Lieutenants' commissions of officers who pass in the 1st class will be antedated two years; and those of officers who pass in the 2d class, 12 months. No antedate will be granted to officers who pass in the third class.

29. Every antedate will date back from two years subsequent to the date of the original commission as Sub-lieutenant. No commission as Lieutenant will be granted until the officer has served two years as Sub-lieutenant.

30. Under the provisions of that portion of Art. 3 of the royal warrant of the 30th of October, 1871, which is amended by the royal warrant of the 30th of January, 1875, Sub-lieutenants may be removed from the service if they fail to pass the examination at the Royal Military College within two years from the date of their commissions as Sub-lieutenants. They will be allowed to be re-examined once, at the Military College, provided two years from the date of their commissions as Sub-lieutenants shall not have expired.

31. In order to ensure due diligence during the whole period of residence, there will be a probationary examination at the end of the first term in the work of the term. No Sub-lieutenant will be permitted to reside for more than one year at the College, except in cases of protracted illness, or long absence from any unavoidable cause, or his being prevented from unavoidable cause from undergoing the final examination.

32. The mess-rooms, ante-rooms, and quarters of the Sub-lieutenants are furnished in all essentials by the government; plate, linen, and china, and every article of mess equipment, are supplied by the government, and no contributions on those accounts will be required from Sub-lieutenants.

33. The messes will be conducted in every respect like a regimental mess, with strict regard to economy.

34. All unmarried officers of the College will be required to mess with the Sub-lieutenants. Those officers who are married will mess with the Sub-lieutenants if required to do so by the Governor.

35. Sub-lieutenants will provide themselves, before they join the College, with the prescribed uniform, and with the books and instruments required for their instruction.

36. Sub-lieutenants will pay for their messing and washing. The amount due from each officer for his messing and washing will be paid by him monthly to the Paymaster of the College.

37. All Sub-lieutenants will be required to contribute a certain sum monthly to meet the expenses of a special laundry which has been found to be requisite.

38. No person whatever belonging to the Royal

Military College will receive a present from any Sub-lieutenant, or from the relations or friends of any Sub-lieutenant.

ROYAL REGIMENT OF ARTILLERY. A battalion usually comprises 8 companies. At a time when the number was 18,000, the regiment comprised 119 companies and troops, averaging somewhat over 150 men each. At other times, the companies have varied from 130 to 200 men each. The companies and battalions of foot-artillery are designated by ordinal numbers, such as '6th company, 12th battalion;' the troops of horse-artillery are designated by letters, such as 'D troop.' There are nominally, 5 officers for each company and troop; but some of these are usually absent on staff or brigade duties. In battles and sieges, a *brigade* of this artillery usually consists of either two or three companies, attached to a division of the regular army. Each company with its quota of guns and stores of all kinds, constitutes a *field-battery;* and each troop with its quota, constitutes a *horse-battery.* It has been proposed to abandon the terms *company* and *troop* altogether, as being properly applicable only to infantry and cavalry, and to use only the term *battery;* but this change has not yet taken place. Among the officers of the Royal Artillery, there are no Majors, Ensigns, or Cornets; equivalent services are rendered by officers otherwise designated. The men are chiefly classified as gunners and drivers.

The Army Estimates for 1859–60 will afford pretty correct information concerning the present state of the Royal Artillery.

Royal Foot Artillery.	
Commissioned Officers	918
Non-commissioned Officers	1,785
Rank and File	22,351
Royal Horse Artillery.	
Commissioned Officers	78
Non-commissioned Officers	148
Rank and File	2,120
Total,	27,400

Of this number, 8707 are placed at the disposal of the East Indies, to be paid for out of Indian revenues. There were also voted 5368 horses for the foot-artillery, and 1880 for the horse.

ROYAL SCOTS.—The regimental title given to the 1st Regiment of Foot. It is supposed to be the oldest regular corps in Europe; the men originally came from Scotland, and entered the French army, but afterwards returned to England in 1633, during the reign of Charles I., and then received the title of Royal Regiment of Foot.

ROYAL SMALL ARMS.—The following arms, etc., are manufactured at the Royal Small-arms Factory: 1. Martini-Henry rifles and carbines. 2. Triangular bayonets. 3. Sword-bayonets of various patterns. 4. The Enfield breech-loading revolver. 5. Lances. 6. Leather scabbards for triangular and sword bayonets. The details of the Martini-Henry system and the principal features of the Enfield revolver have been set forth in the articles Martini-Henry Rifle and Enfield Breech-loading Revolver. Inasmuch as these arms differ in many points of fabrication from the usual processes and operations employed in manufacturing small-arms, we herewith give a detailed description of the fabrication of the Martini-Henry rifle:

The barrel is made of soft or mild steel prepared by the "Siemens-Martin" process, this metal having been found to be of a very uniform nature. The barrel bars or molds are obtained by contract in lengths of 15 inches, the diameter for rifle bars being 1½ inch. The barrel bar is heated to a white heat and passed through the barrel rolling-mill, which consists of ten pairs of rolls arranged alternately horizontally and vertically, when it is drawn out in one heat to the full length required (about 36 inches), taper in form, and solid. It is next passed to the Ryder forging machine, where the "Knox form" is forged on the breech end and the barrel cut to length, then passed through a straightening machine, examined for straightness, and viewed as finished forged. The ends of the barrel are clamp-milled for size and length, and then drilled up about 1½ inch at each end, the diameter of the holes drilled being 0.430 inch. This operation is called "entering the bore," and is very carefully tested to see that

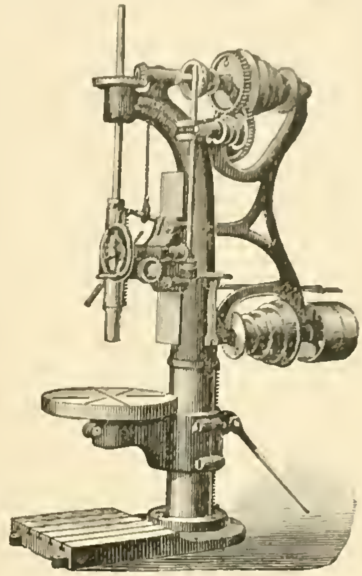


Fig. 1.

the starting of the bore is true and correct. The barrels are now ready for drilling.

The barrels while being drilled are placed vertically in a machine, Fig. 1, where they revolve with a speed of 300 revolutions per minute, the holes already made at each end acting as guides for the set of three drills used in this operation. The method of using these drills insures a long hole of small diameter being drilled perfectly true, and until this method was tried and adopted this was found to be a most difficult task: The drills consist of, first, "the core-drill," for roughly cutting away the metal. This is run in half an inch, when the barrel is taken out and emptied of swarf or cuttings by placing it over a jet-pipe, when a strong stream of washing liquor thoroughly clears out the bore. Another half inch is drilled in the same manner, and the bore again washed out. The second drill or half-round bit is now used. This drill is 0.430 inch in diameter, and having only a cut of 0.05 inch to make in clearing the hole, is run down the one inch the core-drill has cleared without any risk of deviating from the truth. The barrel is then again washed out and No. 3 drill made use of. This has a stock fitting the hole already bored, and ending in a small $\frac{3}{16}$ inch drill, which, being supported by the stock, drills away the center perfectly true with the axis of rotation, ready for the "core" or "roughing drill" to start again. If this system is rigidly carried out inch by inch it is possible to drill a hole three or four feet deep with an error of less than 0.005 inch. A set of drills consists of these three just described, and three sets of different lengths are used. When one-half of the barrel has been drilled, it is turned end for end, and the operation repeated until the holes meet in the center. This system of drilling originated at the Royal Small-arms Factory, and is not in extensive use elsewhere.

After drilling, the hole is broached out with long square bits, on one side of which a strip of oak is placed. Long strips of writing paper are evenly placed between the strip and bit, one upon another, and the bit is run through the barrel until the hole is broached out to the required diameter. This operation is more of a burnishing character than a cutting one, producing a fine, clear, polished surface, down which a shade is readily thrown by holding the barrel at the proper angle to the light. As shadows thrown off straight surfaces are projected in straight lines on any true surface on which they are thrown, the eye can be taught by practice to detect any inaccuracy in the bore of a barrel by the appearance of the edges of the shadow thrown down it. In order to insure absolute certainty that no barrel should be passed on for the exterior to be turned which had not the bore perfectly true, the following mechanical test has been devised, viz: A steel rod is stretched taut between two horizontally fixed head-stocks, having a collar in the center and at one end, which fit the bore loosely, so that the barrel can freely revolve on the rod. If the bore is straight, the end of the barrel where there is no collar on the rod will run perfectly true; but if not straight, it will revolve eccentrically, and its motion is easily detected by any unskilled person. Every barrel is passed through this test before the exterior is commenced upon. The bore is also tested for size by the collars on the rod.

The next operation is to support and hold the bore true while the outside is turned perfectly concentric with it. After a number of experiments to find out a means of fixing a *true turned bush* or collar on a rough exterior, the present method of running sulphur in a liquid state between the barrel and bush was adopted. By this means the exterior of a barrel can be turned perfectly true with the bore without injury to the inside. The barrel is placed vertically, when two plugs, whose centers coincide with the axis of the barrel are placed in the breech and muzzle; the bush is then held over it and melted sulphur is poured in between barrel and bush. This gives a bearing for the outside perfectly true with the bore. The barrel is next rough-turned, finished-turned, draw-polished, gauged, chambered for proof, and screw-thread cut in breech end, to take the "butts" used to close the breech during first proof. This system of turning a barrel enables its exterior to be brought to a definite size, and is greatly superior to the old method of grinding barrels on a large stone and afterwards striking them up. The barrels now undergo the first-proof test which is necessary in order to detect inferior quality of metal and flaws which do not appear on either the exterior or interior surfaces. The first-proof charge is 7½ drams of

sawn to length and brazed on. The barrel is now finished-bored and set, and is then ready for rifling.

The rifling is done with a cutter having a head of suitable form for the rifling required. This is fitted into a groove cut in a box about eight inches in length and fitting the bore. It is drawn through the barrel by a rod fastened to one end of the cutter box, the other end of the rod being coupled into the spindle of the head-stock or traversing saddle. On the spindle is a pinion geared into a sliding rack carried by the same saddle. The end of the rack is fitted to slide backward and forward along a fixed bar, which can be set at any angle necessary to rotate the spindle and cutter box to the amount of spiral required. From four to five cuts are needed for each groove, and the cutter is fed up by a screw tapped into the end of the cutter box, to which a rod is attached, which works through the center boss of a hand wheel. A spiral groove is cut along this rod, in which a feather fixed in the boss of the hand wheel slides, enabling the feed-screw to be screwed in or out by the hand wheel as required. An index is connected with the hand wheel, enabling the operator to read off the depth of cut. The barrel is fixed in a rotating chuck, which is divided so that any number of grooves required can be cut inside the bore. The rifling is of uniform twist of 1 in 22 inches, or one and a half turns in the length of bore (33 inches). The form of rifling is that known as the "Henry rifling;" the grooves are seven in numb r, and are 0.007 inch in depth.

The barrel is suspended inside a hollow rotating spindle by a plug inside the muzzle end, running on a plug fixed in headstock at the breech end. A guide-screw is securely fixed on the rotating spindle, and carries a nut fixed to traversing tool-holder, which holds a peculiar form of chasing tool. The teeth for cutting the screw-thread on the breech end are on the under side, so that, being set over the top of the rotating barrel, it can be lifted in and out of the thread which is being cut, in the shortest possible time and distance, without chopping the thread. The screw being entirely finished, the barrel is then driven from it, while the breech end of it is chambered up for the cartridge. The entire operation of boring and reaming is performed in the lathe represented in Fig. 2. The barrel is now breeched up to body, the action assembled for proof, and the rifle undergoes the second-proof test. The second-proof charge consists of 5 drams of powder, a bullet weighing 715 grains, and a cork made half an inch

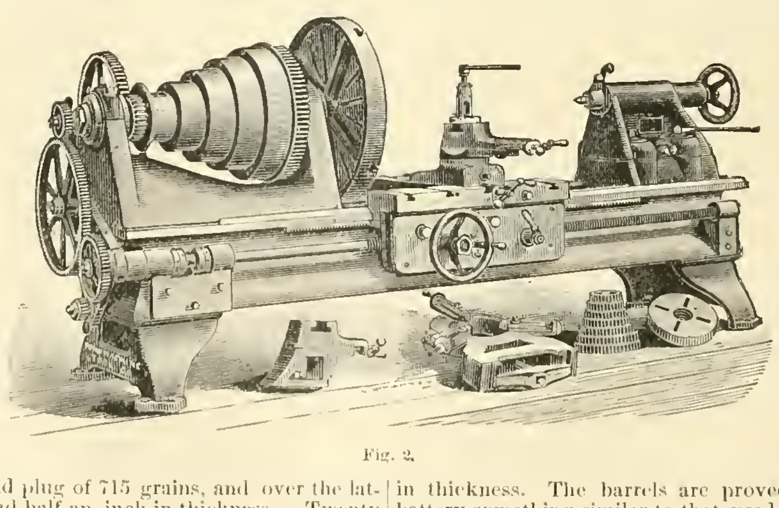


Fig. 2.

powder, a lead plug of 715 grains, and over the latter a cork wad half an inch in thickness. Twenty barrels are proved at the same time in a cast-iron proof battery.

The seat for the front sight is next cross-milled and dove-tailed, and the steel for the front sight is

in thickness. The barrels are proved in a proof battery something similar to that used for the first proof.

The back sight-bed is soldered on to the barrel, and also secured in its place by two screws. Both the back sight and front sight are adjusted and regulated from the axis of the bore, and when viewing the barrels for sighting the greatest care is taken to see that both sights are exactly in position. The body and barrel are browned separately, the following being the browning mixture at present in use:

Spirits of wine	5 ounces.
Spirits of nitre	8 "
Tincture of steel	8 "
Nitric acid	4 "
Sulphuric acid	3 "
Blue vitriol	4 "
Water	1 gallon.

The process is as follows: The barrels and bodies are first scalded in a solution of soda for twenty minutes and are then washed in a clean water. The browning mixture is applied, and they are placed in a damp heat for about one and a half hours, when they are scalded again, and when cool the rust is scratched off. This process is repeated four times, and then the barrels are cleaned off and oiled. The whole operation of browning requires about eight hours.

The body which is to contain the breech action is made from a specially tough class of mild steel. Bars of this metal, 4 or 5 feet in length and 2 inches by 1½ inch in section, are obtained by contract. The body is blocked direct off the end of the bar by five blows under a 15-cwt. steam-hammer. The first blow gives a rough figure, and measures off the quantity of metal required. The second blow fullers in the sides of the body, to displace the metal when working the hole through it. The third blow, by means of a chisel in

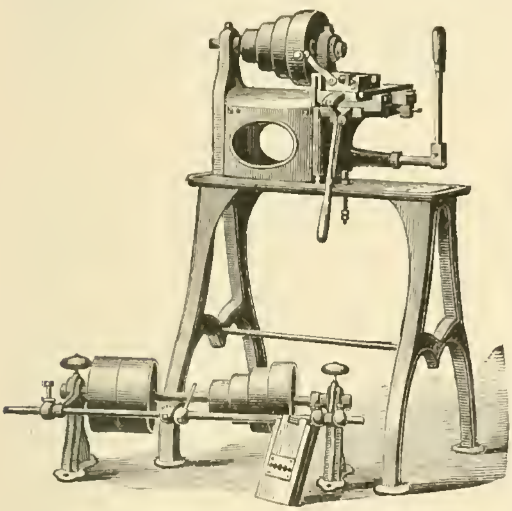


Fig. 3.

the upper die, splits the metal in the center, driving out the sides of the body to fill the die, and leaving the impression of the hole to be made through the body full size at the top. The fourth blow drives a full-sized drift, placed in the hole just made by the chisel, clean through, shearing down the sides, and driving through the small piece left at the bottom of the hole. The hole made through the body is now 3 inches by ⅞ inch by 2¾ inches, and the metal wasted is only 3½ oz. in weight. The fifth blow cuts the body off the bar. A mandrel is now driven in the hole, and a blow is struck upon the ends to square them up, when the body is ready for stamping. The body is reheated and a cold steel mandrel driven into it, when it is at once placed under a powerful steam-hammer. On the anvil of this hammer is the lower die of a pair, the impression cut in the pair of dies being that of the finished size of forged body. One heavy and sudden blow is given, with force sufficient to make the metal flow into every corner of the impression. If this is not done at the first blow, it cannot with safety be attempted by a second blow without reheating, as the surplus metal flows over between the faces of the dies in the form of a thin fin, chilled and black, and this would swallow up itself the force of a second blow and perhaps split one of the dies. The body is next annealed, scale pickled off, fin-trimmed, and passed as "finished forged."

The hole in the body is first drifted out by means of long slightly tapered drifts, which are drawn through it, and the hole produced in this manner is used as a starting point for all the subsequent operations. After drifting, four bodies are placed on a revolving cross-shaped fixing, the arms of which exactly fit the holes in the bodies, while a transverse slide carrying two tool-holders, one on each side, turns up both sides of the four bodies at one operation. This operation leaves the sides of the body equal in thickness and true with the center hole. Twelve bodies are next fixed on a revolving head, and the barrel ends are all cut square and true, the stock ends being treated in the same manner. The hole for the barrel is then drilled, tapped, and the burr thrown up by the tapping is smoothed down. The face is eased, so that when a gauge is screwed in it stands exactly true. The body is now placed in a drilling jeg, and the adjusted face is screwed tight up against a rib in the jeg, while the six axis holes of various sizes are drilled, three in each side. The drills run through hardened steel bushes fixed in the sides of the drilling jeg. These axis holes, after being tested for accuracy, become, in conjunction with the large hole in the body, the base points for the remaining operations.

A number of drilling-machines now operate to cut away the metal so as to form the socket to receive the stock butt. The hole is drilled and tapped to receive the screw end of the stock-bolt, which secures the butt in the socket. Pins in the axis holes in the left side of the body, hold it while the knuckle seat for breech-block is roughly cut out and the seat milled out square and true. A number of minor milling, drilling, and tapping operations bring the body into the shape and figure required, and it is then screwed on, or "breeched up," to the barrel. The barrel is now placed vertically with the end of the chamber resting on the collar of a plug, which enters and exactly fits the chamber, and the face of the barrel is drawn very tightly down on this collar by means of plugs pushed through axis holes in the body. Small mills are now run on a spindle through the block axis-hole and finish cutting out the knuckle seat of the block to a positive length from the face of the barrel. This length between the knuckle seat of the block and the face of the barrel is rigidly maintained, so as to insure that any block will interchange or fit in any body. In order to insure that this may be the case, each breeched-up barrel and body is accurately gauged with hardened steel gauge-blocks. Care is also taken to see that the striker hole, in the face of the gauge-block, coincides with the axis of the bore of barrel to insure the cap of the cartridge being struck in the center. The barrel and body are now passed on for assembling the action for second proof.

A particular form of emery wheel, called a "rim wheel," is employed for finishing up some of the components. Its use has enabled unskilled labor to take the place of a high class of skilled workmen, and the work is better finished. For instance, the slot of the back-sight leaf is first drifted to its true size. By this it is held in a fixing attached to a vertical axis, and both edges with cap attached can be passed across the face of the rim wheel, maintaining it perfectly true, and grinding the edges of the leaf and cap parallel to each other. The sides are done in the same manner. Having given a description of the processes of manufacture for the barrel, and body, it will be unnecessary to describe the manufacture of the other components. The method pursued in the manufacture of all is precisely that followed in the case of the body. All the parts are first of all forged in dies, the fin is trimmed off, they are pickled to remove scale, and then undergo numerous milling, drilling, and other machine operations until they are brought to the correct figure, when they are viewed, gauged, and either case-hardened, browned, blued, hardened, and tempered, etc., as the case may be. The barrels of carbines and pistols are treated in the same manner as the rifle barrel. In order to insure an absolute interchangeability of the various parts the most exact system of gauging is a necessity, and the strict view which is enforced prevents the possibility of any defective parts being assembled in an arm.

The blade of the triangular bayonet is made of tool or sharp steel, the socket of mild steel, the locking ring of wrought iron, and the locking-ring screw of steel. The blade and socket are welded together; the blade is tapered under a Ryder hammer, and then rolled out in segmental rolls to the required length

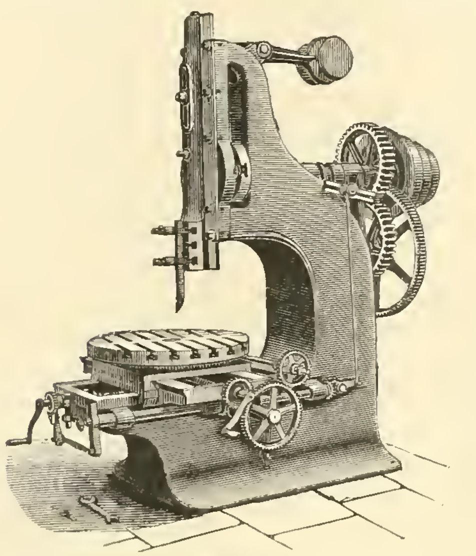


Fig. 4.

and a triangular figure. The socket is stamped to size and then goes through several machine operations, such as drilling, milling, slotting, etc. The blade is hardened and tempered, ground and polished, the socket being browned. The locking-ring is well blued, and its screw is case-hardened. The breech-block, lever, butt-plate, and iron screws are case-hardened. This is done by carefully packing them in iron boxes, in which they are surrounded with bone cuttings or animal charcoal. An iron plate is laid on the top of the box, and it is placed in a furnace and raised to a red heat. The length of time that the various articles are left in the furnace depends on the amount of case-hardening required; and when removed from the furnace they are chilled in a tank of cold water. They are then cleaned, oiled, and examined by gauges to ascertain whether the case-hardening has altered their form. The following components are hardened by being raised to a certain temperature and then cooled in oil. They are afterwards tempered by "blazing," that is by heating them again until the oil or suet with which they have been covered bursts into a flame: Striker, main-spring, indicator, extractor, sight-spring, catch-block spring, trigger-spring, block-axis pin, extractor-axis, sight-slide, and steel screws, etc. The following components are blued: Upper and lower bands, upper and lower band-pins, guard and band swivels, fore-end hook-screws, sight-leaf, lever catch-block and pin, guard, nose-cap, the rod-holder, etc. They are polished, cleaned with lime to remove all grease, and are then covered with powdered charcoal and raised to a temperature of about 550° Fahrenheit.

A milling-machine and a screw-head slotter combined, arranged for taking the short milling cuts, is shown in Fig. 3. The box-shaped head is placed on a planed iron table, which is surrounded by a groove to catch oil and chips. The cross slide is adjusted by a screw that projects in front, and squared by a wrench. The sliding-table is operated for a hand lever and the motion is gauged by an adjustable stop behind. A vertical movement is communicat-

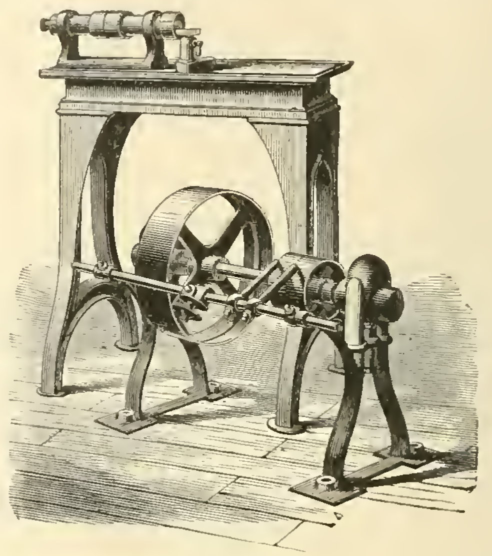


Fig. 5.

ed to the knee slide by means of a rack and gear, operated by a hand lever in front, as shown in the drawing. For slotting screws, a sliding vise is furnished, so arranged that the front or movable jaw tightens on the screw to be slotted by means of two springs under the jaw. The jaw is linked so that it is operated wholly by the hand lever which feeds the vise. With the machine with the lever vertical motion, screws can also be fed up under the saw which greatly increases its capacity. Counter-shaft has adjustable self-oiling hangers. Fig. 4, represents the usual form of slotting-machine, supplied with slotting-bar counter-balances, so as to run without jarring. It is driven by a variable crank, with quick, return motion; has bearing for slotting-bar adjustable vertically, to suit the different heights of work; has compound tables, with circular plate and centering stud; and the feed is self-acting, so as to be perfectly balanced. Fig. 5, represents the screw polishing machine, with bearings so inclosed as to entirely prevent the admission of the emery used for polishing the work. This is the peculiar property of this machine, and being specially adapted for polishing small parts of arms, etc., such as screws, studs, nuts, collars, etc., which are usually finished with oil and emery, its durability is thus secured. The counter-shaft of this machine has a speed of 450 turns per minute. The machines here described together with those illustrated and discussed in the article—Fabrication of fire-arms—will assist the reader in gaining a knowledge of light gun machinery. See *Enfield Breech-loading Revolver*, *Fabrication of Fire-arms*, *Martini-Henry Rifle*, and *Small-arms*.

ROYAL WARRANT.—An act of the Sovereign, authorising, for military purposes, the Secretary of State for War to issue Rules and Regulations for the guidance of the several Departments of the Army. Royal warrants, where the Army is concerned, relate to all matters touching the soldier, his pay, clothing, travelling, food, etc., and are issued from time to time, by the War Office, in Army Circulars, for the observance of all concerned.

RUBBERS.—Strong heavy files, generally made of an inferior kind of steel; they measure from 12 to 18 inches long, from ¾ inch to 2 inches on every side, and are made very convex or fish-bellied. Rubbers are only for coarse manufacturing purposes, when the object is rather to brighten the surface of the work than to give it any specific form. See *File*.

RUBBLE.—A common kind of masonry, in which the stones are irregular in size and shape. Walls faced with ashlar are generally packed with rubble at the back. Rubble is of various kinds, according to the amount of dressing given to the stones. Common rubble is built with stones left almost as they come from the quarry. Hammer-dressed rubble, is so called when the stones are squared with the mason's hammer; coursed rubble, when the stones are squared and equal in height, etc.

RUBEN AND FORNEROD COMBINATION-FUSES.—These two Swiss fuses are alike in principle, and differ only in that the larger one has two tiers of burning composition and is capable of burning 20 seconds, twice the length of time—as a time-fuse—that the smaller one can burn. The fuses consist of three principal parts, the body, A, the inertia igniter, B, and the percussion-fuse attachment, C. A and B constitute the time-fuse. The former is made of an alloy of equal parts of lead and tin, while, B, and C, are of brass. The body, A, is provided on its exterior with a screw-thread by means of which it is connected with the shell; the central cylindrical part is also provided with a screw-thread, into which fits the assembling screw of igniter, B, which binds all the different parts of the time-fuse together.

The body A of the larger fuse (Fig. 1,) is composed of three parts, *a*, *b*, *c*; the upper part *a*, or the

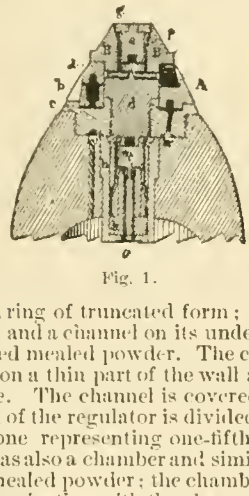


Fig. 1.

regulator, is a ring of truncated form; it has a priming chamber, and a channel on its under side, inclosing compressed mealed powder. The chamber opens externally upon a thin part of the wall and internally upon the core. The channel is covered by a disk of foil. The rim of the regulator is divided into 50 equal parts, each one representing one-fifth of a second. The part, *b*, has also a chamber and similar channel of compressed mealed powder; the chamber opening on top for communication with the channel of *a*, and on the outside for escape of gas, the outside opening being covered with wax. Between, *a*, and, *b*, and glued to the top of, *b*, is a washer of thick cloth, with a small hole through it just over opening to chamber of, *b*. The lower part, *c*, has on its under side a circular channel of rifle-powder covered by a perforated disk of copper—a piece of gauze separates the powder and copper ring; a vertical channel filled with rifle powder allows a communication between powder in, *b*, and the rifle powder in, *c*; separating, *b*, and, *c*, and glued to the top of latter, is a washer of cloth exactly similar to one separating, *a*, and, *b*. The outside rim of this piece is also graduated into 50 equal parts, each one reading one-fifth of a second.

The igniter, B, consists of the parts, *d*, *e*, *f*, and *g*; the stock, *d*, has a cylindrical cavity, at the center of the bottom of which projects a sharp pin-point; four radial holes at bottom of cavity allows the gas from igniter to escape and spread into a circular groove around the outside of the stock; a brass washer separates the hexagonal rim of the head of the stock from the regulator or part, *a*, of the body. At the bottom of the stock there is a cylindrical projecting cup filled with the same composition as that in the igniter, and also covered with a solution of rubber. The cylindrical plunger, *e*, has in the center of its base a recess which contains the fulminate priming, which is believed to be made of five parts chlorate of potassa, one of sulphide of antimony, and one of powdered glass, all coated with a solution of rubber; the crown-shaped spring, *f*, is stamped out of a thin piece of steel; it has four spring leaves; the bottom of the spring is shaped to fit the base of the plunger and to expose the fulminate in plunger; the screw-cap, *g*, closes the top of the stock, *d*; a hole through its center allows the cylindrical projection on top of plunger to pass through and centers the plunger in spring and cylindrical cavity of stock.

The percussion attachment, *C*, consists of five parts, *h*, *k*, *m*, *n*, *o*; the hollow cylindrical stock *h* has a solid bottom, pierced with a small central hole for passage of gas from the fulminating composition into the shell; this hole is closed by a piece of fine netting, or gauze, to prevent the powder in the shell from penetrating fuse-stock or body; a shoulder turned on its exterior fixes its position in the fuse-hole of shell; the cylindrical plunger, *k*, has through its axis a longitudinal channel, at the head of which is secured a sharp steel projecting point; forward movement of the plunger, except upon impact in flight, is prevented by a steel crown-shaped spring, *m*, similar to the one heretofore described. A hollow cylinder, *n*, centers the plunger and is long enough to permit the pin point to reach and pierce the fulminate on impact; the stock is closed by a brass ring, *o*, resting on a shoulder turned in top of stock.

The action of the combination is as follows: Upon the inflammation of the charge, the plunger is thrown back, the spring being compressed, and the plunger, with its fulminate, strikes the metallic point; the gas due to the consequent ignition passes through the openings in the wall of the tube, spreads into the circular groove around the outside of the tube, ignites the priming of the burning column, and thus causes the inflammation of the section of this column in contact with it; inflammation spreads along the

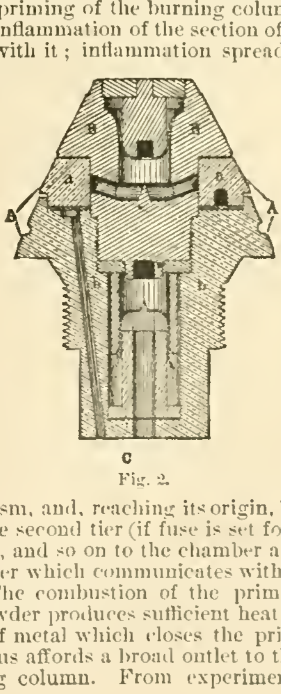


Fig. 2.

burning prism, and, reaching its origin, is communicated to the second tier (if fuse is set for more than 10 seconds), and so on to the chamber and recess of rifled powder which communicates with the powder in shell. The combustion of the priming of compressed powder produces sufficient heat to melt the thickness of metal which closes the priming-chamber, and thus affords a broad outlet to the gas from the burning column. From experiments made in

Switzerland, it is believed these fuses offer entire security against premature ignition, the shells being given the most violent shocks which could be received in transportation, loading, or unloading. The ignition is very certain, even with reduced charges.

Should the fuse strike any resisting object before the burning composition has reached the point to which the time-fuse was set, the plunger or percussion attachment, C, is thrown forward, the spring being compressed, and the pin point pierces the fulminate at base of igniter, B, and the gas resulting has direct access to bursting charge of the shell.

The smaller fuse shown in Fig. 2, has the same general features as the larger; it differs from it in that it has but one layer of composition, which burns 10 seconds. The body, A, is in two parts only; the regulator *a* with its circular groove of compressed mealed powder has on its outside rim 50 equal divisions representing fifths of seconds. The lower part of the, *b*, covers the percussion attachment, C, and has running vertically through one side a hole filled with rifle-powder; this is the channel of communication between burning composition of time-fuse and bursting charge of shell. The conical outside surface of the igniter, B, is roughened to facilitate turning of the assembling screw which binds the different parts of the fuse; by loosening and tightening this screw the regulator is set to the required time. The different parts of this fuse function as those of the larger fuse. See *Fuse*.

RUB-IRON.—A plate on a carriage or wagon-bed, against which the fore-wheel rubs when turning short, is called a *wheel-guard plate* in a field artillery-carriage; one is placed on each side of the stock.

RUFFLE.—A low vibrating sound, which is beat upon the drum, but not so loud as a roll. It is generally performed in paying military compliments to general officers, and at military funerals.

RULE BRITANNIA.—One of the national anthems of Great Britain, which has been described by Southey as "The political hymn of this country as long as she maintains her political power." Its original appearance was in a mask entitled *Alfred*, the words by James Thompson, the poet, and David Mallet, and the music by Dr. Arne, which was performed for the first time on Aug. 1, 1740, before Frederick, Prince of Wales, at his residence at Cliefden. The words of the ode are believed to be the composition of Mallet. *Alfred* was altered by Mallet in 1751, when three stanzas of *Rule Britannia* were omitted, and three others, by Lord Bolingbroke, substituted for them; but it is the ode in its original form that has taken root.

RULE NISI.—In the English and Irish courts of law, is a technical term denoting the first step in an interlocutory application to the Court, such as an application for a new trial. The usual course is for the party who takes the initiative to move, *ex parte*, for a *Rule Nisi*, *i. e.*, an order of the court that something shall be done, *unless* the opposite party, within a certain time, usually three or six days, show cause, *i.e.*, some good reason why the thing proposed should not be done. When the party obtains a rule nisi, he sends a copy of it to the other party, who must then, at the time appointed, show cause, and if the cause is deemed sufficient, the rule is discharged, *i. e.*, the application is refused; if the cause is insufficient, the rule is made absolute, *i. e.*, the opposite party is bound to do the thing asked, otherwise he will be liable to some disadvantage or to imprisonment according to the nature of the subject matter.

RULES OF FIRE.—Those for ordnance which fire horizontally, result from the knowledge of the *mean trajectory*, which, like the mean trajectory of the musket, comprises all the causes of error which can modify the fire; but the trajectory of artillery projectiles being more constant in its form, the results are more accurate, a consequence of the fact that as the caliber of the arm increases, each particular trajectory approaches more nearly the *mean trajectory*.

When *canister* is fired, the balls, having broken the case, escape in the form of a cone, and striking against each other, and against the sides of the piece, diverge more or less according to the distance; but the greater part of the balls are found to be near the center, and the *rules of fire* are still based upon the knowledge of the mean trajectory.

RUMP PARLIAMENT.—In order to bring about the condemnation of Charles I., Oliver Cromwell, on Dec. 6, 1648, sent two regiments, under the command of Colonel Pride, to coerce the House of Commons. Forty-one members of the "Long Parliament" who were favorable to accommodation were imprisoned in a lower room of the house, 160 were ordered to go home, and only 60 of the most violent of the Independents were admitted. The clearance was called *Pride's Purge*, and the privileged members ever afterward passed by the name of the *Rump*, forming, as it were, the fag-end of the "Long Parliament". This assembly, in conjunction with the army, brought about the arraignment, trial, and condemnatian of Charles I. Five years later the "Rump Parliament," forgetting that it was but the creature of the army, attempted to make a stand against certain demands on the part of the soldiers. The result was that Cromwell filled the House with armed men; the speaker was pulled out of the chair, the mace taken from the table, the room cleared, the door locked, and the Parliament declared to be dissolved. Supreme in the three Kingdoms, Cromwell convoked an assembly which assumed the title of Parliament, and acquired from the name of one of its most prominent members, a leather-seller, called Praisegod Barebones, the name of the *Barebones Parliament*. The Barebones Parliament, after subsisting five months, was dissolved, and Cromwell, raised to the dignity of Protector, convoked two Parliaments, and dissolved them for refusing to sanction his measures. On Oliver Cromwell's death, and Richard's succession to the Protectorate, the military Malcontents, coalescing with the Independents in Richard's Parliament, declared the expulsion of the Rump illegal, and restored that Assembly to its functions. With the revival of the Rump, its quarrel with the army revived; and the troops, again surrounding Westminster Hall, expelled it on Oct. 30, 1659, a provisional government of officers assuming the direction of affairs. But the general dissatisfaction having led to a coalition between the Presbyterians and Royalists, the army, unable to carry on the government, was reduced to the necessity of once more restoring the Rump, which had been twice ignominiously expelled. The advance of Monk, however, with the army of Scotland led to a general cry throughout the country for a Free Parliament. A number of the members who had been excluded by Pride's Purge reappearing in the House, placed the Independents in the minority; and on Mar. 16, 1660, the despised and derided Rump at last solemnly decreed its own dissolution. The most prominent members of the Rump Parliament were Vane and Hazlerig.

RUMSEY GUN.—A breech-loading rifle having a fixed chamber closed by a movable breech-block, which slides in the line of the barrel by indirect action, being moved by levers from below. The arm resembles in its general features the Winchester. Its peculiarity consists in having two magazine-tubes, one on each side of the barrel and beneath it. From these the cartridges are fed alternately into the corresponding carriers, which are moved up and down by levers operated by a sliding-rod. This rod is drawn to and from the operator by two thumb-pieces, one of which, for the right hand, is within the trigger-guard, and the other lies along the barrel in a position readily accessible by the fingers of the left hand when supporting the piece in the natural position of firing. The mechanism for communicating this reciprocal motion to the carrier levers, consists mainly of an oscillating lever lying between the other two, and its connections in the form of springs, stops, and pins, which are designed for directing the stroke on each of its sides alternately.

RUN.—The greatest degree of swiftness in marching. It is executed on the same principles as the *double-quick*, but with greater speed. In England, the *Running Drill* forms part of the training of a soldier. It comes under the head of gymnastic training, and is ordered to be carried out in all infantry regiments. The object of it is to make the men supple, active, and capable of bearing fatigue. On alternate days the men run with arms and accouterments.

RUNNING FIGHT.—A battle in which one party flees and the other pursues, but the party fleeing keeps up the contest.

RUNNING FIRE.—A constant fire of musketry or cannon.

RUNNING FUSE.—The running-fuses most used are those known in England as *Bickford's fuse*, and in this country as *Safety-fuse* and *Toy's fuse*. The common fuse ordinarily used in blasting with powder is of this kind. It consists essentially of a column of fine gunpowder enclosed in flax, hemp, or cotton, and made up with different coverings according to the use to which it is applied. When intended for immediate use on light work in dry ground, it is unprotected by additional coverings. When intended for use in wet ground or under water, it is covered with varnished tape or gutta-percha.

These fuses cause ignition by conveying flame to the charge to be exploded. They are somewhat uncertain in their rate of burning, but average about one yard in a minute. The ordinary varieties must be kept in a cool, dry place, and preserved from contact with grease or oil. The gutta-percha-covered varieties are liable to become injured by keeping, from the deterioration of the gutta-percha. Before using, care must be taken that cracking of the gutta-percha has not occurred. They should be able to resist water for twenty-four hours. See *Fuse*.

RUNNING THE GAUNTLET.—A punishment formerly enforced in the English Navy, and which was inflicted also on soldiers. The mode of procedure was as follows. When a soldier was sentenced to *run the gauntlet*, the regiment was paraded in two ranks, facing one another, each soldier having a switch in his hand, and as the criminal ran between the ranks naked from the waist upwards, he was lashed by the soldiers. While he ran the drum beat at each end of the ranks. Sometimes he ran three, five, or seven times, according to the nature of the offence. Happily such a barbarous punishment no longer disgraces that Army or Navy.

RUPTURE OF SHELLS.—When the charge of powder contained in a shell is inflamed, the gases developed expand into the cavity, the expansive force increasing and producing rupture when sufficient to overcome the tenacity of the metal. Rupture will take place in the direction of least resistance, or following the least thickness of metal. If the shell be spherical and homogeneous, and the cavity also be spherical and concentric with the exterior, the surface of rupture must be composed of lines normal to both the interior and exterior surfaces of the shell.

Let R be the radius of the exterior, and r the radius of the interior surface; T, the tenacity of the metal composing the shell, and p, the pressure of the gases on a unit of surface required to overcome the tenacity of the metal.

Let C be the radius of the circle in which the surface of rupture intersects the interior surface of the shell, or the *interior circle of rupture*. The effective pressure exerted on the area of this circle to produce rupture is equal to the sum of the components of all the normal pressures, acting on the spherical segment of which it is the base, taken perpendicularly to the plane of this circle; therefore πpC^2 is the pressure of the gases which tends to break the sphere.

Under this supposition, rupture should follow the surface of the frustum of a cone of which this circle is the smaller base. The surface of this frustum is equal to the difference of the surfaces of two cones whose common apex is at the center of the sphere. The base of the smaller is $2\pi C$, and its slant height r; its surface is therefore equal to πCr. The surface of the larger cone, whose generatrix is the radius of the exterior sphere, being to the smaller as R^2 is to r^2, will be $\pi Cr\frac{R^2}{r^2}$; and their difference, or the area of the surface of rupture, will then equal

$$\pi Cr\left(\frac{R^2}{r^2}-1\right).$$

If the pressure of the gases acted normally to the surface of rupture, or in the direction of the tenacity, this surface multiplied by T would give the total resistance, to which the pressure of the gases should be equal; but it acts obliquely, and to produce rupture should be increased by a quantity which depends upon the angle which the pressure makes with the normal. Denoting this quantity by d, we shall have the relation,

$$p\pi C^2=T\pi Cr\left(\frac{R^2}{r^2}-1\right)+d;$$

or,

$$p=T\frac{r}{C}\left(\frac{R^2}{r^2}-1\right)+\frac{d}{\pi C^2}$$

In this expression, the value of d is unknown, and cannot be practically determined, but it evidently diminishes as the direction of the pressure approaches the normal to the surface of rupture, and when they coincide, d becomes 0. At the same time C increases, and the value of p diminishes, until C becomes equal to r, its maximum value. Therefore, the section of easiest rupture of a hollow sphere passes through a great circle, and the pressure which is *in equilibrio* with the tenacity of the metal, will be given by making $C=r$, and $d=0$, in the foregoing formula, which will then become,

$$p=T\left(\frac{R^2}{r^2}-1\right)=T\left(\left(\frac{R}{r}\right)^2-1\right).$$

When the pressure is less than this value of p, the shell will resist rupture; when greater than this value, rupture will take place.

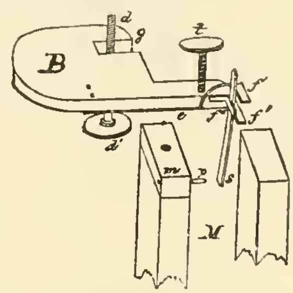
The required pressure being known, the corresponding density will result from Noble's formula,

$$p=14.63\frac{d}{1-ad};$$

this density multiplied by the weight of water that will fill the cavity gives the weight of the bursting charge. See *Projectiles* and *Shells*.

RUSE.—A trick or stratagem. The success of a ruse depends mainly on the Commander's knowledge of human nature in general, and of his opponent's character in particular. Its object is to deceive the enemy as to your designs. If you desire a general action, spread reports of the weakness of your army and appear to avoid one. If the contrary, put on a bold face, and appear desirous to engage. The employment of ruse or stratagem is particularly applicable to operations having for their object the forcing of any long line which it is impossible for an enemy to guard at all points, such as mountain ranges, rivers, entrenched lines, etc.

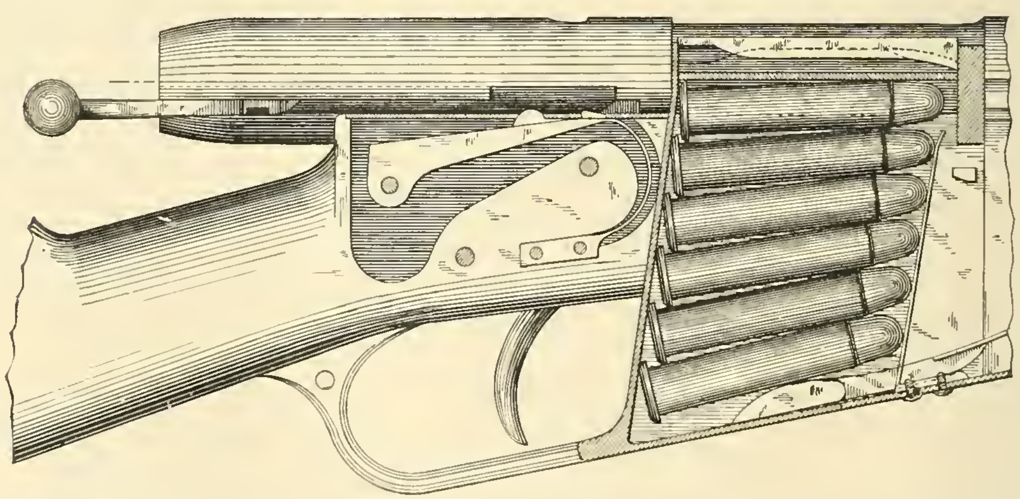
RUSSELL INTERRUPTER.—An electrical interrupter devised by Lieut. A. H. Russell, Ordnance Corps, U. S. Army, for the Schultz chronoscope. The change consists in replacing the detached mercury interrupter now in use by a light metallic spring, which is pressed against the tuning-fork on the inner side of one prong, making the fork its own interrupter when the electrical current is passed through it. The drawing shows the new device. *B*, is a brass plate which is fastened to the table by the screw, *d*, working through the slot, *g*, into the base of the clamp. This screw should have a milled head, as at, *d'*. Riveted or screwed to the plate *B* is an elastic strip, *e*, fitted with a screw, or simply with projections as at, *f'* to hold the spring, *s*. A screw, *t*, works through the plate, *B*, against the strip, *e*, thereby raising or lowering the end of the latter. By this means the spring, *s*, for which a piece of watch-spring may be used, can be pressed against the platinum point, *p*, fixed on the inner side of the counterpoise, *m*, of the tuning-fork. The fork and the spring are connected with the opposite poles of a galvanic battery, and the current is made and broken at, *p*, by the vibration of



the fork. For adjustment the plate, *B*, is slipped under the table and fastened by the screw, *d*, so that the spring, *s*, is just out of contact with the point, *p*. The wires being adjusted, the circuit is completed at, *p*, by a turn of the screw, *t*, and the electro-magnets becoming magnetized draw the prongs apart. This breaks contact at, *p*; the prong flies back and continues to vibrate, the contact being made and broken at every vibration A battery of four Bunsen's cells works the interrupter. The advantages of this device over the old interrupter are as follows: 1. The adjustments are exceedingly simple, and they require but little time, while with the detached mercury interrupter they are very delicate and difficult. 2. The manipulation is very simple and rapid, a mere turn of the screw producing vibration. 3. The use of the mercury cup is entirely avoided. 4. Extra electro-magnets for the interrupter are dispensed with, and the strength of the battery can be greatly reduced. 5. The arrangement is cheap and simple, and not easily deranged This interrupter has been in constant use for several years, and it has been practically and successfully tested with the machine.

RUSSELL MAGAZINE.—This magazine, devised for the Hotchkiss gun, is intended to provide for one continuous supply of the cartridges by the insertion of tin boxes containing five cartridges each in the channel of the butt-stock. Each box contains a spring, which assists gravity in producing a rapid descent of the cartridges. The feeding apparatus is a combination of a ratchet and spiral spring. To the inside of the magazine-tube springs are secured by solder. The oppo ite side of the tube is slotted for the reception of the sliding-bar or ratchet, to which springs are attached in a similar manner. Pivoted to the bar is an arm at the front of which is a projection, over which hooks a corresponding projection on the breech-bolt. When the breech-bolt is withdrawn the arm and ratchet are compelled to move with it until the projection rides under a beveled shoulder at the end of the groove in which it slides, when the arm is released and the magazine-spring returns it and the ratchet to their first position. It will thus be seen that the ratchet is moved automatically, being drawn back by the bolt and returned by the magazine-spring. When the ratchet is withdrawn each spring connected with it passes behind the head of the cartridge next in rear of it; when returned the cartridges are carried forward, the 2d replacing the 1st, which will have entered the chamber, the 3d the 2d, and so on. The magazine carries 9 cartridges.

RUSSELL MAGAZINE-GUN.—This gun devised by Lieut. A. H. Russell, Ordnance Corps, U. S. A., contains many features of novelty. The breech-closing bolt operates by a handle preferably at the side of the arm as in other bolt guns, but instead of a partial rotation of the bolt in locking and unlocking, the force applied to the handle is at all times in a direction nearly parallel with the bore of the barrel. The locking is effected by a cross-shaft in



the bolt a little longer than the diameter of the bolt, having cam-shaped ends which extend into seats in the receiver. In opening the breech these cam projections are turned by the first movement of the handle, which is a pivotal movement, until the bolt is unlocked, when a further backward movement of the handle gives a powerful cam action to start the cartridge, and at the same time slightly starts the firing-pin backward. The final closing movement has the same powerful action to seat the cartridge in its chamber. The magazine feeds the cartridge sidewise, either up through the bottom of the receiver, as in the Lee gun, or at the side of the receiver, and in the latter case a swinging pusher forces the upper one of the column of cartridges sidewise into the receiver in front of the bolt. Lieut. Russell has invented a very simple metallic feed case.

BLACK SEA
Sea of Azov
CASPIAN SEA
AUSTRIA HUNGARY
HUNGARY
RUMANIA
WALLACHIA
MOLDAVIA
BULGARIA
TURKEY
ASIA MINOR
POLAND
WEST RUSSIA
LITTLE RUSSIA
SOUTH RUSSIA
GREAT RUSSIA
BESSARABIA
CRIMEA
CAUCASIA
ARMENIA
GEORGIA
DAGHESTAN
CONSTANTINOPLE
Bosporus
Dardanelles
Sinope
Trebizond
Erekli
Batoum
Kutais
Tiflis
Baku
Derbend
Astrakhan
Saratov
Zaritzin
Kharkov
Poltava
Kiev
Ekaterinoslav
Kherson
Odessa
Sevastopol
Simferopol
Kertch
Taganrog
Stavropol
Varna
Bucharest
Rustchuk
Silistria
Lemberg
Lublin
Inner Kirghiz Horde
Land of the Ural Cossacks
R. Volga
R. Ural
R. Don
R. Dnieper
R. Dniester
R. Danube
Mths. of the Danube
Mths. of the Volga
Mths. of the Ural
MT. ELBURZ
MT. ARARAT
Longitude East from Greenwich
25
30
35
40
45
50


RUSSIA
IN EUROPE
SCALE OF MILES
0 50 100 150 200 250
Railroads
ARCTIC OCEAN
SWEDEN
Gulf of Bothnia
FINLAND
LAPLAND
KOLA PENINSULA
BIELOE MORE OR WHITE SEA
Gulf of Kandalak
ARCHANGEL
OLONETZ
KANINSKAIA PENA.
KOLGUEV I.
WAIGATZ ID.
Kara Sea
URAL MOUNTS.
SIBERIA
Arctic Circle
ST. PETERSBURG
ESTHONIA
LIVONIA
COURLAND
BALTIC
G. of Danzig
Danzig
Memel
Gulf of Finland
L. Ladoga
L. Onega
Archangel
Mezen
Kola
Waranger Fd.
Novgorod
Vologda
Jaroslav
Kostroma
Vladimir
Moscow
Smolensk
Pskov
Riga
Nijni Novgorod
VIATKA
PERM
UFA
R. Petchora
R. Dwina
Tornea
Uleaborg
Helsingfors
GOTTSKA SANDA
GOTHLAND
OELAND
DAGO
OSEL
ALAND IDS.
HOGLAND
Ekaterinburg
Petropavlovsk
10 15 20 25 35 40 45 50 55
55 60 65

constructed of a single piece of bent sheet metal, which will contain just enough cartridges to fill the magazine of this gun, from which the magazine can be recharged as rapidly as a single cartridge could be placed in the receiver. These feed cases are little if any more costly than paper boxes, and are to be thrown away when empty. Capt. Livermore, U. S. A., has jointly with Lieut. Russell, made improvements in magazine arms, and has also invented a series of breech movements for small-arms. See *Magazine-gun*.

RUSSELL PRISM RANGE FINDER. This instrument is shown in perspective in Fig. 1. A is the prism, B the frame; *a*, *b*, *c*, *d*, and *e* are the apertures for observations; *l*, *l*, *l*, the clamps which retain the prism in place; and *m* is the ring to which the string may be attached. Near each aperture is shown an arrow-mark to indicate approximately the direction in which the observer should look into the prism. The aperture at *a* has two of these marks, the right-hand one for use in connection with the aperture *b* and the left-hand one with the aperture *c*. The aperture *e* is used in connection with *d*, *b* with *a*, and

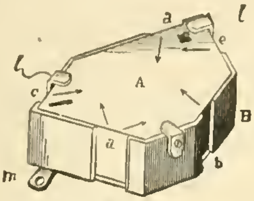


Fig. 1.

c also with *a*. A square, marked on the surface between the apertures *d* and *e*, indicates that they correspond to a right angle, and the acute-angle mark between the apertures *c* and *a* indicates their use together for laying off an acute angle. The apertures *a* and *b* are used together for laying off an obtuse angle. No handle is provided but the instrument is to be grasped by the sides between the thumb and forefinger, usually of the hand opposite the object seen by reflection. The tip of the finger should usually cover the aperture opposite to the one into which the observer is looking, in order to cut off colored rays which might interfere with clear vision. For ins-

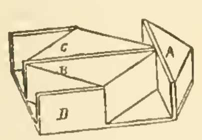


Fig. 2.

tance, while looking through *a* and obtaining the reflection through *b*, the observer should cover *e*; and while obtaining the reflection through *c* he should cover *d*; while looking into *d* he should cover *a*, &c. The proper image to be selected is easily found, as it remains steady, while other images which may be seen move very quickly when the prism is turned horizontally. The principles of reflection are the same as for the Weldon prism.

Three triangular prisms might be substituted for the one six-sided prism, and with this arrangement the method of observation might be learned rather more readily, as there would be no need of covering up the apertures, while the field of view would be somewhat enlarged. Fig. 2, shows such an arrangement: A, B, and C are triangular prisms made on the Weldon principle—A for a right angle, B and C for acute and obtuse supplementary angles respectively. The frame D supports the three prisms. It is doubtful, however, if any real or very great advantage would here obtain over the six-sided single-prism form. See *Nolan Range-finder*, *Pratt Range-finder*, *Telemeter*, *Watkin Range-finder*, and *Weldon Range-finder*.

RUSSENSTEIN SYSTEM OF FORTIFICATION.—This system closely follows Pagan. Only the bastions are very simple. Strong revetments are given to the escarps.

RUSSET LEATHER.—When new, russet leather equipments would be striking, but probably would not accord well with the plainness of our army uniforms. They would be rather conspicuous in the field and easily discolored, presenting an appearance the reverse of military spruceness. When repairs are made the new parts would form a striking contrast to the older ones since there is no blacking in this case to render them uniform in color. When new, russet leather would furnish handsome horse equipments, but the stains incident upon the sweating of the animal, rain, and the spattering of mud could not be easily effaced. Any endeavors to clean such harness would probably result in leaving areas of a murky reddish-brown color.

The question of whether the Army should be supplied with oak or hemlock-tanned leather has been agitated from time to time during and since the war. The government still clings to oak, and nearly all its specifications call for oak-tanned leather, notwithstanding the fact that the greater part of the leather used during the war was bad hemlock, rendered more worthless by attempts to make it imitate oak leather. A large portion of the leather sold to the government since the war has doubtless been hemlock. Of late years the methods of tanning with hemlock bark have improved with astonishing rapidity, and now it is the chief material used. During the past few years hemlock leather has risen greatly in the estimation of consumers. There can be no doubt that as now made it is a valuable product.

There are few Army officers who *know* anything about leather, and it is not possible for Army Inspectors, no matter how great their egotism may be, to detect imitations that defy the skill of expert tanners themselves. Lieutenant D. A. Lyle, U. S. Army, in a report made in 1877, urged that a mixed commission of Army officers, civil or mechanical engineers, and practical tanners be appointed by the government to make a scientific investigation into the relative merits of the several tannages and to determine definitely, if possible, for what purposes the different tannages could be advantageously used. These points should be settled in time of peace, when there is no pressing need for large supplies. See *Harness* and *Leather*.

RUSSIAN ARMY.—One of the chief Continental Armies of Europe. Early in 1870, a new Bill was submitted to the Emperor and the Imperial Council for the reorganization of the Russian Army, and by an Ukase dated November 16 of the same year, it became the military law of the country. This Bill lays down, as a first principle, that the defense of the Russian territory is a sacred duty incumbent on every Russian subject without distinction of class or position. Military service is therefore obligatory, and substitutes are not admitted into the ranks of the army. All young men who have attained the age of 20 are liable to be drawn as Conscripts. A drawing by lot takes place to decide who shall remain at home, after undergoing six week's training. These men, for 6 consecutive years, form part of the reserve. The duration of military service is fixed at 15 years, divided as follows: Four years under the Colors; two on Fourlough; nine in the Reserve, with the exception of the Horse Artillery, Cavalry, and Frontier Guards. The defence of the country is provided for by regular troops or Land Forces and National Legions. The *Land Forces* are composed of —1. The active army, completed by the annual Contingents; 2. The Reserves, composed of time-expired soldiers, called into the ranks in time of war; 3. The Cossacks; 4. Specially organized troops. The *National Legions* are composed of all the men not included in the regular army, but capable of bearing arms, from the age of 20 inclusive up to that of 40. They are divided into two classes:—1. Men destined to fill up the vacancies in the ranks of the army, or to complete the Reserve in case of paucity of numbers; 2. Men forming the Depots of the Legions. There are besides two classes of volunteers admitted into the army: young men who have completed their education in public shools, and those who have formed or still form part of the Legions. The former are bound to serve in the active army for 3 or 6 months or 2 years, according to their education and proficiency. Those who have, on drawing for the conscription, been exempted from joining the Colors are incorporated in the National Legions, and are compelled to go through an annual course of training. Other classes of individuals may also be exempted from service in the active army, such, for instance, as fathers of families: but they are liable to be called out in case of an insufficient supply of Conscripts.

Russia has a male population of 36 millions, and the number of young men who annually attain the age for being drawn in the conscription is set down at 600,000. Estimating the mortality of the men under 4 per cent., and those not on active duty at 2 per cent, the defensive forces of Russia have been computed as follows:—

Age.	Active Army.	Reserve.	Legionaries. 1st Series.	Legionaries. 2nd Series.
21	200,000	...	200,000	...
22	192,000	...	196,000	...
23	184,000	...	192,000	...
24	177,000	...	188,000	...
25	170,000	...	184,000	...
26	163,000	...	180,000	...
27	...	157,000	...	176,000
28	...	154,000	...	172,000
29	...	151,000	...	169,000
30	...	148,000	...	166,000
31	...	145,000	...	163,000
32	...	142,000	...	160,000
33	...	139,000	...	157,000
34	...	136,000	...	154,000
35	...	133,000	...	151,000
36	...	...	..	275,000
37	...	...	...	269,000
38	...	...	...	263,000

Making, without counting the time-expired soldiers, 5,806,000 men. The active army, it will be seen, is set down at 1,086,000 men. In time of peace, however, this number is not kept under arms, for although in special branches the duration of the service is fixed at 7 years, the Infantry is generally discharged during the last 2 years of service; so that the army may really be set down at 700,000 men under the colors, and 300,000 more on furlough. As an adjunct to this army of 1,000,000 of men, the first class of legionaries comprises 1,140,000 men, all of whom may be called upon to fill up the ranks. The reserve is composed of 1,305,000 men, and by the time this part of the law comes in force, they will be all good, solid troops, having passed through the ranks of the army. The second class of legionaries, as shown in the above table, is composed of 2,275,000 men, all of whom will be trained to the use of arms when drawn by the conscription, and they will count amongst them nearly half a million of time expired troops. The Russian peace footing is estimated to have been increased by about 50,000 men in 1875. The troops reinforced are chiefly the Cavalry and Horse Artillery, who have been put on a permanent war footing, and, being mostly stationed along railway lines in the western provinces, are ready for immediate action in the field.

The Russian Territory is divided into 14 military districts; the country occupied by the Cossacks of the Don forms a separate district, with a special organization. The permanent army is divided into 47 divisions of infantry, 7 brigades of rifles, 10 divisions of cavalry, 50 brigades of field artillery, 26 batteries of horse artillery, 5 brigades of engineers; the numerical strength of the whole active army may be put down in peace time at 33,043 officers and 735,539 men, and in time of war at 43,355 officers and 1,358,672 men. The infantry is composed of 12 regiments of the guard, 16 regiments of grenadiers, 4 Caucasian regiments, 4 battalions of rifles of the guard, 20 of rifles of the line, 4 Caucasian and 4 Turkestan rifles, and 148 regiments of infantry, giving a total of 196 regiments of the line. These are massed into 3 divisions of infantry of the guard, 4 of grenadiers, 40 of infantry, and 7 brigades of rifles. The division in the Russian army is the highest unit, there being no *Corps d'armée* except in the guards. Each division of infantry is composed of 2 brigades, each brigade of 2 regiments of 3 battalions each, with the exception of the 2 brigades of the 4 Caucasian divisions, which have 3 regiments. Each battalion is composed of 4 companies. The cavalry is divided into active cavalry and reserve squadrons. The active cavalry comprises 10 regiments of the guard, 77 of the line (including 21 of Cossacks), and 4 of Caucasian troops. The guards are composed of 4 regiments of cuirassiers, 2 of lancers, 2 of hussars, 1 of grenadiers, and 1 of Cossacks. The Russian cavalry is divided into 20 divisions, viz. 4 of the guards (3 mixed and 1 division of Cossacks), 14 of the line, and 2 of Caucasian cavalry. Each division comprises 4 regiments divided into 2 brigades: 1 of lancers, 1 of dragoons, 1 of hussars, and 1 of Cossacks; each regiment having the same number. Thus the 1st division contains the 1st hussars, the 1st lancers, etc. Each brigade of cavalry of the guard has 2 regiments; the 2nd division has 3 brigades. Each regiment has 4 squadrons, with a strength of 224 combatants.

The reserve squadrons, whose duty in time of peace is to train horses and provide their regiments with them, will in time of war fill the vacancies produced by the campaign.

The field artillery is composed as follows:

Batteries of 9-prs..	141 with	1128 guns and	3384 wagons.
Batteries of 4 prs..	94 "	752 " "	1504 "
Batteries of mitrailleurs ..	47 "	376 " "	762 "
Giving a total of ..	282 "	2256 " "	5650 "

Each brigade of foot artillery is composed of 6 batteries (3 batteries of 9-prs., 2 of 4-prs. and 1 of mitrailleurs). The horse artillery of the regular army is composed of 21 batteries and 5 batteries of the guard, 2 depot and 1 instruction batteries; each battery is formed of 6 guns. The organization of these batteries into brigades has been changed with the exception of those of the guard, which are still formed into 1 brigade. Throughout the rest of the army, 2 batteries are attached to each division of cavalry, and come under the immediate command of the Divisional Commander. These will, however, be soon increased to 6 batteries of the guard (1 Cossack), and 28 batteries of ordinary horse artillery (7 Cossack), of 8 guns each. There will be besides 14 Cossack batteries in reserve. The 5 brigades of engineers comprise 1 battalion of sappers of the guard, 1 of grenadiers, and 9 of sappers and miners, total, 11 battalions; 6 half-battalions of pontoon train. There were at the time of the reorganization of the army 3 classes of troops which did not belong to the active army: (1) the *Local* or *Sedentary Troops* (25 battalions of garrison infantry, and 18 battalions of infantry of the line); (2) the Interior Service Troops (71 battalions); and (3) the Reserve Troops (72 Battalions of the line, 10 of rifles, 56 squadrons of cavalry, 6 brigades of artillery, and 4 battalions of sappers). In the military districts of Russia in Asia, the present organization has been maintained for the local troops; but in the other districts they have been reorganized, and form now 29 regiments of 4 companies each of garrison infantry, and 199 battalions of depot troops. When the army is mobilised, the strength of the depot battalions is raised to 1000 men each by means of the men of the 1st class of the militia. On war breaking out, the 2nd class of the militia will be formed into 164 infantry battalions of 4 companies each and with a nominal strength of 1000 men. The duty of these battalions will be to keep up the communications and guard the rear of the army in the field and to garrison the towns. The *Cossack troops* are divided into regiments and *sotnias* (sections of 100 men); the strength of each regiment varies according to the number of *sotnias* called out. The whole male population is obliged to serve. By an order issued in 1872, the Cossacks have been formed into a body of men perfectly organized in time of peace, easily assembled and added to the cavalry divisions in time of war. Under the new arrangements they will supply 62 regiments and 22 batteries in time of war. In peace time they have 21 regiments and 8 horse batteries under arms. The strength of the Cossacks lies between 50,000 and 55,000 men, with a reserve of 30,000 more.

The supreme command of the Russian army is vested in the Emperor, with a War Ministry under him. This Ministry is divided into *bureaux*, including a war council of permanent committees, who deal with all the technical questions appertaining to the different branches of the service. The mode in Russia of officering the army does not differ much from that of other Continental Armies. The young men who decide on a military career proceed at the age of 16 to one of the military schools, whence, at the age of 19 or 20, having passed an examination, they obtain an ensigncy, and then follow the various grades without further examination. A second captaincy is reached in about 8 years' service, and then merit can gain the epaulettes of a General in a very short time. Candidates for the Staff have to pass through the Nicholas Staff Academy. The Russian infantry is armed with Berdan breech-loading rifle.

The cavalry of the Russian army consists of two divisions of cavalry of the Guard, seven of the Line, and one of the Caucasus; the first division of the Guard contains seven regiments, that of the Caucasus four, all other six regiments. Each is composed of four squadrons; thus there are 56 regiments, or 224 squadrons, of regular cavalry in the army. With the exception of those of the Guard and of the Caucasus, each division consists of two regiments of dragoons, two of lancers, and two of hussars. All dragoons, and the rear rank in hussar and lancer regiments, are armed with Berdan's breech-loading carbine. Cuirassiers, hussars and lancers, and all non-commissioned officers, with Smith and Wesson's breech-loading revolver. Dragoons are armed with a long rifle of the Krinker converted pattern—eventually they will be served out with Berdan's—they carry 32 rounds each. All mounted troops wear a sabre, varying in shape and weight for the different branches. There are two establishments for cavalry, namely, the War, and the Peace; in the former there are 128 men per squadron, in the latter 112 men.

Authorized War Establishment of a Russian Cavalry Regiment.

	Regiment.	Squadron.
Officer Commanding	1	...
Lieutenant Colonels	2	...
Regimental Adjutant	1	...
" Paymaster	1	...
" Quartermaster	1	...
" Instructor at Arms	1	...
Officer commanding Non-Combatants	1	...
Trumpet Major	1	...
Senior Surgeon	1	...
Junior Surgeon	1	...
Veterinary Surgeon	1	...
Chaplain	1	...
Squadron Commander	4	1
Captain	4	1
Staff Captain	4	1
Lieutenants	8	2
Cornets	8	2
Senior Sergeants Major	4	1
Cadets	8	2
Junior Sergeants Major	16	4
Non-commissioned Officers	56	14
Trumpeters	16	4
Privates	676	68
Officers' Servants	28	7
	841	207

The generally recognised constitution of a brigade of artillery is four battalions of eight guns each. To each division of infantry there is attached a brigade, consisting of two 9-pounders and two 4-pounders. The Grenadier Artillery Brigade of the Caucasus has three mountain batteries in addition, and 19th, 20th, and 21st Causasian Divisions have an extra 4-pounder attached to them. The Horse Artillery Brigade of the Guard consists of five 4-pounder batteries. The other seven Horse Brigades have but two batteries of the same caliber: there are thus—

48 Batteries, rifled	... ...	9-pounders,
105 " "	... ...	4-pounders,
4 " "	... ...	3-pounders,
18 Horse Batteries, rifled	...	4-pounders,

and it is intended to raise 50 mitrailleuse batteries. The guns are mostly bronze, Krupp's breech-loaders, the weight of the 4-pounders being $6\frac{3}{4}$ cwt., of the 9-pounders, $12\frac{1}{4}$. The smaller gun carries 130, the larger 120 rounds of ammunition. The fuses are mostly percussion; the time-fuse is, however, being rapidly introduced into the service. The larger gun is frequently used as a siege piece, its projectile weighing 30 lbs. All non-commissioned officers and gunners are armed with short dragoon sword and breech-loading revolver, for which they carry 12 rounds in a small pouch.

The Corps of Engineers in the Russian army consists of "Sappers and Miners" and "Pontoniers;" the former include engineer field parks, siege parks, telegraph parks, whilst the latter merely the bridging corps. There are 11 battalions of sappers, and six half-battalions of pontoniers; each of these latter carries sufficient pontoon boats to make a bridge 700 feet in length. As in the infantry, so in the sappers, each battalion is composed of four companies; the peace and war establishment being entirely distinct. The Infantry of the Russian army consists of three divisions of Guards, four of Grenadiers, 41 of the Line, and seven brigades of Rifles; each division is composed of four regiments, those of the Guards numbered according to their division, those of the Grenadiers from 1 to 16, whilst those of the Line run from 1 to 164; the regiments of regular Rifles are styled numerically from 1 to 20; the brigades of Turkestan and the Caucasus have territorial designations. Each regiment is composed of three battalions except in the case of those from 73 to 84 inclusive, which have four battalions. These are again subdivided into five companies, four of the Line, one of Rifles—these latter companies, on service, are amalgamated and form an extra battalion styled the Combined Rifle Battalion. Battalions have four separate establishments, viz.:—1. The War Establishment. 2. The Increased Peace Establishment. 3. The Peace Establishment. 4. The Cadre Establishment. The total strength of the Russian Infantry is 188 regiments, consisting of 580 battalions, with 32 rifle battalions in addition, making a total of 612 battalions of the regular army; but

Authorized Establishment of Batteries of Russian Field Artillery.

	Officers: Lieutenant Colonel.	Officers: Captain.	Officers: Lieutenant.	Officers: Sub-Lieutenant.	Non-com. Officers: Sergeant Major.	Non-com. Officers: Cadet.	Non-com. Officers: Senior Non.-com. Officer.	Non-com. Officers: Junior Non.-com. Officer.	Privates: Bombardier.	Privates: Laboratory Men.	Privates: Gunners.	Privates: Trumpeters.	Privates: Drivers.	Privates: Officers' Servants.	Total.	Horses: Riding.	Horses: Artillery.	Horses: Train.	Horses: Total.	Guns.	Carriages: Ammunition.	Carriages: Provision.	Carriages: Park.	Carriages: Sanitary.	Carriages: Others.	Ammunition Boxes.
4-P. Horse Battery	1	2	2	2	1	2	8	16	8	50	200	4	12	6	314	161	146	17	324	8	16	2	4	1	1	...
4-P. Field Battery	1	1	2	2	1	2	8	16	8	40	140	4	12	6	243	17	126	17	160	8	16	2	4	1	1	...
9-P. " "	1	1	2	2	1	2	8	16	8	50	190	4	13	6	304	17	180	17	214	8	24	2	5	1	1	...
3-P. Mountain	1	1	2	2	1	2	8	11	8	30	145	4	80	6	301	8	120	66	194	8	...	...	...	...	...	112
Mitrailleuse	1	1	2	2	1	2	8	16	8	30	110	4	12	6	203	25	98	17	140	8	8	2	4	1	1	...

there are also 48 frontier battalions of irregular troops. Eventually the whole of the infantry will be armed with the Berdan rifle, which as yet, however, has only been served out to the division of the Guard, and Grenadier division, and Rifle battalions. The Krinka and Earle rifles now are the principal weapons in use. Every soldier carries, in two pouches, 60 rounds. Forty rounds in addition are carried by the regimental train, and 60 more by the army reserve train. Non-commissioned officers of line battalions, and all ranks in the Guard and Grenadier divisions, carry a short, two-edged sword in addition to the bayonet, which is invariably fixed when troops are on the move.

Authorized Establishment of a Battalion of Sappers and Miners.

	Battalion.	Company.
Colonel Commanding	1	...
Lieutenant Colonel	1	...
Battalion Adjutant	1	...
" Paymaster	1	...
" Quartermaster	1	...
Instructor in Arms	1	...
Administrative Officers	2	...
Battalion Drummer	1	...
" Bugler	1	...
Senior Surgeon	1	...
Junior "	1	...
Captains	4	1
Subalterns	16	4
Cadets	4	1
Sergeants Major	4	1
Senior Non-com. Officers	16	4
Junior " "	56	14
Sappers and Miners	832	208
Drummers	12	3
Buglers	12	3
Officers' Servants	20	5
	988	244

In addition to the above the men receive a "mess allowance," varying in amount, but averaging about 1¼d. per diem, and the following rations free—Flour, 2lbs.; barley, ¼lb.; salt, ¼ oz.

Authorized War Establishment of a Half Battalion of Pontoniers.

	Half Battalion.	Company.
Colonel Commanding	1	...
Battalion Adjutant	1	...
" Paym'ster & Q'rm'ster	1	...
" Drummer	1	...
" Bugler	1	...
Senior Surgeon	1	...
Veterinary Surgeon	1	...
Captains	2	1
Lieutenants	2	1
Sub-Lieutenants	2	1
Ensigns	2	1
Sergeants Major	2	1
Senior Non-com. Officers	10	5
Junior " "	28	14
Pontoniers	240	120
Drivers	120	60
Drummers	6	3
Buglers	6	3
Officer's Servants	8	4
	435	214

Scale of Annual Pay and Table Money of Officers.

	Ordinary Pay.						War Pay.						Table Money.	
—	Old Guard.		New Guard, Artillery, and Engineers.		Cavalry and Infantry of Line.		Old Guard.		New Guard, Artillery, and Engineers.		Cavalry and Infantry of Line.			
	£	s.	£	s.	£	s.	£	s.	£	s.	£	s.	£	s.
General	297	17	297	17	297	17	446	15	446	15	446	15	315	11
Lieutenant General	238	6	238	16	238	6	357	8	357	8	357	8	315	11
Major General	178	14	178	14	178	14	268	1	268	1	268	1	315	11
Colonel	120	15	120	15	120	15	181	2	181	2	181	2	193	4
Lieutenant Colonel	...	...	93	8	93	8	...	...	140	1	140	1	...	...
Major	...	...	...	...	77	6	140	1	...	...	115	18	...	...
Captain	93	8	77	6	64	8	...	...	115	18	96	12	...	...
2d Captain	77	6	64	8	59	11	115	18	96	12	89	7	...	...
Lieutenant	64	8	59	11	54	15	96	12	89	7	82	2	...	...
Sub-Lieutenant	59	11	54	15	51	10	89	7	82	2	77	6	...	...
Ensign or Cornet	54	15	51	10	48	6	82	2	77	6	72	9	...	...

N.B.—The following command allowances are also granted:

		£	s.
Officer Commanding	Battalion	90	3
" "	Squadron	22	4
" "	Battery	86	8
" "	Company	17	8

We will give a brief account of the campaign of 1828-29. To the military student, it will be a proof that it does not do in these days of the breech-loader and the spade to rehearse the tactics of our fathers; and that, after all as Napoleon pithily expressed it, "God favors the heaviest battalions." In December, 1827, Russia then being at war with Persia, the feud between the Sultan and the Czar that had been slumbering for many years broke out. Hastily concluding a peace with the Shah on the 6th February, Paskiewitch, Governor General and Commander-in-Chief of the Caucasus, commenced preparations for the subjugation of Armenia. Irrespective of the natural wish to extend her conquests completely round the Black Sea, a campaign in Anatolia necessarily must form a portion of the plan of any war waged between the Porte and Russia. The vast resources Turkey possesses in her Asiatic provinces enable the Sultan to recruit his forces to an almost unlimited extent from the hardy mountaineers of Armenia, consequently the aim and object of the Russian War Minister is, by decisively attacking the Ottoman on this side, to hinder men from being despatched to Europe to swell the armies there. The forces at the disposal of Paskiewitch for his operations amounted at this time to 51 battalions of infantry, 11 squadrons of cavalry, 17 regiments of Cossacks, 12½ batteries of artillery, numbering 154 guns. The policy of Persia, in spite of the recent peace, was still undefined, and it was thought more than probable she would take advantage of the fact of Russia's complications, and once more declare war. She had only just ceded to the Czar two rich provinces, and paid a very heavy war contribution, so Paskiewitch deemed it advisable to be quite prepared for her entering into an alliance offensive and defensive with the Turk. To guard against any coalition of troops, the Russian General organised a corps under Pankratieff, consisting of six battalions, two regiments of Cossacks, and sixteen guns, which he posted at Khoi, in Persian territory, be it minded. Another evil has to be guarded against in all wars between Russia and Turkey, and that is insurrection in the Caucasian provinces. They were, it was known, ripe for revolt, and it was rumored Mahomedan emissaries had been travelling through the Abkhasian and Mingrelian country, endeavoring to incite the people to rise. To guard against this, Paskiewitch occupied the Caucasian country with fifteen battalions, three squadrons of cavalry, forty-two guns, and four regiments of Cossacks. Thus there were left for the expeditionary army—30 battalions, 8 squadrons of cavalry, 11 regiments of Cossacks, 96 guns. The ports of Poti and Batoum were, as for many years they had been, the object of Russia's desire; consequently, Paskiewitch detailed one column to act on the shores of the Black Sea whilst, with the remainder of his army, he determined to operate in two columns: the main or central one advancing by the Allaghoz chain was to reduce the frontier towns of Akhalzik, Akhalkalaki, Hertwitz, Kars, and Ardahan; whilst the left corps, pushing across the Ararat range, was to subjugate the province of Bayazid, and guard the flank against the attacks of the Kurds, who, it was known, attracted by "loot," would swoop down from Van and Moosh. In fact, the corps operating on Poti and on Bayazid were acting as wings of the main army advancing into Armenia. The right, or Batoum army, was placed under the command of Major General Hesse, and consisted of—8 battalions of infantry, 14 field guns, 1 regiment of Cossacks.

The left, or Bayazid column, was under the order of Tchavachavadzi, the reigning prince of the Abkhasians, and numbered 3 battalions of infantry, 8 field pieces, 1 regiment of Cossacks. Whilst at Natschevan keeping open free communication between the left wing and main army were posted 2 battalions. Paskiewitch himself commanded the main column, which was to be massed in the neighbor-

Pay of Non-commissioned Officers and Men.

	Guard.		Line.	
	Annual Pay.	Daily Pay.	Annual Pay.	Daily Pay.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Sergeant Major	5 15 11	0 0 $3\frac{3}{4}$	3 17 3	0 0 $2\frac{1}{2}$
Senior Non-commissioned Officer	2 15 7	0 0 $1\frac{3}{4}$	0 14 9	0 0 $0\frac{1}{2}$
Junior Non-commissioned Officer	2 14 8	0 0 $1\frac{3}{4}$	0 13 3	0 0 $0\frac{5}{12}$
Bombardier and Lance Corporal	1 0 9	0 0 $0\frac{3}{4}$	0 9 2	0 0 $0\frac{1}{3}$
Private, Drummer, and Bugler	0 13 $0\frac{1}{2}$	0 0 $0\frac{4}{9}$	0 8 8	0 0 $0\frac{1}{4}$

Authorized Establishment of Infantry Regiment, Battalion, and Company of the Russian Army.

	Regiment.	Battalion.	Company.
Regimental Staff.			
Major General	...	...	..
Field Officer for Interior Economy	1	...	...
Executive Field Officer	1	...	...
Regimental Adjutants	3	...	...
Paymaster	1	...	...
Quartermaster	1	...	...
Instructor in Arms	1	...	...
Officer in command of Non-combatants	1	...	...
Regimental Drummer	1	...	...
" Bugler	1	...	...
Senior Surgeon	1	...	...
Junior Surgeons	4	...	...
Chaplains	2	...	...
Battalion Staff.			
Colonels	4	1	...
Battalion Adjutants	4	1	...
" Drummers	4	1	...
" Buglers	4	1	...
Captains	20	5	1
Lieutenants	20	5	1
Sub-Lieutenants	20	5	1
Ensigns	20	5	1
Cadets	20	5	1
Sergeants Major	20	5	1
Senior Non-commissioned Officers	80	20	4
Junior " "	240	60	12
Corporals	400	100	20
Privates	2,960	740	148
Drummers	60	15	3
Buglers	60	15	3
Officers' Servants	80	20	4
	4,034	1,004	200

N.B. Each Company is provided with the following tools:—12 hatchets, 6 shovels, 3 picks, 3 axes, 1 scythe.

hood of Goomri, and amounted to 18 battalions of infantry, 9 squadrons of cavalry, 7 regiments of Cossacks, 56 field guns. The Russian commander felt that his forces were too weak for him to hope to reduce Erzeroum in one campaign, for prior to an advance across the Soghanly range, it would be necessary to seize all the fortified places, many of them very strongly garrisoned, in the provinces of Kars, of Akhalzik, and of Bayazid. He therefore determined to devote his whole time to subjugate these districts, leaving the conquest of Armenia to the following year. There were many reasons in favor of Goomri being chosen as the base of operations in Armenia. In the first place, the ground between it and Kars was open, and feasible for the movements of large bodies of troops; in the second place, it enabled a blow to be struck at one of the main Turkish fortresses, without exposing the Russian frontier to the danger of an attack; and thirdly, it threatened the flank of any army advancing by the Soghanly range to the relief of Ardahan or Akhalzik. There were other minor reasons, too, which led to the selection of Goomri: it was in a central position, and easily furnished with supplies; the siege train, quartered at Erivan, could more easily be moved by this road than any other; and lastly, the subjugation of Kars gave the Russians possession of the large valley watered by the Kars and Arpa rivers, with an abundance of grain and forage. Then, as now, the Ottoman organisation was ill adapted for offensive warfare, and it never seemed to have struck Paskiewitch that the Turks could plan a counter-stroke.

Prior to commencing operations, the Russian Commander-in-Chief threw forward a detachment under Major General Popoff to Suram, to guard the defiles of Bordjom. This force numbered 3 battalions, 608 Cossacks, 4 guns, and formed a connecting link with Hesse's troops on the Batoum line. Thus on the 12th of June, all preparations being complete, Paskiewitch massed his troops at Goomri, which now consisted of but 15 battalions of infantry, 8 squadrons of cavalry, 6 regiments of Cossacks, 52 guns. crossed the Arpa Tchai, carrying with him in his vast commissariat train forty days' provisions. He halted that day at Tikhniss, in Turkish territory, and the next morning moved to Maskni, encountering slight opposition from a small party of Turkish horse. A brief reconnaissance of the fortress of Kars induced the Russian General to determine on attacking Kars on the southern face, the northern and eastern being too precipitous to admit of assault, or, of the construction of regular siege works. Moreover, the oc-

Distribution of Russian Army, 12th June, 1825.

Designation of Column.	Inf.	Cav.	Guns.
Major General Hesse. Black Sea Column	4,541	462	14
Major General Popoff. Bordjom Flanking Column	1,180	608	4
General Paskiewitch. Central or Main Column.			
Chief of the Staff General Von Sacken.			
Quartermaster General Colonel Valkhovski.			
1st Brigade Infantry, Major General Mouravieff	2,511	...	...
2d " " " " Bergmann	2,562	...	...
3d " " " " Korolkoff	3,488	...	...
Cavalry Brigade, Colonel Rarevsky	...	3,346	...
Artillery " General Gillenschmidet	...	...	70
Major General Prince Tchavachavadzi. Left or Armenian Column	2,151	336	8
General Merlini. Left Central or Natschevan	1,730	47	2
General Pankratieff. Corps of Observation on Persian Frontier	2,691	715	16
Total	20,854	5,514	114

Great pains were taken to arrange a good commissariat establishment, the organization of which the Commander-in-Chief himself took in hand; and in May he had already succeeded in collecting at Goomri—Government wagons, 530; hired arabas, 540; pack animals, 2,250; whilst in the vast storehouses at Goomri and in its immediate vicinity, he had stored for transport—12,000 sacks of biscuits, 1,000 sacks of barley, four thousand sacks of wheat, 4,000 casks of salt meat, 1,100 gallons of brandy. More than 3,000 men were hired to assist in the commissariat train; an extremely liberal scale of wages, coupled with firm supervision, ensured good work. Field hospitals were established, one at Goomri for 300; one at Tsalki for 200 sick. An ambulance train for the movable columns was organized, numbering sixty-six specially-constructed *fourgons;* there were two companies of trained hospital orderlies to aid the surgeons in their work, whilst a large corps of litter-bearers were also organized. Let us now turn to the Turkish Army, of which, we regret to say, we can find no such detailed account as of the Russian. The most strenuous exertions were made, not only to strengthen the garrisons of all the fortresses, but also to organize an army for offensive operations. For this purpose—during the early spring—the chief of the Karakapaks reconnoitered the whole course of the Arpa River, as well as the passes through the Bordjom range, all of which were held by strong detachments of irregular troops. Akhalkalaki was held by 1,000 Lazi volunteers; Ardahan was occupied by upwards of 2,000 regular soldiers; Akhalzik was reinforced by a large detachment of cavalry; and Kars, considered the key of Armenia, besides being furnished with a garrison of 15,000 infantry to man the walls, was further strengthened by a brigade of 3,000 cavalry, with fourteen field guns. Van was garrisoned by 15,000 men; Bayazid by 1,000; whilst a corps of 40,000 was being organized by Halib Pasha with which to take the offensive. The religious feeling of the multitude being worked up by the Moolahs, recruits came forward in great numbers, and it seemed evident that the Porte would be able to crush the Russian forces by sheer dint of numbers. On the 14th of June, Paskiewitch, advancing from Goomri, cupation of ground on the south-east face cuts off communication more completely with Erzeroum. Consequently, on the 17th, Paskiewitch moved *via* Azatkui to Magardjik, where he halted for the night, and the following day advanced to Kitcik-kui; but during this march his flank was exposed to attack, and the Turkish commander was not slow to take advantage of the opportunity presented him: he made a vigorous sortie, which for some time promised success; but the conduct of his irregular Kurds and Karakapaks threw the main force into confusion, and he was eventually compelled to retire with heavy loss, the casualties amongst the Russians amounting to twelve killed and thirty-nine wounded. On the 20th of June the siege park reached Paskiewitch, and enabled him to commence his offensive operations against the city. At the same time he was aware that Kiossa Mahomed Pasha was advancing in all haste to relieve the fortress, so he threw up some field works on the banks of the Kars river to guard his left flank. On the 22nd of June, covering the work by a feigned attack on the citadel, Paskiewitch opened his first parallel, and on the 23rd assaulted the place on the south and south-western faces with numerous columns. At 8 A. M. he was in possession of the enceinte, when the Pasha surrendered the citadel with 151 guns, and 11,000 men became prisoners of war. Kiossa Mahomed Pasha, hearing of the fall of Kars, abandoned his intention of crossing the Soghanly, and moved north towards Hoonkiar-Dooz. Paskiewitch now determined to capture Akhalkalaki. For this purpose he left Kars, with a strong garrison, under General Bergmann, and on the 17th of July, moving to Zaim, and thence, by the eastern shore of Lake Tchildar, to Ghegh Dagh. On the 22nd, he sent Colonel Abukoff to the commander of the fortress of Akhalkalaki with a flag of truce, to demand the surrender of the place. This was fired on, and that officer killed. On the 24th, Paskiewitch assaulted the town and captured it, with fourteen guns and 300 men. The Russian soldiers, infuriated at the conduct of the Turks for having fired on their flag of truce, slew upwards of 600 men. Without losing a moment of time, the Russian General detached the chief of his staff, General Sacken, to Hertweiz, which surrendered without firing a shot. Thirteen guns and 300 men fell with the place. General Hesse, in the meantime, with the right column,had captured Poti,with forty-three guns, thirteen standards, and 2,000 men. By the capture of Akhalkalaki and Kars the routes by the Bordjom mountains and Arpa-Tchai were now opened to the Russians; and on the 26th of July the much needed reinforcements reached Paskiewitch from Tsalki and Goomri. On the 1st of August, the Russian Commander learned that the Osmanli forces had reached Ardahan and were moving forward intending to attack him. The Russians, nothing loath to accept battle, advanced towards Akhalzik, reaching Koltchi-kui on the 3d inst. On the 5th, he attacked the troops and drove them back, but Kiossa Mahomed Pasha was able to effect his junction with the garrison of Akhalzik, where now were encamped 30,000 men. On the ninth, after a hard battle, in which the Russians were victorious, the Turks abandoned their guns and fled towards Ardahan. On the 10th, Paskiewitch commenced the siege of Akhalzik, and by the 12th had completed the investment of the place. On the 15th, breach-batteries were opened, and on the 16th of August, after a desperate fight, the place was captured. The garrison fought with the most determined valor, and it is computed that upwards of 5,000 men were slain in the defence. Out of 400 artillerymen who manned the guns on its walls, but 50 were left to tell the tale. Thirteen hundred Lazis out of a body of 1,800 recently raised were slain. Sixty-seven guns, and fifty-two standards, were captured; the Russian loss being only 128 killed and 495 wounded. In consequence of the heroism displayed by the defence, Paskiewitch permitted the garrison of the citadel to march out with all the honors of war. On the 18th the Russian Marshal determined to reduce Aitzkui, and despatched Colonel Vidbelski, with five companies and six guns, to effect this. The place surrendered, with twenty-four pieces of artillery, without attempting a defence.

In the meantime orders had been sent to Bergmann, in Kars, to move on Ardahan, and the Commander-in-Chief, on the 18th inst., directed Mouravieff to march for the same place. This officer, however, learned on his road there that the fortress had capitulated to Bergmann on the 16th inst. The left column in the meantime had been equally successful. Having subjugated the whole province of Bayazid, with the exception of the citadel, which was left masked. Prince Tchavachavadzi had marched as far as Toprak Kale. He had been reinforced by two battalions and four guns from Khoi, and Bergmann had also sent a force down from Kars to keep open communication with him. On the 20th September, the Prince, finding that his flank was threatened by the Pasha of Moosh, at the head of a large body of Kurds, determined to recapture Bayazid, and hold it. For this purpose he returned, and attacked a body of 3,000 Kurds, who were covering the place, when the garrison fled, and with the loss of but ten men Bayazid, with his twelve guns, and three standards, fell into the hands of the Russians.

Early in September, the Prince, having made all arrangements for the government of the province, advanced into Alashgird plain, seized the fort of Toprak Kale which was occupied by Kurds during his absence, and busied himself with collecting supplies on the fertile district.

On the 19th inst., the Pasha of Moosh having advanced to Grakon; the Prince determined to attack him, and on the following day defeated him, with a loss of 600 men,his own casualties amounting to sixty-seven. On the 28th,finding that the Pasha of Van was rousing all the Kurds in the district, and fearing that his communications might be cut off, he retired on Bayazid. Winter now setting in, Paskiewitch felt that his forces were far too weak to attempt the subjugation of Erzeroum in one campaign. He therefore left strong garrisons in the principal towns, and returned with the main portion of his army to Russian territory. General Berbutoff was left in command at Akhalzik with 2,300 infantry, 326 cavalry, and four guns. Bergmann was left at Kars with 2,400 infantry, and 280 cavalry, and twelve guns; whilst Pankratieff occupied Bayazid and the neighboring towns with 8,000 men, 376 cavalry, and eighteen guns. Thus, with a force of 20,000 infantry, 5,000 cavalry, and ninety-six guns, Paskiewitch had completely conquered the provinces of Kars, Akhalzik, Bayazid, and Poti in the short space of five months, had captured three fortresses and several fortified towns, 313 guns, and 8,000 prisoners graced the Russian General's triumph, whilst his own casualties only amounted to 3,200 killed and wounded. As may be imagined, the greatest consternation reigned at Constantinople. On learning of the reverses in Armenia, the Generals in command were immediately disgraced, and two new officers who were in favor at court were sent to supersede them.

Every effort was made to raise the army in Anatolia. Envoys were sent to Persia to endeavor to draw her into the war, and emissaries were despatched to Abkhasia, Ghuriel, and Mingrelia, to stir up revolt there.

The plan of the new Turkish Generals, Salegh and Hakki Pashas was as follows. An army of 80,000 men and 66 guns was to be massed at Erzeroum, and advanced *via* the Soghanly range on Kars; whilst a second army of 50,000 men and 50 guns was to be massed on Van to act on the Russian flank.

In February, Paskiewitch heard that the Turks were advancing on Akhalzik, and he at once detached Mouravieff to Suram with six battalions and eighteen guns to cover that fortress, whilst General Hesse was directed to suppress the insurrection in Ghuriel as promptly as possible.

On the 28th of February, Osman Bey entered the city of Akhalzik. The garrison retired into the citadel, and there succeeded in keeping him at bay. The Turks, with their usual ferocity, commenced a system of carnage, and, as at Bayazid in these latter days, so at Akhalzik in 1829, every Christian inhabitant was slain.

Mouravieff in the meantime pushed forward with vigor to relieve the place, and on the 28th attacked the Turks, defeated them with a loss of 3,000 men, and relieved the garrison.

Hesse, after some sharp skirmishes in which his casualties amounted to 187 men, succeeded in suppressing the rebellion in Ghuriel. The snow having cleared away, and the roads being tolerably practicable for troops, in April Paskiewitch determined to renew his operations for the subjugation of Erzeroum. Pankratieff, at Bayazid, was directed to proceed with four battalions and twelve guns to Katchewenk on the Arpa-Tchai, whilst Paskiewitch, on the 19th of May having settled the difficulty with Persia, rejoined head-quarters at Akhalkalaki, and none too soon, for he here learned that the Turks had 15,000 men near Ardahan, marching to the relief of that fortress, whilst 50,000 men were at Hassan Kale, on the western slopes of the Soghanly Dagh. On the 25th May, Pankratieff was directed to march on Karadjuran, near Kars, to cover that fortress Paskiewitch at the same time pushed forward to Beghli Ahmed. Salegh Pasha had now reached the Soghanly. Finding that the majority of the Russians were at Kars, he determined to move towards Akhalzik, Mouravieff was sent to counteract this movement to Tsurskab; and on the 2d of June this General attacked the Turkish forces, defeated them, and took one gun and 1,200 prisoners. The Osmanli being thus checked in their advance on the northern road, Paskiewitch felt free to concentrate all his troops and advance on Erzeroum. This movement was carried out in three columns, the right under the command of Mouravieff, the left under the command of Pankratieff, and the third under the Commander-in-Chief; the two roads leading from Kars and Erzeroum diverge at Kotanli and meet again at

Kuipri Kui, the first or southernmost road passing through Sara Kamysh, Mellidooz, and Khorassan, whilst the second or northernmost road passes by Deli Mussa, Kara Orghan, and Zewin. Salegh Pasha, at the head of the main body of the Turkish army, barred the northernmost road on the Zewin Dooz; whilst Hakki Pasha, with 1,300 infantry, 7,000 cavalry, and sixteen guns, took up the entrenched position on the Mellidooz plateau. Just where the road ascends from the Sara Kamysh defile, a knoll in the centre of the plateau commands all the roads, and this was strongly intrenched by the Turks. On the 11th of June, Paskiewitch, who determined to advance by the northern road, sent forward strong parties of cavalry to patrol the Sara Kamysh defile, and thus draw off attention from his main attack. Burtsoff, with 2,00 infantry, was now sent into the defile, whilst the Commander-in-Chief, with 14,000 men and fifty guns, moved towards the Tchakir Baba. On the 13th of June, Burtsoff made a threatened attack on Hakki Pasha's camp. Fearing assault, this General drew in all the outposts, and thus the Russian Commander-in-Chief was enabled to cross the Soghanly Range without firing a shot. On the 17th inst., however, Osman Pasha, with 1,200 men, was detached to Bardez to reconnoitre, and on the 17th he was attacked by Mouravieff and driven back, not on his own army, but on Salegh Pasha's forces at Zewin. Further concealment now was useless, and Paskiewitch determined to attack the Turkish Commander-in-Chief, who was posted on the Zewin plateau with 40,000 men. Pankratieff was sent to the left bank of the Chansu to prevent Hakki Pasha falling back and joining his chief, and Burtsoff was warned to attack the Mellidooz position directly the Turks showed a disposition to abandon it. On the 19th, Paskiewitch, passing Kanli, descended towards Zewin; Salegh Pasha advanced to meet him, but was driven back into his entrenched position, which was immediately attacked by the Russians, who drove the Turks off in complete disorder, captured 500 prisoners and twelve guns. The following day, Paskiewitch, leaving a force at Zewin, and crossing the Chansu, ascended the Kara Orghan to attack Hakki Pasha at Mellidooz. After a sharp fight, the Turks were defeated, the commander and fifteen guns being taken.

Being aware that promptitude constitutes half the battle in fighting with Oriental nations, Paskiewitch set off in pursuit of the Turks, and on the 23d inst. reached Kuipri Kui, which he found to have been abandoned. He at once placed himself at the head of a flying column of cavalry, eighteen horse-artillery guns, and dashed on Hassan Kale. So close was the pursuit, that Selegh Pasha had only just time to escape from the place, leaving twenty-nine guns in the hands of the Russians. On the 24th the whole of the Russian army concentrated at Hassan Kale, and a *parlementaire* was sent in to the Governor of Erzeroum, demanding its surrender. This was refused; so on the 25th Paskiewitch advanced to the Nabitchai stream, and on the 27th seized the Devi Boyun heights unmolested. On the 28th the city surrendered, a slight skirmish taking place between the excited soldiery in the citadel and the Russian troops as they entered the town, 150 guns, four Pashas, and about eight thousand prisoners falling into the hands of the Russian General. Thus, in five short weeks from the commencement of the campaign, Paskiewitch had been enabled to effect his object. He subsequently moved towards Trebizond, and occupied Baiboort. Insurrections among the Laziz, however, broke out, and this, coupled with the badness of the roads, prevented him advancing further than Gumish Khane. In August the Treaty of Adrianople having been duly signed, the Russians evacuated all the conquered provinces with the exception of Akhalzik, Akhalkalaki, and Kars.

The frontier line was laid down afresh, and has remained unaltered since those days. In the war of 1855, Kars capitulated to Mouravieff, Paskiewitch's Lieutenant; but by the Treaty of Paris, in 1856, it was again ceded to the Turks. It is not our province to speculate on the future of Armenia, but we doubt if an instance has occurred in the history of any nation, of a province twice conquered at the point of the sword, having been twice ceded by a stroke of the pen.

RUSSIAN BERDAN RIFLE. A breech-loading small-arm having a fixed chamber closed by a movable breech-block, which rotates about a horizontal axis at 90° to the axis of the barrel, lying above the axis of the barrel, and in front. The piece is opened by drawing back the locking-bolt to its full extent, thereby cocking the piece, and then throwing the breech-block upward and forward by the handle on its side. It is closed by shutting the breech-block, and is locked by the friction of the rear face of the breech-block against the recoil-shoulder on the locking-bolt guide, against which the longitudinal motion of the hinge-strap slide, to which the block is attached, allows it bodily to slide under the influence of the discharge. It is also held in place by the entrance of the locking-bolt into the counter-bore of the firing-pin hole when the piece is fired. In drawing back the locking-bolt to open the piece it compresses the spiral mainspring which surrounds it, and riding over the point of the spring-sear is caught by it and retained against the tension of the mainspring when the support of the hand is withdrawn. When released through the trigger in the usual way it is impelled against the firing-pin, and so discharges the piece. Extraction is accomplished by an extractor swinging on the joint-screw and struck above its center of motion by the forward end of the breech-block near the completion of its movement in opening. Ejection is caused by accelerating the movement of the extractor by the ejector-spring, one end of which has a solid bearing on the hinge-strap slide, and the other resting on the extractor above the center of motion; as the shell passes out it is deflected by the beveled surface of the ejector-stud, and is thrown clear of the piece.

RUSSIAN BRIDGE.—The Russians use in their bridge equipages a very light kind of ponton formed of a frame-work covered with canvas. The frame is composed of two side-frames, constructed of 4″ scantling. These two frames are connected below by movable transoms, with tenons at each end which fit into mortises in the bottom sills, and above by two transoms, one at each end, which are laid on the top string-pieces, about 2 feet from the ends, and lashed to them. The canvas cover is stretched over the bottom, sides, and ends, brought over the ends, and lashed to the top transoms. It is secured along the sides of the top string-pieces by small nails, passing through eyelet holes along the edges of the cloth. It is 10¾′ wide, 30′ long in the middle, 23′ long along the edges, and is painted black on both sides. A plank is laid along the bottom for the pontoneers to stand on, and the cables are attached to the top transoms. There are special supports for the hand-ropes. The *Birago* trestle and abutments are used with these pontons.

RUSSIAN FUSE.—This fuse consists of a fuse-plug made of a mixture of lead and tin, conical in shape, the head of which projects beyond the external surface of the shell, and of a paper fuse, filled with fine powder rammed hard, which is introduced into the fuse-plug just before firing. There are two sets of these fuses, and three lengths in each, which burn in the first set, 2¾″, 4″, and 5″, and in the second 3¼″, 4½″, and 5½″.

These were the fuses used by the Russians in the Crimea, since which a new system has been adopted, in which the fuse-plug is made of papier mâché, and the fuse-tube of lead.

RUSSIAN GOVERNMENT.—With the abolition of serfdom, Old Russia disappeared for ever, and New

Russia arose from its grave. The old distinction of classes into nobles and bondsmen was merged into that beautiful weapon of constitutional despotism, known on the Continent as universal compulsory service in the army. Henceforth, instead of fighting for their King, Emperor, or Czar, the people of such happy lands now fight for their country only. It is true, the common populace is so blinded by its prejudices, that it is apt not to understand the difference as long as the country is under the immediate and irresponsible control of its whilom Sovereign; and Russia forms no exception to this rule. Consequently, though the form has somewhat changed, the material remains the same; and where it has altered it has been sagaciously made use of to fit into the new order of things, and to form an integral portion of the new system. Thus the result of abolishing serfage was the creation of a fresh national feeling; the ex-bondsmen felt that he had a stake in his newly-acquired soil; whilst, on the other hand, the noble felt that a new danger was threatening him by the growth of this national consciousness and the growing conviction in the ex-serf that he really was a unit in the empire, and that many units piled up on the top of the other, amounted to a very considerable sum, and no mean force if united in action. To counterbalance these ideas it was necessary to shape certain grooves for the new national feeling to run in. Thus three principal channels were fashioned. 1. Compulsory military service. 2. The institution of communal self-government. 3. The reunion of the Schismatics and other dissidents under the paternal care of the Orthodox Greek Church, as represented by the Holy Synod, as represented by the Czar, who in turn represents the Diety himself, in Russia. These grooves having been duly fashioned, the next thing to be done was to furnish a reservoir for them to run into—a vast reservoir that would contain the national food for long years to come, and prevent its overflowing the channels cut for it, and causing serious damage at home. This great goal was set up in the shape of Panslavism; the object of Panslavism being the reunion of all the various Slav races in Austria, in Prussia, and in Turkey, under the sceptre of him who rules at St. Petersburg. The attention of the freshly-made freeman was thus to be diverted from home matters to foreign affairs, and his black bread spread with the butter of glory abroad rather than with the fat of the land at home, for which it appears that the noble has a remarkable fancy. Of the working of this new system, of the bad that exists, and the good that is latent in the communal system; of the atrocities of the Holy Synod; of the burden the armys imposes upon the nation, we shall speak in the proper place. The above rapid sketch is simply designed to give in a few words the character of the change that has come over Russia, and made her again an enemy and a standing menace to the peace of Europe, and the cause of liberty, commerce, and progress. And if, as Gœthe says, "The gods against ignorance battle in vain," it may well be imagined what a very formidable task Europe has before her, when she shall be called upon to wage war against the bottomless ignorance of eighty million souls, all well armed with breech-loaders and Krupp guns. Under such circumstances, it may well be asked why Europe should submit to a continual threat in order to enable a Muscovite nobility to preserve their station against those principles of individual liberty and local self-government they are so proud of pointing to as the lever that is to raise Slavonic Russia on the ruins of an effete western civilization, and to regenerate the sluggish blood of worn-out Europe? In short, why should Europe allow the Russian leaders and rulers to impede the development of liberty at home, by imposing a tyrannic rule on races abroad, under the catch-penny title of national glory? Is the country too small and too poor to support its teeming population? Is it a kind of magnified Montenegro, that must perforce extend its boundaries to feed its starving population? If so, there would, perhaps, be some excuse for its periodical attacks on somebody or other—on the Khan of Khiva yesterday, the Sultan of Turkey today, and probably the Shah of Persia to-morrow. But we find exactly the contrary to be the case; for whilst Europeans count their inhabitants to the square mile in some cases by thousands, and inmost cases by the hundred, we find in Russia a population of about ten to the square mile. Let any one try to stretch his imagination to the wonderful extent of fancying himself in the possession of 309,760 square yards of soil—or the use of it—and he will have an accurate idea of the position of the Russian in his native land. Is there any biped, be he white, yellow, or black, belonging to the working classes—to the classes to whom labor is a necessity—who would not be satisfied with such a possession, or at any rate be content to increase it by legitimate means, and thus in possession of material independence, would not also be in possession of his moral independence, and defy the intrigues of those who will not work themselves, but buy up streams of living blood and bushels of money in exchange for a few tinsel tatters of impalpable, evanescent glory?

The reply is self-evident; so self-evident that the Russian government has never propounded the question, and works upon a system by which they hope it will never be proposed. What this system is we now propose showing, for it is the most important element foreign nations have to consider in their relations with Russia. It is the government that does everything, without consulting the people. There is no appeal to the nation. What the Czar and his Nobles decree has to be performed, and is performed in the same unreasoning, slavish spirit of obedience, which the liberation of the serfs has in no way changed. In dealing with Russia, we have to deal with a crafty, unprincipled, Asiatic government, and a mass of ignorance in all things that concern the Russian's relations with foreign nations and ideas. Not that there are not communities upon communities who cultivate the soil in peace, and successfully; whose villages are all that could be desired from an agricultural and social point of view. Of these there are many; and there is an amount of good nature and common sense in the Russian peasant that only needs time and opportunity for development to make him one of the most peaceable and industrious of men. But just for this very reason, *because* he has the capacity for attaining material and moral independence, the vast army of drones do all they can to stifle these good qualities in a mass of bigotry, ignorance, and superstition. Be it well understood—what we find to protest against is not the mere existence of the people of Russia, but of the Russian government, which is a great deal worse than the Turkish rule, and for the simple reason that the Russian government has not the same excuse which the Turkish has, of being a weak government that has fallen into the hands of the Jews and Greeks. The Russians discovered that the Crimean war had opened the eyes of the people to the fact, that Russia was not altogether the blessed paradise her rulers tried to make them believe, and that an entire re-constitution of the government system was necessary to satisfy the growing discontent. How to do this and yet alter nothing; how to give liberty and yet at the same time to curtail it, was no easy task. But it was accomplished. The Czar, whose official title is Autocrat—Self-ruler—of all the Russias, is the fountain-head of all legislation. All laws proceed from him; he alone makes them; he alone can unmake them. This is done as follows:—All decrees of the Czar published by the Senate are Laws; all decrees published by other departments of the State are only to be regarded as decrees; and theoretically, disobedience to these decrees, or ukases, can only be punished when such punishment can be legally justified, and it is proved that the ukase in question was known to the culprit. As a matter of fact, there is, practically, no distinction between the two. Administrative ukase, or imperial senatorial law, they both amount to the same thing, and center in the irresponsible Czar.

The executive power is also in the hands of the Czar, and all departments act in his name. The Minister of Police, for instance, is responsible to no one but the Czar. A man disappears; and inquiries show that he has been arrested by the police; there the matter ends, and it depends entirely upon the police or the Czar whether or not he ever reappears. Life under such circumstances would be unsupportable, were it not that the communes retain a species of self-government that invests them with a show of liberty. Of the nature of such liberty suffice it to say that the system is based on the principle, not of a division of property, as the Socialists try to make out, but upon the division of the use of the soil, which is a very different matter altogether. It is, in short, a system that fully employs the spare time and all the spare brains of the peasantry to carry out, and prevents them from agitating for that representation of the people in the councils of the nation, which is the first step to liberty. To keep the peasantry in this circumscribed oasis of local liberty in the commune, or *mir*, and prevent their union with each other in the cause of universal and general liberty, is, of course, the chief object and aim of the nobility. Compulsory service is one of these means. The church affords another. To bring all the various sects of Russia under the control of the parish priest and Holy Synod, who can command the assistance of the civil authorities and of the military authorities, is the great object, for the prompt attainment of which such measures have been taken as those that furnished the material for the Blue Book published recently by the British Government. An imperial ukase was published in 1871, subjecting all the heterodox, or dissenting, churches to the authority of the Holy Synod. This is equivalent to an act of parliament, in England, placing all the Nonconformists, Catholics and Jews under the administration and authority of the Church of England. Thus the Uniates were ordered to conform in all respects to the habits of the Orthodox clergy—to alter their churches in conformity with the system adopted by the Orthodox church. Priests who complied with these instructions were to be compensated for any pecuniary losses; disobedient priests to be transferred to some other place, or banished. An inquisitorial commission sat in permanence at Siedlce, before which the clergy were summoned from time to time, and examined as to their conduct. These measures were energetically enforced, but met with great resistance, especially on the part of the inhabitants of Chelm, Lublin, Popil, and Siedlce. On hearing of this, Count Tolstoi gave strict orders that the necessary measures were to be enforced with the utmost rigor, and no benches, organs, rosaries, mass-bells, etc., to be allowed in the churches under any pretense whatever. Most of the clergy yielded; the peasantry, however, refused to obey the tyrannical order, and many conflicts, resulting in loss of life, occurred in many places. At Myncieviez, the peasants defended their church by force, but were defeated by the Cossacks, and every one of the congregation summoned to sign forthwith a declaration of his conversion to the Orthodox church. On their refusing, every man received fifty strokes of the knout, every woman twenty-five, and every child, irrespective of age or sex, ten blows. One woman, who was especially energetic in her refusal, received more than one hundred blows, and is described as having her flesh completely mashed. These brutalities were taking place just at the same time of the wedding of the Duke and Duchess of Edinburgh, and created so painful a feeling at St. Petersburgh that they were suspended for a time. In fact, so great was the indignation aroused amongst the foreign community, that it was openly wondered at that an English prince could ally himself with a power guilty of such atrocities; and it is said, on apparently good authority, that the coolness between the Duke of Edinburgh and the Russian royal family is due to a very energetic expression of opinion by the Duke on the subject. This was in January, 1874. In February the atrocities recommenced; villages were occupied by troops of Cossacks who plundered the wretched peasants, and "hunted them down" when they took refuge and bivouacked in the forests. Fines to a large amount were imposed upon the congregation, their crops trampled down, and, in one case, six hundred married men banished to Cherson (on the 14th of February, 1876), and employed in hard labor—stone-breaking—all day long, whilst their wives and families remained at home, with a number of Cossacks quartered upon them. Under such circumstances, it is not surprising to read, in Count Tolstoi's report (1877), that no less than 237,000 Russian subjects saw the error of their ways in 1876, and were converted to the Orthodox faith.

Having thus undergone a preliminary preparation for their subsequent complete subjection to the autocrat government, which is supposed to represent paternal solicitude and authority, the Russian is then put into the drilling machine provided by the military system, and which ever afterwards holds him in its iron grasp. When the man who stole a loaf excused the act by saying he must live, the Magistrate appropriately replied that he did not see the necessity at all. On the same principle, the existence of the Russian is only regarded as a necessity in so far as he forms an element in the army which keeps the government and its friends on its legs. Consequently it is necessary that the army should be subjected to the strictest discipline, and be as perfect as possible. A sketch of the machine is therefore necessary to understand the working of the system. See *Russian Army*.

There is, unquestionably, a falling-off in the rigid bearing, in the smart performance of movements that used formerly to be a characteristic feature of Russian infantry. There is, perhaps, a little too much of the french *laisser-aller*; and as regards the drill for action in loose order, it is performed without either the precision or dash of the Prussian or Austrian armies. Respecting the cavalry, all that can be said is, that the addition of the Cossacks has deprived it, to some extent, of its gallant and soldierly bearing. The regulars have learnt from the Cossacks their bad habits. The teams of the artillery are excellent, and the movements rapid. There is, however, a great dearth of men able to lay a gun. The distinction between divisional and corps artillery appears to be unknown.—The most important element in an army is its officers; and here great changes have been effected of late years. Formerly, a great many officers got a commission through mere favor; but this abuse has been reformed by the able War Minister, General Milutine. No man can now obtain a commission without undergoing a strict examination. To promote the means of military education, General Milutine created "Junker," or, as we should say, Cadet Schools. These schools, since their creation, have turned out upwards of 10,000 candidates for commissions, and 2,000 cadets duly qualified for commissions now pass through them every year; they remain at the disposition of the State, and get appointments as vacancies occur. In spite of many praiseworthy efforts to raise it, the intellectual level of the officers is not high; but they know the routine of their business thoroughly well, and are regarded generally with respect and affection by their men. As to the question, "Has Russia a General?" it would be difficult to answer it. The march to Khiva, and the more recent campaign in Central Asia, has not revealed the existence of any man of genius in the Russian ranks.

In time of peace the Russian infantry has no ready-formed reserve, with the exception of the skeleton of a battalion of the Reserve Regiment of the Guard, which has to be created in time of war. There is something quite peculiar about this regiment which requires little detail to be made intelligible. When the decree is issued for the mobilisation of the army, it becomes necessary to create 164 battalions of reserves—that is to say, one battalion for each infantry regiment, with the exception of the Guards and the Grenadiers. This latter is the sole four-battalion reserve regiment to be created in case of war: it consists of twelve line companies and four companies of Rifles, the reserve battalions having no Rifle companies. Up to the present time, there exists no machinery in the Russian service for the formation of infantry reserves in peace-time: all that is provided is, that in the event of the formation of a reserve being deemed advisable, a Field-officer, and four officers of lower rank, together with a Quartermaster and two clerks belonging to the active or local troops, should be transferred to these reserve battalions. An intention, however, is entertained of drawing up the cadres thoroughly on paper in time of peace; but as there are really no cadres at the command of the government, the question yet remains unsettled. The strength of the reserve battalions of the line and the Guards is estimated at 960 men. To provide the requisite reserves in the event of mobilisation would require 168 battalions, and an effective of 168,000 men. When the mobilisation is decreed, 192 depot battalions are created for the supply of men to the line, and nine depot battalions for the Rifles. But a mobilization in Russia is a matter of no very small difficulty, on account of the extent and scanty population of the territory, as well as the scarcity of communication, and the precautions which require to be taken against the population in Poland and other provinces. The country, indeed, is divided into a certain number of recruiting districts; but as the corps belonging to these districts are generally quartered elsewere, when the order for mobilisation goes forth, there is a *chassez-croisez* of men and horses all over the empire. As regards the artillery, its mobilisation requires a supplement of 40,000 horses. Under the most favorable circumstances, the mobilisation of the Russian army cannot be effected under from five to six weeks. Such, in few words, is the character of official Russia. But there is another Russia—the Russia of the masses,—unofficial Russia, which slowly, but surely, is modifying and influencing the government and its principles; so that, even in the army, there is a marked difference between the old generation and the younger, that is much in favor of the latter.

Down to the time of the Crimean war, Russia was an earthly paradise for all diplomatists of the old school. Enjoying great social consideration, and living in an almost constant round of splendid festivities, they had only very light and very simple duties to perform. They never required to undertake such complicated operations as calculating the strength of political parties or the force of public opinion. All the springs of government were to be found within a radius of a mile from the Winter Palace; and beyond this small enchanted circle there was nothing for a diplomatist to observe. The Czar and his Ministers worked the great machine as they pleased, free from control and extraneous advice, and the nation confined itself to unquestioning obedience. If any voice did happen to rise from the crowd, it was very soon silenced. Once, in a moment of heroic self-forgetfulness, a rash newspaper editor ventured timidly to hint that some new seats in the imperial garden were not quite in perfect taste; but the all-seeing eye of the press-censor was upon him, and he was severely punished for venturing to criticise seats that had been fortunate enough to obtain the imperial approval! These halcyon days for old-fashioned diplomatists and statesmen of the Metternich type are now beginning to be numbered amongst the things of the past. The Czar, though still as autocratic as ever in the legal sense of the term, no longer drives the machine by his own unaided energy. There are still, it is true, no regularly constituted political parties, no National Assembly; but the great silent inert mass, composed of eighty millions of human beings, has begun to show, here and there symptoms of human intelligence and human will, and the government is no longer at liberty to act entirely as it pleases. Russia has now, in fact, many of the blessings which belong to advanced political development, and which complicate enormously the art of government. There is a press which, though liable to be gagged occasionally, criticises things much more important than rustic seats in imperial gardens; and a public which, though enthusiastically loyal to the head of the State, insists sometimes on having opinions of its own. There was a Slavonic Committee which supplied the Servians with a Commander-in-Chief, and sent several thousand volunteers to fight the Turks; and there are even secret societies which aim at overthrowing the government and inaugurating a Socialistic millennium. In a word, this is the unofficial Russia, which exercises a certain influence on the government, and which must therefore be taken into consideration by diplomatists and statesmen in their endeavors to forecast the policy of the country.

Between St. Petersburg and Moscow their exists an antagonism of long standing. Ever since its foundation, St. Petersburg has striven to be a European city and to adopt all the products of West-European civilization. Moscow, on the contrary, strives to be distinctively Russian, and affects to look down on her younger rival as a half-caste *parvenu*. Abandoned by the imperial family and the heads of administration, she glories in her ancient monuments and her ancient spirit, and boasts that she still holds the first place in the veneration and love of the Russian people. All Moscovites are more or less imbued with this Platonic hostility to the capital on the Neva, and love to reproach its inhabitants—the Ministers and other official dignitaries not excepted—with gross ignorance of Russia and the true Russian character, but when they come to discuss the present and future of their country, they are by no means unanimous. We easily distinguish amongst them two groups or *coteries*, holding peculiar views, which distinguish them from each other. The one is composed of the Slavophils, the other may be called the Moscovites proper. These groups are often confounded, and the confusion is excusable, for many worthy Moscovites themselves do not clearly distinguish between the two and consider that they belong to both; but in reality there is a decided distinction, for the leaders are by no means at one, and do not generally entertain very friendly relations. The chief difference may be briefly stated. The Slavophils are the representatives of the old Russian orthodox spirit. They idealize and admire ancient Russia condemn the sweeping reforms of Peter the Great, and the foreign principles of administration in vogue since his time, profess an inordinate admiration for the uneducated, uncorrupted peasantry, aspire to the creation of a specifically Russian culture on the basis of the Slavonic character and Eastern orthodoxy, are deeply imbued with Slavonic patriotism, and hope to see some day a great Slavonic federation or Panslavonic empire. With regard to questions of home policy, they are adherents of the Mir, or Rural Commune, with its periodical reallotment of the sand, advocate the fostering of native industries by means of protective tariffs, desire the elimination of the German element and German influence from the administration, and would like to see the church emancipated from the supervision and control of the State. The party of the Moscovites proper is at once more modern in its conceptions and more modest in its aims. Though desiring equally to see the German influence eliminated from the administration, it has no feeling of hostility to Peter the Great and Western culture, and no sentimental love of ancient Russia. It thinks that Russia ought to adopt all manner of civilization and enlightenment from Western Europe, and shows no sympathy with institutions simply because they are specially Russian. On the contrary, it holds that the social and political development of the country must be fundamentally the same as that of the West-European nations, and hails with delight all reforms conceived in the West-European spirit. Whilst the Slavophils believe that the mission of Russia is to develop certain very abstruse principles which are supposed to be hidden in the Slavonic nature and in Greek orthodoxy, this party —less dreamy and wiser in its generation think that Russia should develop her institutions by the light of modern experience, and extend her political influence by the same means as other nations.

In ordinary times the influence of the Moscovite spirit, as represented by these two parties, is very small. The Petersburgians look upon it with kindly condescensions as an amiable provincialism, and some Russians are rather proud of it, as they are of the old picturesque buildings of the Kremlin; but it has little practical significance. The Slavophils, with their mystical principles, which have an interest for those who study the philosophy of history rather than for practical administrators stand apart from the busy crowd in a region of philosophical abstraction. If they indulge in any practical activity, it takes the form of educating young Bulgarians or sending ecclesiastical vestments and sacred vessels to the Slavs of Turkey and Austria. All this, however, is changed when certain political complications arise. As soon as the Eastern question is raised, and Russia finds herself in antagonism with Western Europe, Moscow always comes prominently to the front, as the representative of Holy Russia and of the genuine national spirit. Words which at ordinary seasons would only provoke a smile are now listened to with attention and respect. For the moment the two sections of Moscovite society combine. The Slavophils declare that the time has come for emancipating the Slavonic brethren, and protecting them against the insidious influences of Western Europe; whilst the more moderate party urge the government to uphold the honor of the country, and maintain legitimate Russian influence in the Slavonic world. In view of the national danger, the government well thinks it necessary to know the real sentiments of the people, and considers that Moscow is the truest representative of these sentiments. The Czar visits the ancient capital, and the inhabitants show him unbounded devotion—humbly urging him, in more or less disguised language, to impregnate himself with the genuine national spirit, to close his ears to the seductive voice of foreign counsellors, and to act as a Czar who can rely implicitly on the boundless devotion and self-sacrifice of his loyal subjects. Though his Majesty may be a man of cool head and unimpulsive character, he cannot remain wholly impervious to the patriotic excitement. It was during one of those visits that Alexander II. pronounced the famous speech, in which he pledged himself to act independently, if the powers would not act with him, for the protection of the Christians in Turkey.

Thus we see, though autocracy is still unshaken in Russia, that section of unofficial Russia which is represented by Moscow exercises a certain influence on the imperial government, and consequently its views and aims are worthy of attention. Now the bulwark of unofficial Russia of the masses—is undoubtedly the Zemstvo. It is impossible to translate this word Zemstvo by any other phrase than local government. But the very existence of such an institution, hedged in as it is, and as we have already seen, by the government and its autocratic principles, is in itself a most remarkable feature; and it is from this institution that the future, not only of Russia, but of all the Slavonic races, is expected to blossom forth in a perfection so far distant that it must be regarded as Utopian at any rate, as far as Europe is concerned, as it presupposes the possession of an abundance of ground that does not exist in Europe in sufficient quantity to allow of each individual holding his own acres, whether personally or communally.

The Zemstvo was instituted in 1864. There is a provincial Zemstvo and a district Zemstvo. Each district Zemstvo consists of a Zemstvo Assembly and a Zemstvo Executive. The Assembly consists of the landowners of the district and members chosen by the municipal and country communities. Neither the Governor nor Vice-Governor of the district can be a member of the Zemstvo. Nor can any member of the government nor lawyers be elected. The term of office is three years. The Executive is chosen by the Assembly, and consists of a President and two Assistants, who are paid by the Assembly. The Executive thus has to carry out the orders of the Assembly, and depends upon it entirely. The provincial Zemstvo is constituted in a precisely similar manner, divided into an Assembly and an Executive. Both Zemstvos meet once a year.

By this means the government has transferred a great burden from its own shoulders to those of the people, which has accordingly no small sum to pay for the privilege. The people are placed in a condition thereby—and it is part of their duty— to provide for their material and moral progress; but at the same time, in making these concessions, the government has not ceded one jot of its own rights. The Zemstvo may build hospitals, appoint surgeons and doctors, construct roads, and open schools, all at its own expense. But further than this it cannot go. On the policy of the central government, it has but the smallest, if indeed any, influence. Still, as we said before, the development of the Zemstvo is the only hope the Russian has of progressing; and, though slowly, it is doing its work. Thus there was a debate recently in one of the Ural Zemstvos, when a proposal was brought forward by a Colonel Steinfeldt, to award an increase to the school funds of 15,000 roubles. The proposal was supported by one peasant only, and that peasant an ex-serf. He said —"It has been fully proved that, with the education of the laborer, his wealth also increases. Even for this reason alone, it would be the duty of the Zemstvo to promote the cause of education by all the means in its power. Those who say that the existing town schools suffice, and that we have no need of primary village schools, forget that the case is the same for us as with the buffet here in the ante-chamber. It is open to all: quite true! But, it does not suit our pockets. We do not want champagne and Strasburg pies." But, in spite of the sturdy peasant's good common sense, the proposition was almost unanimously rejected. Nor are such matters confined to the remote districts of the Ural. The Zemstvo of Odessa, for instance, can only boast of thirteen schools, with 500 pupils upon which it expends a sum of 6,000 to 7,000 roubles; whilst the sale of playing-cards, which is a monopoly of the Zemstvo, brought in a net profit of 32,000 roubles. But then gambling is a vice to which the Russians, especially the higher classes, are notoriously addicted, more so than in any other country. Still it is satisfactory to find even one peasant endeavoring to promote the cause of education. Some of the seed has fallen on good ground. On the other hand, nothing exemplifies the spirit in which the government instituted and regards the Zemstvo so much as the fact, that when several Zemstvos endeavored to introduce compulsory education, the home ministry placed its veto on the proposal, saying—"All compulsion prevents, but does not forward, the development of the good!"

Of the country which is thus governed, we find that European Russia comprises 2,261,657 sq. miles, with a population of 78,281,447; Asiatic Russia, 6,170,882 sq. miles, with a population of 7,229,495: forming a total of 8,432,549 sq. miles, with a population of 85,510,942. Gifted with an almost boundless territory, with enormous tracts of land yet unreclaimed from the primitive wilderness, with mines which yield prolific stores of wealth, what a power of expansion such a population must necessarily possess! What will that population be within a century? What, even in the year 1900? Evidently an enormous, perhaps irresistible, power for good or for evil. A solid foundation for European despotism, or a glorious aid to that rationally free and constitutional government which appears to be so safe and wise in action. Russia may abandon a policy which exhausts the energies of the people, in adding to its already overgrown dominions countries it cannot benefit by; but its present Czar does not seem to have forgotten the ambitious lessons of Peter and Catherine, whilst directing his attention to promoting the prosperity of the vast empire he possesses. Russia, with all her craft and crime, has yet been the pioneer of civilization in the sterile and savage north: it is now time that she should rest in her dazzling and feverish progress, and, turning back her eyes on the lands and peoples she has subdued, devote herself to cultivating the one, and elevating the other. Her nobles and officers are among the most polished gentlemen of Europe; but her people are yet scarcely more than semi-Asiatic hordes, deeply plunged in barbarism and superstition, and almost as much an anomaly in Europe as the Turks. In political, as well as in social progress, it may be certainly pronounced that "The bells of time are ringing changes fast."

The present age is one of transition for Russia. She cannot continue into the future that which she was in the past. Nature cries aloud, in tones of commanding eloquence, to empires as well as to men—"Advance, or perish!" The statesmen of Russia are too wise to remain insensible to an injunction which is as unalterable as destiny, as "unshunnable as death." Should their successors be blind to the great problem which will stand before them for solution, the works of an empire's progress and redemption will be done in other ways. Czardom is not necessarily eternal; and revolution may accomplish what the slow and silent progress of genial reforms could not effect. In spite of political statistics and ominous inferences, we have great hope for the future of Russia. The young giant is wilful and sullen, but we think he is growing wiser, though it may not appear so at the present moment.

RUSSIAN GUN.—The Russian artillery may be said to be in a transition state, experiments being continually carried on if not to change its matériel, to modify the present ordnance so as to allow that branch of the army at least to bear comparison with that adopted or on the point of being adopted by other armies. The guns of the Russian artillery are 4-pr. and 9-pr. B. L. R. guns for the most part of bronze. The 4-pr., of 3.3 inch caliber fires a projectile weighing 12lbs. The 9-pr. gun which forms three-fifths of its actual armament, fires a shell weighing 24 lbs. with a charge of 2.69 lbs., and possesses an initial velocity of 1060 feet only. Experiments have been made of late with steel guns of the Krupp system, as well as with the 9-pr. modified. The improvement made in that gun by means of casting the metal in metallic molds and then chilling it, have enabled it to obtain an initial velocity of 1369 feet. It differs slightly from the old 9-pr., the dimensions of the chambers being made to allow the use of a charge of 7.23 lbs. of powder. The projectile is provided with 2 belts of copper in lieu of a leaden coat. In order to obtain a flatter trajectory in long ranges, a truncated shot-bottom similar to one proposed by Whitworth has been tried. The weight of the gun and that of the projectile are the same as in the old 9-pr. See *Russian Rifling*.

RUSSIAN LIFE SAVING ROCKET.—The Russian Life-saving Rocket is made of sheet iron, about one-tenth (0″.1.) of an inch in thickness. The body is a cylindrical tube, closed at the front end by a metallic head, held in position by four short screws. The rear end is closed by a diaphragm, which is perforated by six vents or fuse holes, equidistant circumferentially, whose centers are on the circumference of a circle concentric with the diaphragm. An axial hole in the diaphragm has a female screw thread cut on its interior surface to engage the male thread on the rocket stick. The body is fastened to the perforated disk by crimping and by short iron pins. The cylinder is filled with rocket composition The body of the stick is made of light wood, cylindrical near the base and tapering to the front, forming the frustum of a cone. The front end of the stick, which screws into the rocket, is made of wrought iron, hollow at its base for the insertion of the wooden body. The latter is held in place by screws. The rear end of the body is rounded, and on one side carries a strong iron hook, about five (5″) inches in length, with its point turned towards the front, and curved slightly outwards from the axis of the stick. A curved steel spring is placed between the point of the hook and the shank strap to prevent the egress of the ring of the rocket chain after firing. This hook is bolted to the wooden body of the rocket stick. When prepared for packing, the rocket sticks are screwed into the rockets and the fuse holes or vents are covered by disks of water-proof tarred cloth. The diameter of the disk is enough larger than that of the rocket to admit of its being folded over the end of the rocket and secured by several turns of twine, tied tightly around it. The whole rocket, except the wooden body, is then treated with a coat of black paint. The cap or disk must be cut away before firing, in order to expose the fuse holes.

The principal dimensions and weights are as follows:

	Inches.	Centimeters.
Rocket body { Length	25.25	64.12
Rocket body { Exterior diameter	3.2	8.13
Rocket body { Interior diameter	3.0	7.62
Total length of rocket	27.2	69.08
Total length of rocket stick	29.2	74.16
Total length of rocket and stick	55.5	140.97
Length filled with composition	23.1	58.67
Maximum diameter of stick	2.8	7.11
Diameter of vents or fuse holes	0.6	1.52
Number of vents, six		
	Pounds.	Kilos.
Average weight of rocket and stick	25.5	11.56

The rocket stand is a rectangular tube of sheet-iron mounted upon a wooden tripod. The cross-section of the tube is square with one of its diagonals situated in a vertical plane when the stand is in position for use. This hollow parallelopipedonal tube is formed from a single piece of sheet-iron. The longitudinal faces forming the lower edge do not join to complete the regular figure, except for two (2″) inches at the lower end, but are bent outwards from each other, forming two parallel flanges. These flanges are 1″.7 wide, and have a space half an inch wide between them throughout their length, which serves as a channel for the grappling hook on the under side of the rocket-stick to slide in when the rocket is fired. It is also necessary for the same purpose in placing the rocket in position before firing. The rear end of the square tube is bound and strengthened by a band of strap iron 2″ wide and one-tenth (0″.1) of an inch thick. The front end of the tube is reinforced in a similar manner, but with this difference: The band at its lower edge has a cylindrical tube 1″.7 in diameter, projecting to the front 2″.3, for the purpose of holding the ring of the rocket chain. This short tube embraces the front ends of the flanges of the body, and has a longitudinal slot, corresponding in width to the space between the flanges along its upper surface to permit the passage of the rocket hook. A rectangular notch 1''.1 deep is cut in the lower side to accommodate the upper link of the rocket chain when the ring is placed over the projecting tube. Near the middle of the longitudinal bottom flange on the right-hand side of the body tube is attached a rectangular brass plate, 10'' long and 1''.6 wide, with a lug and eye-hole projecting from its under edge near the middle. Through this eye-hole passes the horizontal axis. In a corresponding position on the left side is a semicircular brass plate attached to the other flange. The arc of this plate is graduated into degrees, in order to indicate the elevation of the axis of the main tube. A lug and eye-hole at the center of this arc admits of the insertion of the horizontal axis. A slotted brass support with holes pierced through the upper ends of the vertical arms sustains the horizontal axis that carries the rocket tube and its graduated arc. A clamp screw passes through this support from the right side and clamps the arc in any given position. All motion in altitude within the limits of the scale is governed by this screw. The lower end of the support terminates in a cylindrical tenon 3''.2 in length and 1''.2 in diameter, which fits in a corresponding hole in the tripod head. Two elliptical openings opposite to each other, are made in the upper sides of the tube for the insertion of the port-fire to ignite the rocket composition.

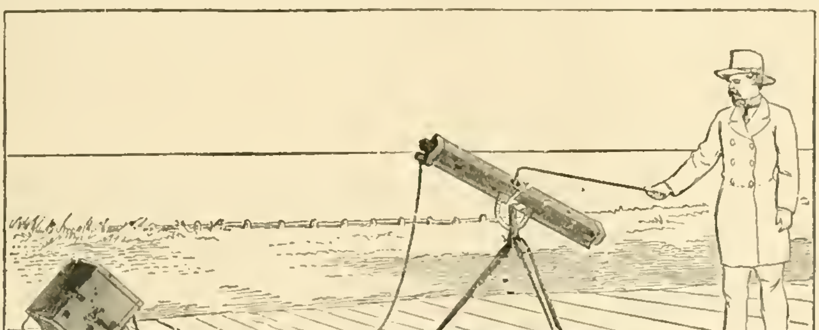
The following are the principal dimensions, weights, etc., of the stand:

		Inches.	Centimeters.
Total length of rocket-tube		53.3	135.38
Cross-section, square.	Exterior	4.3	10.92
	Interior	4.1	10.41
Weight of rocket stand		39.0	17.69
Weight of rocket chain		4.625	2.17
Weight of port fire handle		0.5625	0.25
Total weight without packing box		44.1875 =	20.13
Weight of coil of rocket line		62.0	28.12

A port-fire holder or firing staff accompanies the rocket stand. It is a simple wooden handle with a bent head of brass. The brass head is hollow and is slitted on the sides so as to form a rude clamp. The port-fire is inserted in the split end of the head and then ignited in the usual manner. The rocket-chain is a hand-made iron chain, six feet in length, terminated at one end by a ring two inches in diameter. The ring is placed over the tubular projection on the front end of the rocket stand in firing. The other end of the chain is fastened to the end of the rocket line. The rocket line is a loosely-twisted hemp-line about the size of the No. 8 or No. 9 service lines.

The following is the method of using:—The rocket stand is taken from the box, the legs of the tripod extended, and the stand placed at the firing point. The index being clamped at zero on the graduated arc, the tripod is leveled by the eye by making the axis of the rocket tube horizontal. This can only be done approximately; then loosen the lower clamp screw and swing the stand around until it points in the desired direction. Clamp the vertical spindle and by turning the upper clamp screw to the left the required elevation may be given; after which the screw must be tightened, in order to retain the tube in place. Take a rocket from its box, tear off the cap over the vents, insert the rocket, base first into the rectangular tube with the hook on the stick gliding down between the flanges on the lower side of the tube. When the hook strikes the band at the lower end of the rocket tube, the rocket is in position for firing. Place the fakes or the faking box in front of the stand, put the ring of the chain over the cylindrical tubular projection on the front end of the stand, letting the chain attached to the line hang below. Stand clear of the line, and, with a port-fire inserted in the holder, advance and ignite the rocket by thrusting the port-fire gently through one of the elliptical openings in the rocket tube. Care must be taken not to disturb the aim. An instant after the composition in the base of the rocket is ignited, the latter leaps forward guided by the rocket tube, and as it leaves the tube the hook engages the ring of the chain attached to the line and carries out the chain and line. The chain should be fastened to the line before wanted for use. See *Life-saving Rockets*.

RUSSIAN PRINCIPALITIES.—The period that extends from ten hundred and fifty-four, the year of Iaroslaf's death, to twelve hundred and twenty-four the year of the first appearance of the Tatars, or, to take the French chronology, from the reign of Henry the First to the death of Philip Augustus, is one of the most confused and troubled in Russian history. As the barbarian custom of division continued to prevail over the Byzantine ideal of political unity,



the national territory was ceaselessly partitioned. The princely anarchy of Eastern Europe has its parallel in the feudal anarchy of the West. M. Pogodin reckons during this period sixty-four principalities which had an existence more or less prolonged, two hundred and ninety-three princes who disputed the throne of Kief and other domains, and eighty-three civil wars, in some of which the whole country was engaged. There were, besides, foreign wars to augment this enormous mass of historical facts. Against the Polovtsui alone the chroniclers mention eighteen campaigns, while these barbarians made no less than forty-six invasions of Russia. It is impossible to follow the national chroniclers in the minute details of their annals; we will only treat of the principalities which lasted some time, and of the facts which were most important. The ancient names of the Slav tribes have everywhere disappeared, or remain only in the names of some of the towns, for example that of the Polotchané in Polotsk, and that of the Severiané in Novgorod-Severski. The elements of which Russia was now composed were no longer tribes, but principalities. We hear no more of the Krivitchi or the Drevliané, but of the principalities of Smolensk and Volhynia. These little states were perpetually dismembered at each new partition between the sons of a prince, and then were reconstituted to be divided anew into appanages. Notwithstanding all these vicissitudes, some of them maintained a steady existence, corresponding to certain topographical or ethnographical conditions. Without speaking of the distant principality of Tmutorakan, situated at the foot of the Caucasus in the center of Turkish and Circassian tribes, and reckoning eight successive princes, the following are the great divisions of Russia from the eleventh to the thirteenth century :—

The principality of Smolensk occupied the important territory which is, as it were, the central point in the mountain system of Russia. It comprehends the ancient forest of Okof, where three of the largest Russian rivers, the Volga, the Dnieper, and the Dwina, take their rise. Hence the political importance of Smolensk, attested by all the wars to gain possession of it; hence also, its commercial prosperity. It is noticeable that all its towns were built on one or other of these three great rivers; therefore the entire commerce of ancient Russia passed through its hands. Besides Smolensk we must mention Mojaïsk, Viasma, and Toropets, which was the capital of a secondary principality, the property of two celebrated princes, Mstislaf the Brave and Mstislaf the Bold. The principality of Kief was *Rus*, Russia in the strict sense of the word. Its situation on the Dnieper, the neighborhood of the Greek Empire, the fertility of the Black Land, long secured to this state the supremacy over the Russian principalities. On the south it bordered directly on the nomads of the steppe, against whom her princes were forced to raise a barrier of frontier towns. They often took these barbarians into their pay, granted them lands, and constituted them into military colonies. The principality of Pereiaslavl was a dependence of Kief; Vuishegorod, Bielgorod, Tripoli, Torshok, were at times erected into principalities for princes of the same family. On the tributaries of the right bank of the Dnieper, notably the Soja, the Desna, and the Seïm, extended the two principalities of Tchernigof, with Starodub and Lubetch; and also of Novgorod-Severski, with Putivl, Kursk, and Briansk. The principality of Tchernigof, which reached towards the Upper Oka, had therefore one foot in the basin of the Volga; its princes, the Olgovitchi, were the most formidable rivals of Kief. The princes of Severski were always engaged in war with the Polovtsui, their neighbors on the south. It was a prince of Severski whose exploits against these barbarians formed the subject of a sort of epic poem, called the Song of Igor, or the Account of Igor's Expedition.

Another principality, whose very existence consisted in endless war against the nomads, was the double principality of Riazan and Murom, the principal towns of which were Riazan, Murom, Pereiaslavl-Riazanski, situated on the Oka, Kolomna at the junction of the Moskova with the Oka, and Pronsk on the Prona. The Upper Don formed its western boundary. This principality was placed in the very heart of the Muromians and Meshtcheraki, Finnish tribes. The reputation of its inhabitants, who were reckoned extremely warlike in their character, and rough and brutal in their manners, was no doubt partly the result of the mixture of the Russian race with the ancient inhabitants of the country, and of their perpetual and bloody struggle with the nomad tribes. The double principalities of Suzdal, with their towns of Suzdal, Rostof, Iurief-Polski on the Kolosha, Vladimir on the Kliazma, Iaroslavl, and Pereiaslavl-Zalieski, were situated on the Volga and the Oka amongst the thickest of northern forests, and in the middle of the Finnish tribes of Muromians, Meria, Vesui, and Tcheremisa. Although placed at the farthest extremity of the Russian world, Suzdal exercised an important influence over it. We shall find its princes now establishing a certain political authority over Novgorod and the Russia of the Lakes, the result of a double economic dependence; now intervening victoriously in the quarrels of the Russia of the Dnieper. The Suzdalians were rough and warlike, like the Riazanese. Already we can distinguish among these two people the characteristics of a new nationality. That which divides them from the Kievans and the men of Novgorod-Severski, occupied like themselves in the great war with the barbarians, is the fact that the Russians of the Dnieper sometimes mingled their blood with that of their enemies and becamed fused with the nomad, essentially mobile Turkish races, whilst the Russians of the Oka and the Volga united with the Finnish tribes, who were agricultural and essentially sedentary. This distinction between the two foreign elements that entered the Slav blood has doubtless contributed to the difference in the characters of the two branches of the Russian race. From the eleventh to the thirteenth century, in passing from the basin of the Dnieper to the basin of the Volga, we can already watch the formation of Great and Little Russia.

The principalities of Kief, Tchernigof, Novgorod-Severski, Riazan, Murom, and Suzdal, situated on the side of the steppe with its devastating hordes, formed the frontier states of Russia. The same part to play on the northwest, opposite the Lithuanians, Letts, and Tchudi, fell to the principality of Polotsk which occupied the basin of the Dwina; and to the republican principalities of Novgorod and Pskof on the Lakes Ilmen and Peïpus. To the principality of Polotsk, that of Minsk was attached which lay in the basin of the Dnieper. The possession of Minsk was often disputed by the Grand Princes of Kief. To Novgorod belonged the towns of Torjok, Volok-Lamski, Izborsk, and Veliki-Luki, which were at times capitals of particular states. Southeast Russia comprehended: Volhynia, in the fan-shaped distribution of rivers formed by the Pripet and its tributaries, with Vladimir-in-Volhynia, Lutsk, Turof, Brest and even Lublin, which is certainly Polish; Gallicia proper, or Red Russia, in the basins of the San, the Dniester, and the Pripet, whose ancient inhabitants, the White Kroats, seem to have sprung from the stock of the Danubian Slavs. Her chief towns were Galitch, founded by Vladimirko about eleven hundred and forty-four, Peremuisl, Terebovl, and Zvenigorod. The neighborhood of Hungary and Poland gave a special character to these principalities, as well as a more advanced civilization. The epic songs speak of Gallicia, the native land of the hero Diuk Stepanovitch, as a fabulously rich country. The Account of Igor's Expedition gives us a high idea of the power of these princes. "Iaroslaf Osmomuisl of Gallicia!" cried the poet to one of them, "thou art seated very high on thy throne of wrought gold; with thy regiments of iron thou sustainest the Carpathians; thou closest the gates of the Danube; thou barrest the way to the King of Hungary; thou openest at thy will the gates of Kief, and with thine arrows thou strikest from afar!"

The disposition of these fifteen or sixteen principalities confirms all that we have said about the essential unity of the configuration of the Russian soil. Not one of the river basins forms an isolated and closed region. There is no line of heights to establish barriers between them or political frontiers. The greater number of the Russian principalities belong to the basin of the Dnieper, but extend everywhere beyond its limits. The principality of Kief, with Pereiaslavl, is nearly the only one completely confined within it; but Volhynia puts the basin of the Dnieper in communication with those of the Bug and the Vistula, Polotsk with the basins of the Dnieper and the Dwina, Novgorod-Severski with the basin of the Don, Tchernigof and Smolensk with the basin of the Volga. Watercourses everywhere established communications between the principalities. Already Russia, though broken up into appanages, had the germs of a great united empire. The slight cohesion of nearly all the states, and their frequent dismemberments, prevented them from ever becoming the homes of real nationalities. The principalities of Smolensk, Tchernigof, and Riazan have never possessed as definite an historic existence as the duchy of Bretagne or the county of Toulouse in France, or the duchies of Saxony, Suabia, and Bavaria in Germany.

The interests of the princes, their desire to create appanages for each of their children, caused a fresh division of the Russian territory at the death of every sovereign. There was, however, a certain cohesion in the midst of all these vicissitudes. There was a unity of race and language, the more sensible, notwithstanding all dialectic differences, because the Russian people was surrounded everywhere, except at the southwest, by entirely strange races, Lithuanians, Tchudi, Finns, Turks, Magyars. There was a unity of religion; the Russians differed from nearly all their neighbors, for in contrast with the Western Slavs, Poles, Tcheki, and Moravians, they represented a particular form of Christianity, not owning any tie to Rome, and rejecting Latin as the language of the Church. There was the unity of historical development, as up to that time the Russo-Slavs had all followed the same road, had accepted Greek civilization, submitted to the Variagi, pursued certain great enterprises in common,—such as the expeditions against Byzantium and the war with the nomads. Finally there was political unity, since after all, in Gallicia as in Novgorod, on the Dnieper as in the forests of Suzdal, it was the same family that filled the thrones. All these princes descended from Rurik, Saint Vladimir, and Iaroslaf the Great. The fact that the wars that laid waste the country were civil wars, was a new proof of this unity. The different parts of Russia could not consider themselves strangers one to the other, when they saw the Princes of Tchernigof and Suzdal taking up arms to prove which of them was the eldest, and which consequently had most right to the title of Grand Prince and the throne of Kief. There were descendants of Rurik who governed, successively, the remotest States of Russia, and who, after having reigned at Tmutorakan on the Straits of Ienikale, at Novgorod the Great, at Toropets, in the country of Smolensk, ended by establishing their right to reign at Kief. In spite of the division into appanages, Kief continued to be the center of Russia. It was there that Oleg and Igor had reigned, that Vladimir had baptized his people, and Iaroslaf had established the metropolis of the faith, of arts, and of national civilization. It is not surprising that it should have been more fiercely disputed than all the other Russian cities. Russia had many princes; but she had only one Grand Prince, the one that reigned at Kief. He had a recognized supremacy over the others which he owed not only to the importance of his capital, but to his position as eldest of the royal family. Kief, the mother of all cities, was always to belong to the eldest of the descendants of Rurik; this was the consequence of the patriarchal system of the Slavs, as was the custom of division. When the Grand Prince of Kief died, his son was not his rightful heir; but his uncle or brother, or whichever of the Princes was the eldest. Then the whole of Russia, from the Baltic to the Black Sea, held itself in readiness to support the claims of this or that candidate. It was the same with the other principalities, where the possessors of different appanages aspired to reign in the metropolis of the region. The civil wars, then, themselves strengthened the sentiment of the Russian unity. What were they, after all, but family quarrels?

The persistent conflict between the Byzantine law, by which the son inherited the possessions of the father, and the old national laws of the Slavs which caused them to pass to the eldest of all the family, was an inexhaustible source of civil wars. Even had the law been perfectly clear, the princes were not always disposed to recognize it. Thus, although the eldest of Iaroslaf's sons had in his favor the formal will of his father, giving him the throne of Kief, and though Iaroslaf on his death-bed had desired his other sons to respect their elder brother as they had done their parent, and look on him as their father, Isiaslaf at once found his brother Sviatoslaf ready to take up arms and overturn his throne. He was obliged in ten hundred and seventy-three to seek refuge at the Court of Henry the Fourth of Germany, who sent an embassy to Kief, commanding Sviatoslaf to restore the throne to Isiaslaf. Sviatoslaf received the German envoys with such courtesy, made them such a display of his treasures and riches, that, dazzled by the gold, they adopted a pacific policy. Henry the Fourth himself, disarmed by the liberalities of the Russian Prince, spoke no more of chastising the usurper. Isiaslaf did not return to Kief till after the death of his rival in ten hundred and seventy-six. When his own death took place, in ten hundred and seventy-eight, his son Sviatopolk did not succeed him immediately. It was necessary that all the heirs of Iaroslaf should be exhausted. Vsevolod, a brother of Isiaslaf, whose daughter married the Emperor Henry the Fourth or Henry the Fifth—it is not quite certain which—reigned for fifteen years, from ten hundred and seventy-eight until ten hundred and ninety-three. In accordance with the same principle, it was not the son of Vsevolod, Vladimir Monomakh, who succeeded his father; but after the crown had been worn by a new generation of princes, it returned to the blood of Isiaslaf. Vladimir Monomakh made no opposition to the claims of Sviatopolk Isiaslavitch. "His father was older than mine," he said, "and reigned first in Kief," so he quitted the principality which he had governed with his father, and valiantly defended against the barbarians. But every one was not so respectful to the national law as Vladimir Monomakh.

Two terrible civil wars desolated Russia in the reign of the Grand Prince Sviatopolk, between ten hundred and ninety-three and eleven hundred and thirteen: one about the principality of Tchernigof, the other about Volhynia and Red Russia. Sviatoslaf had enjoyed Tchernigof as his share, to which Tmutorakan in the Taurid, Murom and Riazan in the Finn country, were annexed. Isiaslaf and Vsevolod, Grand Princes of Kief, had despoiled the sons of Sviatoslaf, their brother, depriving them of the rich territory of Tchernigof, and only leaving them Tmutorakan and the Finnish country. Even Vladimir Monomakh, whom we have seen so disinterested, had accepted a share of the spoil. The injured princes were not people to bear this meekly, especially the elder, Oleg Sviatoslavitch, one of the most energetic men of the eleventh century. He called the terrible Polovtsui to his aid, and subjected Russia to frightful ravages. Vladimir Monomakh was moved by these misfortunes; he wrote a touching letter to Oleg, expressing his sorrow for having accepted Tchernigof. At his instigation a Congress of Princes met at Lutbetch, on the Dnieper, in ten hundred and ninety-seven. Seated on the same carpet, they resolved to put an end to the civil wars that handed the country as a prey to the barbarians. Oleg recovered Tchernigof, and promised to unite with the Grand Prince of Kief and Vladimir Monomakh against the Polovtsui. The treaty was ratified by the oath of each prince, who kissed the cross and swore, "that henceforth the Russian land shall be considered as the country of all; and whoso shall dare to arm himself against his brother becomes our common enemy."

In Volhynia the prince, David, was at war with his nephews, Vasilko and Volodar. The Congress of Lubetch had divided the disputed territories between them, but scarcely was the treaty ratified than David went to the Grand Prince Sviatopolk and persuaded him that Vasilko had a design on his life. With the light faith habitual to the men of that date, the Grand Prince joined David in framing a plot to attract Vasilko to Kief on the occasion of a religious festival. When he arrived he was loaded with chains, and the Grand Prince convoked the boyars and citizens of Kief, to denounce the projects of Vasilko. "Prince," replied the boyars, much embarrassed, "thy tranquility is dear to us. Vasilko merits death, if it is true that he is thine enemy: but if he is calumniated by David, God will avenge on David the blood of the innocent." Thereon the Grand Prince delivered Vasilko to his enemy David who put out his eyes. The other descendants of Iaroslaf the First were indignant at this crime. Vladimir Monomakh united with Oleg of Tchernigof, his ancient enemy, and marched against Sviatopolk. The people and clergy of Kief succeeded in preventing a civil war between the Grand Prince and the confederates of Lubetch. Sviatopolk was forced to disavow David, and swear to join the avengers of Vasilko. David defended himself with vigor, and summoned to his help, first the Poles, and then the Hungarians. At last a new congress was assembled at Vititchevo in the year eleven hundred, on the left bank of the Dnieper, a town of which a deserted ruin is all that now remains. As a punishment for his crime, David was deprived of his principality of Vladimir in Volhynia, and had to content himself with four small towns. After the new settlement of this affair, Monomakh led the other princes against the Polovtsui, and inflicted on them a bloody defeat; seventeen of their khans remained on the field of battle. One khan who was made prisoner offered a ransom to Monomakh; but the prince showed how deeply he felt the injuries of the Christians,—he refused the gold, and cut the brigand chief in pieces.

When Sviatopolk died, the Kievans unanimously declared they would have no Grand Prince but Vladimir Monomakh. Vladimir declined the honor, alleging the claims of Oleg and his brothers to the throne of Kief. During these negotiations a sedition broke out in the city, and the Jews, whom Sviatopolk had made the instruments of his fiscal exactions, were pillaged. Monomakh was forced to yield to the prayers of the citizens. During his reign, from eleven hundred and thirteen until eleven hundred and twenty-five, he obtained great successes against the Polovtsui, and Petchenegi, the Torki, the Tcherkesui, and other nomads. He gave an asylum to the remains of the Khazarui, who built on the Oster, not far from Tchernigof, the town of Belovega. The ruins of this city that remain to-day prove that this Finnish people, eminently capable of culture, and already civilized by the Greeks, were further advanced in the arts of construction and fortification than even the Russians themselves. According to one tradition, Monomakh also made war on the Emperor Alexis Comnenus, a Russian army invaded Thrace, and the Bishop of Ephesus is said to have brought gifts to Kief, among others a cup of carnelian that had belonged to Augustus, besides a crown and a throne, still preserved in the Museum at Moscow, under the name of the crown and throne of Monomakh. It is now known that they never belonged to Vladimir, but it was the policy of his descendants, the Tsars of Moscow, to propagate this legend. It was of consequence to them to prove that these tokens of their power were traceable to their Kievan ancestor, and that the Russian Monomakh, grandson of the Greek Monomachus, had been solemnly crowned by the Bishop of Ephesus as Sovereign of Russia. The Grand Prince made his authority felt in other parts of Russia. A Prince of Minsk, who had the temerity to kindle a civil war, was promptly dethroned, and died in captivity at Kief. The Novgorodians saw many of their boyars kept as hostages, or else exiled. The Prince of Vladimir in Volhynia was deposed, and his states given to a son of the Grand Prince.

Monomakh has left us a curious paper of instructions that he compiled for his sons, and in which he gives them much good advice, enforced by examples drawn from his own life. "It is neither fasting, nor solitude, nor the monastic life, that will procure you the life eternal,—it is well-doing. Do not forget the poor, but nourish them. Do not bury your riches in the bosom of the earth, for that is contrary to the precepts of Christianity. Be a father to the orphans, judge the cause of widows yourself. . . . . Put to death no one, be he innocent or guilty, for nothing is more sacred than the soul of a Christian. . . . . Love your wives, but beware lest they get the power over you. When you have learnt anything useful, try to preserve it in your memory, and strive ceaselessly to get knowledge. Without ever leaving his palace, my father spoke five languages, a thing that foreigners admire in us. . . . . I have made altogether twenty-three campaigns without counting those of minor importance. I have concluded nineteen treaties of peace with the Polovtsui, taken at least a hundred of their princes prisoners, and afterwards restored them to liberty: besides more than two hundred whom I threw into the rivers. No one has travelled more rapidly that I. If I left Tchernigof very early in the morning, I arrived at Kief before vespers. Sometimes in the middle of the thickest forest I caught wild horses myself, and bound them together with my own hands. How many times I have been thrown from the saddle by buffaloes, struck by the horns of the deer, trampled under foot by the elands! A furious boar once tore my sword from my belt; my saddle was rent by a bear, which threw my horse down under me! How many falls I had from my horse in my youth, when, heedless of danger, I broke my head, I wounded my arms and legs! But the Lord watched over me!" Vladimir completed the establishment of the Slav race in Suzdal, and founded a city on the Kliazma that bore his name, and that was destined to play a great part. Such, in the beginning of the twelfth century, when Louis the Sixth was fighting with his barons of the Isle de France, was the ideal of a Grand Prince of Russia.

Of the sons of Vladimir Monomakh, Iuri Dolgoruki became the father of the princes of Suzdal and Moscow, and Mstislaf the father of the princes of Galitch and Kief. These two branches were often at enmity, and it was their rivalry that struck the final blow at the prosperity of Kief. When Isiaslaf, son of Mstislaf, was called to the throne in eleven hundred and forty-six by the inhabitants of the capital, his uncle, Iuri Dolgoruki, put forward his rights as the eldest of the family. Kief, which had been already many times taken and retaken in the strife between the descendants of Oleg of Tchernigof and the descendants of Vladimir Monomakh, was fated to be disputed anew between the uncle and the nephew. It was almost a war between the Old and New Russia, the Russia of the Dnieper and that of the Volga. The princes of Suzdal, who dwelt afar in the forests in the northwest, establishing their rule over the remnants of the Finnish races, were to become greater and greater strangers to Kievan Russia. If they still coveted the "mother of Russian cities," because the title of Grand Prince was attached to it, they at least began to obey and to venerate it less than the other princes.

Iuri Dolgoruki found an ally against Isiaslaf in one of the Olgovitchi, Sviatoslaf, who thirsted to avenge his brother Igor, dethroned and kept prisoner in Kief by the Grand Prince. The Kievans hesitated to support the sovereign they had chosen; they hated the Olgovitchi, but in their attachment to the blood of Monomakh they respected his son and his grand-son equally. "We are ready" they said to Isiaslaf, "we and our children, to make war on the sons of Oleg. But Iuri is your uncle, and can we dare to raise our hands against the son of Monomakh?" After the war had lasted some time, a decisive battle was fought. At the battle of Pereiaslavl Isiaslaf was completely defeated, and took refuge, with two attendants, in Kief. The inhabitants, who had lost many citizens in this war, declared they were unable to stand a siege. The Grand Prince then abandoned his capital to Iuri Dolgoruki, and retired to Vladimir in Volhynia, whence he demanded help from his brother in-law, the King of Hungary, and the Kings of Poland and Bohemia. With these reinforcements he surprised Kief, and nearly made his uncle prisoner. Understanding that the national law was against him, he opposed eldest with eldest, and declared himself the partisan of another son of Monomakh, the old Viatcheslaf, Prince of Turof. He was proclaimed Grand Prince of Kief, adopted his nephew Isiaslaf as his heir, and during his reign, from eleven hundred and fifty to eleven hundred and fifty-four, gave splendid fêtes to the Russians and Hungarians. Iuri returned to the charge, and was beaten under the walls of Kief. Each of these princes had taken barbarians into his pay: Iuri, the Polovtsui; Isiaslaf, the Black Caps, that is, the Torki the Petchenegi, and the Berendians.

The obstinate Prince of Suzdal did not allow himself to be discouraged by this check. The old Viatcheslaf, who only desired peace and quiet, in vain addressed him letters, setting forth his rights as the eldest. "I had already a beard when you entered the world," he said. Iuri proved himself intractable, and went into Gallicia to effect a junction with his ally, Vladimirko, Prince of Galitch. This Vladimirko had violated the oath he had taken and confirmed by kissing the cross. When they reproached him, he said, with a sneer, "It was such a little cross!" To prevent this dangerous co-operation, Isiaslaf, without waiting the expected arrival of the Hungarians, began the pursuit of Iuri, and came up with him on the borders of the Rut, a small tributary of the Dnieper. A bloody battle was fought, where he himself was wounded and thrown from his horse, but the Suzdalians and their allies the Polovtsui were completely defeated in eleven hundred and fifty-one. Isiaslaf survived this victory only three years. After his death and that of Viatcheslaf, Kief passed from hand to hand. Iuri finally reached the supreme object of his desires. He made his entry into the capital in eleven hundred and fifty-five, and had the consolation of dying Grand Prince of Kief, at the moment that a league was being formed for his expulsion, in eleven hundred and fifty-seven. "I thank thee, great God," cried one of the confederates on learning the news, "for having spared us, by the sudden death of our enemy, the obligation of shedding his blood!" The confederates entered the town; one of them assumed the title of Grand Prince, the others divided his territories. Henceforth there existed no grand principality, properly speaking and with the growing power of Suzdal, Kief ceased to be the capital of Russia. A final disaster was still reserved for it.

In eleven hundred and sixty-nine Andrei Bogoliubski, son of Iuri Dolgoruki, and Prince of Suzdal, being disaffected to Mstislaf, Prince of Kief, formed against him a coalition of eleven princes. He confided to his son Mstislaf and his voïevod Boris an immense army of Rostovians, Vladimirians, and Suzdalians to march against Kief. This time the Russia of the forests triumphed over the Russia of the steppes, and after a three days' siege Kief was taken by assault. "This mother of Russian cities," says Karamsin, "had been many times besieged and oppressed. She had often opened her Golden Gate to her enemies, but none had ever yet entered by force. To their eternal shame, the victors forgot that they too were Russians! During three days not only the houses, but the monasteries, churches, and even the temples of Saint Sophia and the Tithe, were given over to pillage. The precious images, the priestly ornaments, the books, and the bells, all were taken away."

From this time the lot of the capital of Saint Vladimir, pillaged and dishonored by his descendants, ceases to have a general interest for Russia. Like other parts of Slavonia, it has its princes, but the heads of the reigning families of Smolensk, Tchernigof, and Galitch assume the once unique title of Grand Prince. The center of Russia is changed. It is now in the basin of the Volga, at Suzdal. Many causes conspired to render the disaster of eleven hundred and sixty-nine irremediable. The chronic civil wars of this part of Russia, and the multitudes and growing power of the nomad hordes, rendered the banks of the Dnieper uninhabitable. In twelve hundred and three Kief was again sacked by the Polovtsui, whom the Olgovitchi of Tchernigof had taken into their pay. On this soil, incessantly the prey of war and invasion, it was impossible to found a lasting order of things; it was impossible that a regular system of government should be established, —that civilization should develop and maintain itself. Less richly endowed by nature, and less civilized, the Russia of the forests was at least more tranquil. It was there that a grand principality was formed, called to fulfil high destinies, but which, unhappily, was to be separated for three hundred years, by the southern steppes and the nomads who dwelt there, from the Black Sea; that is, from Byzantine and Western civilization. See *Russian Republics.*

RUSSIAN REPUBLICS.—Novgorod has been, from the most remote antiquity, the political center of the Russia of the northwest. The origin of the Slavs of the Ilmen, who laid the foundations of it, is still uncertain. Some learned Russians, such as M. Kostomarof, suppose them to belong to the Slavs of the south, others to the Slavs of the Baltic; others, again, like M. Bielaef and M. Ilovaiski, make them a branch of the Krivitch or Smolensk Slavs. We find the Novgorodians, at the opening of Russian history, at the head of the confederation of tribes which first expelled and then recalled the Variagi to reign over Russia. Novgorod, from very ancient times, was divided into two parts, separated by the course of the Volkhof, which rises in Lake Ilmen and falls into the Ladoga. On the right bank was the side of St. Sophia, where Iaroslaf the Great built his celebrated cathedral; where the Novgorod kreml was situated, enclosing both the palaces of the Archbishop and the Prince; and where the famous Russian monument was consecrated in eighteen hundred and sixty-two. On the left bank is the side of commerce, with its Court of Iaroslaf; the bridge which joins the two halves of the city is celebrated in the annals of Novgorod. The side of Saint Sophia includes the Nerevsky or Nerevian quarter, as well as those of Zagorodni, or the suburbs, and of the potters. The side of commerce comprised the quarters of the carpenters and Slavs. Ancient documents also speak of a Prussian or Lithuanian quarter. Some of these names seem to indicate that many races have concurred, as in ancient Rome, to form the city of Novgorod. Gilbert of Lannoy, who visited the republic about fourteen hundred and thirteen, has left us this description of it: "Novgorod is a prodigiously large town, situated in a beautiful plain, in the midst of vast forests. The soil is low, subject to inundations, marshy in places. The town is surrounded by imperfect ramparts, formed of gabions; the towers are of stone." Portions of these ramparts still exist, and allow us to form an idea of the immense extent of the ancient city. The kreml forms its acropolis. The cathedral has preserved its frescoes of the twelfth century; the pillars painted with images of saints on a golden ground: the imposing figure of Christ on the cupola; the banner of the Virgin, which was to revive the courage of the besieged, on the ramparts; the tomb of St. Vladimir Iaroslavitch, of the Archbishop Nikita, by whose prayers a fire was extinguished, of Mstislaf the Brave, the devoted defender of Novgorod, and of many other saints and illustrious people. Without counting the tributary cities of Novgorod, such as Pskof, Ladoga, Izborsk, Veliki-Luki, Staraia-Rusa, or Old Russia, Torjok, Biejitchi, its primitive territory was divided into five counties, which included the land to the south of the lakes Ladoga and Onega. Its conquests formed five bailiwicks or cantons, occupying the whole of Northern Russia, and extending as far as Siberia. These bailiwicks were the Zavolotché, or the land lying beyond the canton, between the Onega and the Mezen: Russian Lapland: Permia, on the Upper Kama; Petchora, on the river of the same name: and Iugria, on the other side of the Ural Mountains To these we must add Ingria, Karelia, and part of Livonia and Esthonia.

Novgorod, which had summoned the Variag Princes, was too powerful, with one hundred thousand inhabitants and three hundred thousand subjects, to allow itself to be tyrannized over. An ancient tradition speaks vaguely of a revolt against Rurik the Old under the hero Vadim. Sviatoslaf, the conqueror of the Bulgaria of the Danube, undertook to govern it by mere agents, but Novgorod insisted on having one of his sons for its prince. "If you do not come to reign over us," said the citizens, "we shall know how to find ourselves other princes." Iaroslaf the Great, as a reward for their devotion, accorded them immense privileges, of which no record can be found, but which are constantly invoked by the Novgorodians, as were the true or false charters of Charles the Great by the German cities. These republicans could not exist without a prince, but they rarely kept one long. The assembly of the citizens, the *vetché*, convoked by the bell in the Court of Iaroslaf, was the real sovereign. The republic called itself "My Lord Novgorod the Great." "Who can equal God and the great Novgorod?" was a popular saying. From the distance of the city from the Russia of the Dnieper, and its position towards the Baltic and Western Europe, it took little part in the civil wars of which Kief was the object and the center. The Novgorodians profited by this in a certain sense; for, in the midst of the strifes of princes and of frequent changes in the grand principality, no sovereign was strong enough to give them a master. They could choose between princes of the rival families. It could impose conditions on him whom they chose to reign over them. If discontented with his management, they expelled the prince and his band of antrustions. According to the accustomed formula, "they made a reverence, and showed him the way" to leave Novgorod. Sometimes, to hinder his evil designs, they kept him prisoner in the Archbishop's palace, and it was left to his successor to set him at liberty. Often a revolution was accompanied by a general pillage of the partisans of the fallen prince, and they were even drowned in the Volkhof. A Grand Prince of Kief, Sviatopolk wished to force his son on them. "Send him here," said the Novgorodians, "if he has a spare head." The princes themselves contributed to the frequent changes of reign. They felt themselves only half-rulers in Novgorod, so they accepted any other appanage with joy. Thus, in eleven hundred and thirty-two, Vsevolod Gabriel abandoned Novgorod to reign at Pereiaslavl. When his hopes of Kief were crushed, and he wished to return to Novgorod, the citizens rejected him. "You forgot your oath to die with us, you have sought another principality; go were you will." Presently they thought better of it, and took him back. Four years afterwards he was again obliged to fly. In a great vetché, to which the citizens of Pskof and Ladoga were summoned, they solemnly condemned the exile, after reading the heads of very characteristic accusations: "He took no care of the poorer people; he desired to establish himself at Pereiaslavl; at the battle of Mount Idanof, against the men of Suzdal, he and his drujina were the first to leave the battle-field; he was fickle in the quarrels of the princes, sometimes uniting with the Prince of Tchernigof, sometimes with the opposite party."

The power of a Prince of Novgorod rested not only on his drujina, which always followed his fortunes, and on his family relations with this or that powerful principality, but also on a party formed for him in the heart of the republic. It was when the opposing party grew too strong that he was dethroned, and popular vengeance exercised on his adherents. Novgorod being above all a great commercial city, its divisions were frequently caused by diverging economic interests. Among the citizens, some were occupied in trade with the Volga and the East, others with the Dnieper and Greece. The former naturally sought the alliance of the Princes of Suzdal, masters of the great Oriental artery: the latter that of the Princes of Kief or Tchernigof, masters of the road to the south. Each of the two parties tried to establish a prince of the family whose protection they sought. If he fell, yet succeeded in escaping from the town, he would try to regain his throne by the arms of his family, or to install himself and his drujina either at Pskof, like Vsevolod-Gabriel, who became prince of that town, or at Torjok, like Iaroslaf of Suzdal, and thence he would blockade and starve the great city. The Prince of Suzdal was soon the most formidable neighbor of Novgorod. We have seen that Andrei Bogoliubski sent an army against it, then that his nephew Iaroslaf besieged his ancient subjects till Mstislaf the Bold freed them by the battle of Lipetsk in twelve hundred and sixteen. He was the son of Mstislaf the Brave, who had defended them against Vsevolod Big-Nest, and against Suzdal and the Tchudi. The remains of "the Brave" rest at Saint Sophia, in a bronze sarcophagus. His son, "the Bold," was of far too restless a nature to die also at Novgorod. He reduced the principality to order, and then assembled the citizens in the court of Iaroslaf and said to them, "I salute Saint Sophia, the tomb of my father, and you, Novgorodians. I am going to reconquer Galitch from the strangers, but I shall never forget you. I hope I may lie by the tomb of my father, in Saint Sophia." The Novgorodians in vain entreated him to stay. This was in twelve hundred and eighteen. We have seen him use his last armies in the troubles of the southeast, and die Prince of Galitch.

After his departure the republic summoned his nephew, Sviatoslaf to the throne; but he could not come to terms with the magistrates and a populace equally turbulent. The posadnik, Tverdislaf, caused one of the boyars of Novgorod to be arrested. This was the signal for a general rising; some took the part of the boyar, others that of the posadnik. During eight days the bell of the kreml sounded. Finally both factions buckled on their cuirasses and drew their swords. Tverdislaf raised his eyes to Saint Sophia, and cried, "I shall fall first in the battle, or God will justify me by giving the victory to my brothers." Ten men only perished in this skirmish, and then peace was re-established. The prince, who accused Tverdislaf of being the cause of the trouble, demanded that he should be deposed. The vetché inquired what crime he had committed. "None," replied the prince, "but it is my will." "I am satisfied," exclamed the posadnik, "as they do not accuse me of any fault; as to you, my brothers, you can dispose alike of posadniki and princes." The assembly then gave their decision. "Prince, as you do not accuse the posadnik of any fault, remember that you have sworn to depose no magistrate without trial. He will remain our posadnik, we will not deliver him to you." On this Sviatoslaf quitted Novgorod, in twelve hundred and nineteen. He was replaced by Vsevolod, one of his brothers, who was expelled two years later. The Suzdalian party having made some progress, they recalled the same Iaroslaf who was beaten at Lipetsk, but the Princes of Suzdal were too absolute in their ideas to be able to agree with the Novgorodians. Iaroslaf was again put to flight, and replaced by Vsevolod of Smolensk, who was expelled in his turn. The Grand Prince of Suzdal now interposed, levied a contribution on Novgorod, and a prince of Tchernigof was imposed on them, who hastened in twelve hundred and twenty-five to return to the south of Russia. In seven years the Novgorodians had five times changed their rulers. Iaroslaf himself came back for a third and even a fourth time. A famine so much reduced the Novgorodians that forty-two thousand corpses were buried in two cemeteries alone. These proud citizens implored strangers to take them as slaves for the price of a morsel of bread. The same year a fire destroyed the whole of one quarter of Novgorod. The calamities subdued their turbulence. Iaroslaf succeeded in governing them despotically till he was called to fill the throne of the Grand Prince in twelve hundred and thirty-six. He left them, as their prince, his son, Alexander Nevski.

From the fact that no dynasty of princes could establish itself at Novgorod, that no princely band could take a place among the native aristocracy, it follows that the republic kept its ancient liberties and customs intact under the short reigns of its rulers. In all Russian cities, it is true, the country existed side by side with the Prince and boyars, the assembly of citizens side by side with the Prince's men, and the native militia side by side with the foreign drujina; but at Novgorod the country, the veteché, and the municipal militia had retained more vigor than elsewhere. The town was more powerful than the Prince, who reigned by virtue of a constitution, traces of which may be observed, no doubt, in other regions of Russia, but which is found in its original form at Novgorod alone. Each new monarch was compelled to take an oath, by which he bound himself to observe the laws and privileges of Iaroslaf the Great. This constitution, like the *pacta conventa* of Poland, signified distrust, and was intended to limit the power of the Prince and his men. The revenues to which he had a right, and which formed his civil list, were carefully limited, as also were his judicial and political functions. He levied tribute on certain cantons, and was entitled to the commutation for crimes as well as to certain fines. In some bailiwicks he had his lieutenant, and Novgorod had its own. He could not execute justice without help of the posadnik, nor reverse any judgment; nor, above all, take the suit beyond Novgorod. This was what the Novgorodians feared most, and with reason. The day when the people of Novgorod bethought themselves of appealing to the tribunal of the Grand Prince of Moscow was fatal to the independence of the republic. In the conflicts between the men of the prince and those of the city, a mixed court delivered judgment. The Prince, no more than his men, could acquire villages in the territory of Novgorod, nor create colonies. He was forbidden to hunt in the woods of Staraïa Rusa except in the autumn, and had to reap his harvests at a specified season. Though they thus mistrusted their Prince, the Novgorodians had need of him to moderate the ancient Slav anarchy. As in the days of Rurik, "family armed itself against family, and there was no justice." In Novgorod the veteché had more extensive powers, and acted more regularly than in the other Russian cities. It was the veteche which nominated and expelled princes, imprisoned them in the archiepiscopal palace, and formally accused them; elected and deposed the Archbishops, decided peace and war, judged the State criminals. According to the old Slav custom, preserved in Poland till the fall of the republic, the decisions were always made, not by a majority, but by unanimity of voices. It was a kind of *liberum veto*. The majority had the resource of drowning the minority in the Volkhof. The Prince as well as the posadnik, the boyars as well as the people, had the right of convoking the veteché. It met sometimes in the Court of Iaroslaf, sometimes in Saint Sophia's. As Poland had its confederations, its "diets under the shield," Novgorod occasionally saw on the banks of the Volkhof two rival and hostile assemblies, which often came to blows on the bridge. Before being submitted to the general assembly, the questions were sometimes deliberated in a smaller council, composed of notable citizens, of acting or past magistrates.

The chief Novgorodian magistrates were, first, the posadnik, called by contemporary German writers the burgomaster, who was changed nearly as often as the Prince. The posadnik was chosen from some of the influential families, one of which alone gave a dozen posadniki to Novgorod. The first magistrate was charged to defend civic privileges, and shared with the Prince the judicial power and the right of distributing the taxes. He governed the city, commanded its army, directed its diplomacy, sealed the acts with its seal. The second officer was the *tuisatski*, who was a military chief, a Colonel who had the Captains of the town militia under his orders. He had a special tribunal, and seems to have been specially intrusted with the defence of the rights of the people, thus recalling the Roman Tribunes. And besides the Captains there was a *starosta*, a sort of district Mayor, for each quarter of the town.

The chief document of the Novgorodian law is the *Letter of Justice*, of which the definite publication may be placed at fourteen hundred and seventy-one. It contains the same principles as the Code of Iaroslaf the Great. As in all the early Germanic and Scandinavian laws, we find the right of private revenge, the fixed price of blood, the "boot," or fine for injury inflicted, the oath admitted as evidence, the judgment of God, the judicial duel, which was still resorted to by Novgorod even after its decadence, in the sixteenth century. We also find records of corporal punishments. The thief was to be branded; on the second relapse into crime, he was to be hung. Territorial property acquires a greater importance, and, a sure evidence of Muscovite influence, a second court of appeal is admitted, —the appeal to the tribunal of the Grand Prince.

From a social point of view, the constitution of Novgorod presents other analogies with the constitution of Poland. Great inequality then existed between the different classes of society. An aristocracy of boyars had ultimately formed itself, whose internal quarrels agitated the town. Below the boyars came the *dieti boyarskié*, a kind of inferior nobility; then the different classes of citizens, the merchantmen, the *black people*, and the peasants. The merchants formed an association of their own, a sort of guild, round the Church of Saint John. Military societies also existed, bands of independent adventurers or followers of some boyar who, impelled by hunger or a restless spirit, sought adventures afar on the great rivers of Northern Russia, pillaging alike friends and enemies, or establishing military colonies in the midst of Tchud or Finnish tribes.

The soil of Novgorod was sandy, marshy, and unproductive: hence the famines and pestilences that so often depopulated the country. Novgorod was forced to extend itself in order to live; it became therefore a commercial and colonizing city. In the tenth century Konstantin relates how the Slavs left Nemogard, or Novgorod, descended the Dnieper by Milinisca, or Smolensk, Teliutza, or Lubetch, Tchernigof, Vuishegorod, Kief, and Vititchevo; crossed the Cataracts of the Dnieper, passed the naval stations of Saint Gregory and Saint Etherius, at the mouth of the river, and spread themselves over all the shores of the Greek Empire. The Oriental coins and jewels found in the barrows of the Ilmen show that the Novgorodians had an early and extensive commerce with the East. We see them exchange iron and weapons for the precious metals found by the Iugrians in the mines of the Urals. They traded with the Baltic Slavs; and when the latter lost their independence, and a flourishing center, Wisby, was formed in the Isle of Gothland, Novgorod turned to this side also. In the twelfth century there was a Gothic market and a Variag Church at Novgorod, and a Novgorodian Church in Gothland. When the Germans began to dispute the commerce of the Baltic with the Scandinavians, Novgorod became the seat of a German market, which finally absorbed the Gothic one. When the Hanse League became the mistress of the North, we find the Germans established not only at Novgorod, but at Pskof and Ladoga, at all the outlets of the network of Novgorodian lakes. There they obtained considerable privileges, even the right to acquire pasture-land. They were masters, and at home in their fortified markets, in their stockade of thick planks, where no Russian had the right to penetrate without their leave. This German trading company was governed by the most narrow and exclusive ideas. No Russian was allowed to belong to the company, nor to carry the wares of a German, an Englishman, a Walloon, or a Fleming. The company authorized a wholesale commerce only, and, to maintain its goods at a high price, it forbade imports beyond a certain amount. "In a word," says a German writer, Riesenkampf, in "Der Deutsche Hof," "during three centuries the Hanse League held a monopoly of all the external commerce of Northern Russia. If we inquire what profit or loss it brought this country, we must recognize that, thanks to it, Novgorod and Pskof were deprived of a free commerce with the West. Russia, in order to satisfy the first wants of civilization, fell into a state of complete independence. It was abandoned to the good pleasure and pitiless egotism of the German merchants."

The ecclesiastical constitution of Novgorod presents a special character. In the rest of Russia the clergy was Russian orthodox. At Novgorod it was Novgorodian before everything. It was only in the twelfth century that the Slavs of Ilmen, who had been the last to be converted, could have an Archbishop that was neither Greek nor Kievan, but of their own race. From that time the Archbishop was elected by the citizens, by the vetché. Without waiting to be invested by the metropolitan bishop at Kief, he was at once installed in his episcopal palace. He was one of the great personages, the first dignitary of the republic. In public acts his name was placed before the others. "With the blessing of Archbishop Moses," says one letter-patent, "posadnik Daniel and tuisatski Abraham salute you." He had a superiority over the Prince on the ground of being a native of the country, whilst the descendant of Rurik was a foreigner. In return, the revenues of the Archbishop, the treasures of Saint Sophia, were at the service of the republic. In the fourteenth century we find an Archbishop building at his own expense a kreml of stone. In the fifteenth century the riches of the cathedral were employed to ransom the Russian prisoners captured by the Lithuanians. The Church of Novgorod was essentially a national church; the ecclesiastics took part in the temporal affairs, the laity in the spiritual. In the fourteenth century the vetché put to death the heretical *strigolniki*, proscribed ancient superstitions, and burnt the sorcerers. As the citizens of Novgorod nominated their Archbishop, they could also depose him. The orthodox religion extended with the Novgorod colonization among the Finnish tribes. In opposition to the Finns, the interests of the Church and the republic were identical. It was religion that contributed to the splendor of the city, and that specially profited by its wealth. Novgorod was full of churches and monasteries, founded by the piety of private individuals. Novgorod, which had shaken off the political supremacy of Kief, wished also to free itself from its religious domination, and no longer to be obliged to seek on the Dnieper the investiture of its Archbishop, but to make him an independent metropolitan. It failed. When Moscow became of importance, she threatened not only the political, but the religious supremacy of Novgorod. Religion was, in the hands of the Muscovite Princes, an instrument of government. The Novgorodian prelate always made common cause with his fellow-citizens, and endured with them their master's bursts of anger.

The literature of Novgorod was as national as the Church herself. The pious chronicles of the Novgorodian convents shared all the quarrels and all the passions of their fellow-citizens. "Even their style," says M. Bestujef, "reflects vividly the active, business-like character of the Novgorodians. It is short, and sparing of words; but their narratives embrace more completely than those of other Russian countries all the phases of actual life. They are the historians, not merely of the princes, and boyars, but of the whole city. The lives of the saints are the lives of Novgorodian saints; the miracles they relate are to the glory of the city. They tell for example, that Christ appeared to the artist charged with the paintings under the dome of Saint Sophia, and said to him: 'Do not represent me with my hand extended for blessing, but with my hand closed, because in it I hold Novgorod, and when it is opened it will be the end of the city.'" The tale of the panic excited among the soldiers of Andrei Bogoliubski by the image of the Virgin wounded by a Suzdalian arrow was spread abroad. Novgorod has its own cycle of epic songs. Its heroes are not those of the Kievan poems. There is Vasili Buslaévitch; the bold boyar, who with his faithful drujina stood up to his knees in blood on the bridge of Volkhof, holding in check all the muzhiki of Novgorod, whom he had defied to combat. Vasili Buslaévitch is the true type of these proud adventurers, who knew neither friend nor enemy,—a true Novgorodian oligarch, a hero of civil war. Still more popular was Sadko, the rich merchant, a kind of Novgorodian Sindbad or Ulysses, a worthy representative of a people of merchants and adventurers, who sought his fortune on the waves. A tempest rose, and men drew lots to decide who should be sacrificed to the wrath of the gods. Sadko threw a little wooden ring into the water, the others flung in iron rings: O prodigy! the others swam, his sank. He obeyed his destiny, and threw himself into the waves, but he was received in the palace of the king of the sea, who tested him in various ways and wished him to marry his daughter. Then suddenly Sadko found himself on the shore with great treasures, but what were these compared to the treasures of the city? "They see that I am a rich merchant of Novgorod, but Novgorod is still richer than I."

Of all the towns subject to Novgorod, Pskof was the most important. On the point formed by the junction of the Pskova and the Velikaía rises its kreml, with its crumbling ramparts, its ruined gates and towers. These once famous walls are to-day a mass of ruins, and the street-boys amuse themselves by throwing stones in the Pskova to frighten the laundresses. Pskof is only a poor little place with ten thousand souls. Scarcely anything remains of its past splendor save the Cathedral of the Trinity at one end of the kreml. There rest in metal coffins the bones of the best-loved princes, Vsevolod-Gabriel and Dovmont, a converted Lithuanian who came in the thirteenth century to defend the republic against his own compatriots. The old town still has many churches and monasteries; the distant view of it is beautiful, and on fête days the dead city seems to awake at the chimes of its innumerable bells, which ring as merrily as in the days of its glorious past. Nestor makes Pskof the native land of Saint Olga. Its whole history is summed up in those two facts: first, the struggle against the Tchudi, and, later, against the Germans of Livonia; second, its efforts to become free from Novgorod. The independence of the city was ultimately secured by its wealth and commerce. The first Prince who ruled it as a separate State, Vsevolod-Gabriel, was expelled by his subjects, and therefore was welcomed with the greater eagerness by the Pskovians. When the Suzdalian party ruled at Novgorod, it was generally the contrary party that triumphed in Pskof. About twelve hundred and fourteen the little republic contracted an offensive and defensive alliance with the Germans; Pskof undertook to help them against the Lithuanians, and they were to support Pskof against Novgorod. This was playing rather a dangerous game. In twelve hundred and forty, one Tverdillo delivered the city up to the Livonians, and it was not set free till twelve hundred and forty-two. From this moment Pskof ceased to mix in the civil wars of Novgorod. It had enough to do with its own affairs and its struggle against the Germans, Swedes and Lithuanians. It also claimed the title "My Lord Pskof the Great;" but it was only in thirteen hundred and forty-eight that the Novgorodians, needing its help against Magnus, King of Sweden, formally recognized its independence, by the treaty of Bolstof, and concluded a bond of fraternal friendship. Novgorod became the elder brother, and Pskof the younger. The organization of Pskof is almost that of its ancient metropolis. We again find the Prince, the Vetché, the division into quarters, up to the number of six, each one having its Mayor.

In the twelfth century a new Novgorodian colony was founded between the Kama and the Viatka, which remained a republic until the fifteenth century. "This distant country," says M. Bestujef-Riumin, "is still quite Novgorodian. When the traveller has passed the Viatka, he meets with a peculiar mode of constructing the huts. There are no longer whole lines of hovels joined one to the other, as on this side of the river, but there is a high house, where the court, rooms, and offices are surrounded by a rampart of pales, and united under the same roof: in a word, it is a Novgorodian house. You hear the Novgorodian dialect; you see the Novgorodian cap. It is the Novgorod colonization still living." In eleven hundred and seventy-four some adventurers from the Great Republic came from the Kama to the Viatka, and advanced from east to west, and founded a colony on this river, which is to-day the village of Nikulitsuin. Another band defeated the Tcheremisa, and on their territory raised Koshkarof, at present called Kotelnitch. Then the two bands reunited, and penetrated into the Votiak country. On the right bank of the Viatka, on the summit of a high mountain, they perceived a city surrounded by a rampart and a ditch, which contained one of the sanctuaries of the people. As pious as the companions of Cortez and Pizarro, the Russian adventurers prepared themselves for the assault by a fast of several days, then invoked Saints Boris and Gleb, and captured the town. Next, at the mouth of the Khluinovitsa, in the Viatka, not very far off, they built the city of Khluinof, which became, under the name of Viatka, the capital of all the colonies. It had no walls, but the houses, built close together, formed an unbroken rampart against the enemy, a wall and defence. At the news of this success, other colonists flocked from Novgorod and the forests of the north, and founded other centers of population. These bold pioneers had more than once to reunite, sometimes against the aboriginal Finns or the Tatar invaders, sometimes against the pretensions of Novgorod, or the Grand Prince of Moscow. We find among them, as in the metropolis, boyars, merchants and citizens. They had voievodui or atamans for their military chiefs. Their spirit of religious independence equalled their political independence. Jonas, Metropolitan of Moscow, writes angrily about the indocility of their clergy, and avenges himself by blaming their morals. "Your spiritual sons," he writes to the priests of Viatka, "live contrary to the law. They have five, six, or even seven wives. And you dare to bless these marriages."

In this connection, we will briefly review the battles of the Kalka, of Riazan, of Kolomna, and of the Sit, and the influence of the Tatars on Russian development. Up to this time the history of Russia has presented some analogy with that of the West. Slavonia, like Gaul, had received Roman civilization and Christianity from the South. The Northmen had brought it an organization which recalls that of the Germans; and it had enjoyed a certain semblance of unity under Iaroslaf, like the West under Charles the Great, while it was afterwards dismembered and divided like France in feudal times. But in the thirteenth century Russia suffered an unprecedented misfortune; it was invaded and subjugated by Asiatic hordes. This fatal event contributed quite as much as the disadvantage of the soil and the climate to retard its development by many centuries. "Nature," as M. Soloviof says, "has been a step-mother to Russia"; fate was another step-mother.

"In those times," say the Russian chroniclers, "there came upon us for our sins, unknown nations. No one could tell their origin, whence they came, what religion they professed. God alone knew why they were, God and perhaps wise men learned in books." When we think of the horror of the whole of Europe at the arrival of the Mongols, and the anguish of a Frederick, of a Saint Louis, an Innocent the Fourth, we may imagine the terror of the Russians. They bore the first shock of those mysterious foemen, who were, so the people whispered, Gog and Magog, who, according to Joinville, "were to come at the end of the world, when Antichrist is to destroy everything." The Ta-ta, or Tatars, seem to have been a tribe of the great Mongol race, living at the foot of the Altai, who in spite of their long-continued discords frequently found means to lay waste China by their invasions. The portrait drawn of them recalls in many ways those already traced by Chinese, Latin, and Greek authors, of the Huns, the Avars, and other nomad peoples of former invasions. "The Ta-tzis, or the Das," says a Chinese writer of the thirteenth century, "occupy themselves exclusively with their flocks; they go wandering ceaselessly from pasture to pasture, from river to river. They are ignorant of the nature of a town or a wall. They are unacquainted with writing and books: their treaties are concluded orally. From infancy they are accustomed to ride, to aim their arrows at rats and birds, and thus acquire the courage essential to their life of wars and rapine. They have neither religious ceremonies nor judicial institutions. From the Prince to the lowest among the people all feed upon the flesh of the animals the skins of which they use for clothing. The strongest among them have the largest and fattest morsels at feasts; the old men are put off with the fragments that are left. They respect nothing but strength and bravery; age and weakness they despise. When the father dies, the son marries his youngest wives." A Mussulman writer adds, that they adore the sun, and practise polygamy and the community of wives. This pastoral people did not take an interest in any phenomenon of nature except the growth of grass. The names they gave to their months were suggested by the different aspects of the prairie. Born horsemen, they had no infantry in war. They were ignorant of the art of sieges. "But," says a Chinese author, "when they wish to take a town, they fall on the suburban villages. Each leader seizes ten men, and every prisoner is forced to carry a certain quantity of wood, stones, and other materials. The use these for filling up fosses, or digging trenches. In the capture of a town the loss of ten thousand men was thought nothing. No place could resist them. After a siege all the population was massacred, without distinction of old or young, rich or poor, beautiful or ugly, those who resisted or those who yielded; no distinguished person escaped death, if a defence was attempted." It was these rough tribes that Temutchin, or Genghis Khan, who ruled from eleven hundred and fifty-four until twelve hundred and twenty-seven, succeeded in uniting into one nation after forty years of obscure struggles. Then in a general congress of their princes he proclaimed himself Emperor, and declared that, as there was only one sun in heaven, there ought to be only one Emperor on the earth. At the head of their forces he conquered Mantchuria, the kingdom of Tangut, Northern China, Turkestan, and Great Bokhara, which never recovered from this disaster, and the plains of Western Asia as far as the Crimea. When he died, he left to be divided between his four sons the largest empire that ever existed. It was during his conquest of Bokhara that his Lieutenant Tchep and Subudaï-bagadur subdued in their passage a multitude of Turkish peoples, passed the Caspian by its southern shore, invaded Georgia and the Caucasus, and in the southern steppes of Russia came in contact with the Polovtsui.

The hereditary enemies of the Russians proper, the Polovtsui, asked the Christian Princes for help against these Mongols and Turks, who were their brothers by a common origin. "They have taken our country," said they to the descendants of Saint Vladimir; "to-morrow they will take yours." Mstislaf the Bold, then Prince of Galitch, persuaded all the dynasties of Southern Russia to take up arms against the Tatars; his nephew Daniel, Prince of Volhynia, Mstislaf Romanovitch, Grand Prince of Kief, Oleg of Kursk, Mstislaf of Tchernigof, Vladimir of Smolensk, Vsevolod, for a short time Prince of Novgorod, responded to his appeal. To cement his alliance with the Russians, Basti, khan of the Polovtsui, embraced orthodoxy. The Russian army had already arrived on the Lower Dnieper, when the Tatar ambassadors made their appearance. "We have come by God's command against our slaves and grooms, the accursed Polovtsui. Be at peace with us; we have no quarrel with you." The Russians with the promptitude and thoughtlessness that characterized the men of that time, put the ambassadors to death. They then went farther into the steppe, and encountered the Asiatic hordes on the Kalka, a small river running into the Sea of Azof. The Russian chivalry on this memorable day showed the same disorder and the same ill-advised eagerness as the French chivalry at the opening of the English wars. Mstislaf the Bold, Daniel of Galitch, and Oleg of Kursk were the first to rush into the midst of the infidels, without waiting for the Princes of Kief, and even without giving them warning, in order to gain for themselves the honors of victory. In the middle of the combat the Polovtsui were seized with a panic and fell back on the Russian ranks, thus throwing them into disorder. The rout became general, and the leaders spurred on their steeds in hopes of reaching the Dnieper.

Six princes and seventy of the chief boyars, or voievodui, remained on the field of battle. It was the Crecy and Poitiers of the Russian chivalry. Hardly a tenth of the army escaped; the Kievans alone left ten thousand dead. The Grand Prince of Kief, however, Mstislaf Romanovitch, still occupied a fortified camp on the banks of the Kalka. Abandoned by the rest of the army, he tried to defend himself. The Tatars offered to make terms; he might retire on payment of a ransom for himself and his drujina. He capitulated, and the conditions were broken. His guard was massacred, and he and his two sons-in-law were stifled under planks. The Tatars held their festivals over the inanimate bodies in twelve hundred and twenty-four. After this thunderbolt, which struck terror into the whole of Russia, the Tatars paused and returned to the East. Nothing more was heard of them. Thirteen years passed, during which the princes reverted to their perpetual discords. Those in the northeast had given no help to the Russians of the Dnieper; perhaps the Grand Prince, Iuri the Second of Suzdal, may have rejoiced over the humiliation of the Kievans and Gallicians. The Mongols were forgotten; the chronicles, however, are filled with fatal presages in the midst of scarcity, famine and pestilence, of incendiaries in the towns and calamities of all sorts, they remark on the comet of twelve hundred and twenty-four, the earthquake and eclipse of the sun of twelve hundred and thirty.

The Tatars were busy finishing the conquest of China, but presently one of the sons of Genghis, Ugudei or Oktai, sent his nephew Batui to the West. As the reflux of the Polovtsui had announced the invasion of twelve hundred and twenty-four, that of the Saxin nomads, a tribe akin to the Khirghiz, who took refuge on the lands of the Bulgarians of the Volga, warned men of a new irruption of the Tatars, and indicated its direction. It was no longer South Russia, but Suzdalian Russia that was threatened. In twelve hundred and thirty-seven Batui conquered the Great City, capital of the half-civilized Bulgarui, who were, like the Polovtsui, ancient enemies of Russia, and who were to be included in its ruin. Bolgary was given up to the flames, and its inhabitants were put to the sword. The Tatars next plunged into the deep forests of the Volga, and sent a sorcerer and two officers as envoys to the Princes of Riazan. The three princes of Riazan, those of Pronsk, Kolomna, Moscow, and Murom advanced to meet them. "If you want peace," said the Tatars, "give us the tenth of your goods." "When we are dead," replied the Russian Princes, "you can have the whole." Though abandoned by the princes of Tchernigof and the Grand Prince Iuri the Second, of whom they had implored help, the dynasty of Riazan accepted the unequal struggle. They were completely crushed; nearly all their princes remained on the field of battle. Legend has embellished their fate. It is told how Feodor preferred to die rather than see his young wife, Euphrasia, the spoil of Batui, and how, on learning his fate, she threw herself and her son from the window of her chamber. Oleg the Handsome, found still alive on the battle-field, repelled the caresses, the attention, and religion of the khan, and was cut in pieces. Riazan was immediately taken by assault, sacked, and burned. All the towns of the principality suffered the same fate. It was now the turn of the Grand Prince, for the Russia of the northeast had not even the honor of falling in a great battle like the Russia of the southwest, united for once against the common enemy. The Suzdalian army, commanded by a son of Iuri the Second, was beaten on the day of Kolomna, on the Oka. The Tatars burned Moscow, then besieged Vladimir on the Kliazma, which Iuri the Second had abandoned to seek for help in the North. His two sons were charged with the defence of the capital. Princes and boyars, feeling there was no alternative but death or servitude, prepared to die. The princesses and all the nobles prayed Bishop Metrophanes to give them the tonsure; and when the Tatars rushed into the town by all its gates, the vanquished retired into the cathedral, where they perished, men and women, in a general conflagration. Suzdal, Rostof, Iaroslavl, fourteen towns, a multitude of villages in the Grand Principality, were all given over to the flames in twelve hundred and thirty-eight. The Tatars then went to seek the Grand Prince, who was encamped on the Sit, almost on the frontier of the possessions of Novgorod. Iuri the Second could neither avenge his people nor his family. After the battle the Bishop of Rostof found his headless corpse. His nephew Vasilko, who was taken prisoner, was stabbed for refusing to serve Batui. The immense Tatar army, after having sacked Tver, took Torjok; there "the Russian heads fell beneath the sword of the Tatars as grass beneath the scythe." The territory of Novgorod was invaded; the great republic trembled, but the deep forests and the swollen rivers delayed Batui. The invading flood reached the Cross of Ignatius, about fifty miles from Novgorod, then returned to the Southeast. On the way the small town of Kozelsk, near Kaluga, checked the Tatars for so long and inflicted on them so much loss, that it was called by them the wicked town. Its population was exterminated, and the prince, Vasili, still a child, was "drowned in blood."

The two following years were spent by the Tatars in ravaging Southern Europe. They burnt Pereiaslaf, and Tchernigof, defended with desperation by its princes. Next Mangu, grandson of Genghis Khan, marched against the famous town of Kief, whose name resounded through the east and in the books of the Arab writers. From the left bank of the Dnieper the barbarian admired the great city on the heights of the right bank, towering over the wide river with its white walls and towers adorned by Byzantine artists, and innumerable churches with cupolas of gold and silver. Mangu offered the Kievans terms of surrender; the fate of Riazan, of Tchernigof, of Vladimir, the capitals of powerful states, announced to them the lot that awaited them in case of refusal, yet the Kievans dared to massacre the envoys of the khan. Mikhail, their Grand Prince, fled; his rival, Daniel of Galitch, did not care to remain. On hearing the report of Mangu, Batui came to assault Kief with the bulk of his army. The grinding of the wooden chariots, the bellowings of the buffaloes, the cries of the camels, the neighing of the horses, the howlings of the Tatars, rendered it impossible, says the annalist, to hear your own voice in the town. The Tatars assailed the Polish Gate, and knocked down the walls with a battering-ram. "The Kievans, supported by the brave Dmitri, a Gallician boyar, defended the fallen ramparts till the end of the day, then retreated to the Church of the Tithe, which they surrounded by a palisade. The last defenders of Kief found themselves grouped around the tomb of Iaroslaf. Next day they perished. The khan gave the boyar his life, but 'the Mother of Russian cities' was sacked. This third pillage, which took place in twelve hundred and forty, was the most terrible. Even the tombs were not respected. All that remains of the Church of the Tithe is a few fragments of mosaic in the Museum at Kief. Saint Sophia and the Monastery of the Catacombs were delivered up to be plundered." Volhynia and Gallicia still remained, but their princes could not defend them, and Russia found itself, with the exception of Novgorod and the northwest country, under the Tatar yoke. The princes had fled or were dead; hundreds of thousands of Russians were dragged into captivity. Men saw the wives of boyars, "who had never known work, who a short time ago had been clothed in rich garments, adorned with jewels and collars of gold, surrounded with slaves, now reduced to be the slaves of barbarians and their wives, turning the wheel of the mill, and preparing their coarse food."

If we look for the causes which rendered the defeat of the brave Russian nation so complete, we may, with Karamsin, indicate the following:— Though the Tatars were not more advanced, from a military point of view, than the Russians, who had made war in Greece and in the West against the most warlike and civilized people of Europe, yet they had an enormous superiority of numbers. Batui probably had with him five hundred thousand warriors. This immense army moved like one man; it could successively annihilate the small armies of the princes, or the militia of the towns, which presented themselves one at a time to its blows. The Tatars had found Russia divided against itself. Even though Russia had wished to form a confederation, the sudden irruption of an army entirely composed of horsemen did not leave it time. In the tribes ruled by Batui every man was a soldier; in Russia the nobles and citizens alone bore arms; the peasants, who formed the bulk of the population, allowed themselves to be stabbed or bound without resistance. It was not by a weak nation that Russia was conquered. The Tatar-Mongols, under Genghis Khan, had filled the East with the glory of their name, and subdued nearly all Asia. They arrived, proud of their exploits, animated by the recollection of a hundred victories, and reinforced by the numerous peoples they had vanquished, and hurried with them to the West. When the Princes of Galitch, of Volhynia, and of Kief arrived as fugitives in Poland and Hungary, Europe was terror-stricken. The Pope, whose support had been claimed by the Prince of Galitch, summoned Christendom to arms. Louis the Ninth prepared for a crusade. Frederick the Second, as Emperor, wrote to the sovereigns of the West: "This is the moment to open the eyes of body and soul, now that the brave princes on whom we reckoned are dead or in slavery." The Tatars invaded Hungary, gave battle to the Poles in Liegnitz in Silesia, had their progress a long while arrested by the courageous defense of Olmutz in Moravia, by the Tchek voievod, Iaroslaf, and stopped finally, learning that a large army, commanded by the King of Bohemia and the Dukes of Austria and Karinthia, was approaching. The news of the death of Oktai, second Emperor of all the Tatars, in China, recalled Batui from the West, and during the long march from Germany his army necessarily diminished in number. The Tatars were no longer in the vast plains of Asia and Eastern Europe, but in a broken hilly country, bristling with fortresses, defended by a population more dense and a chivalry more numerous than those of Russia. To sum up, all the fury of the Mongol tempest spent itself on the Slavonic race. It was the Russians who fought at the Kalka, at Kolomna, at the Sit; the Poles and Silesians at Liegnitz; the Bohemians and Moravians at Olmutz. The Germans suffered nothing from the invasion of the Mongols but the fear of it. It exhausted itself principally on those plains of Russia which seem a continuation of the steppes of Asia. Only in Russian history did the invasion produce great results. About the same time Batui built on one of the arms of the Lower Volga a city called Sarai, or the Castle, which became the capital of a powerful Tatar Empire, the Golden Horde, extending from the Ural and Caspian to the mouth of the Danube. The Golden Horde was formed not only of Tatar-Mongols, or Nogais, who even now survive in the Northern Crimea, but particularly of the remains of ancient nomads, such as the Petchenegi and Polovtsui, whose descendants seem to be the present Kalmucks and Bashkirs; of Turkish tribes tending to be sedentary, like the Tatars of Astrakhan in the present day; and of the Finnish populations already established in the country, and which mixed with the invaders. Oktai, Kuiuk, and Mangu, the first three successors of Genghis Khan, elected by all the Mongol Princes, took the title of Great Khans, and the Golden Horde recognized their authority; but under his fourth successor, Khubulai, who usurped the throne and established himself in China, this bond of vassalage was broken. The Golden Horde became an independent state in twelve hundred and sixty. United and powerful under the terrible Batui, who died in twelve hundred and fifty-five, it fell to pieces under his successors; but in the fourteenth century the Khan Uzbek reunited it anew, and gave the Horde a second period of prosperity. The Tatars, who were pagans when they entered Russia, embraced the faith of Islam about twelve hundred and seventy-two, and became its most formidable apostles.

Iaroslaf, after his defeat at Lipetsk, entered Suzdal on the tragic death of his brother, the Grand

Prince Iuri the Second, in twelve hundred and thirty-eight, and found his inheritance in the most deplorable condition. The towns and villages were burnt, the country and roads covered with unburied corpses; the survivors were hiding in the woods. He recalled the fugitives and began to rebuild. Batui, who had completed the devastation of South Russia, summoned Iaroslaf to do him homage at Sarai, on the Volga. Iaroslaf was received there with distinction. Batui confirmed his title of Grand Prince, but invited him to go in person to the Great Khan, supreme chief of the Mongol nation, who lived on the banks of the river Sakhalian, or Amur. To do this was to cross the whole of Russia and Asia. Iaroslaf bent his knees to the new master of the world, Oktai, succeeded in refuting the accusations brought against him by a Russian boyar, and obtained a new confirmation of his title. On his return, in twelve hundred and forty-six, he died in the desert of exhaustion, and his faithful servants brought his body back to Vladimir. His son Andrei succeeded him at Suzdal, and ruled until twelve hundred and fifty-two. His other son, Alexander, reigned at Novgorod the Great. Alexander was as brave as he was intelligent. He was the hero of the North, and yet he forced himself to accept the necessary humiliations of his terrible situation. In his youth we see him fighting with all the enemies of Novgorod, Livonian knights and Tchudi, Swedes and Finns. The Novgorodians found themselves at issue with the Scandinavians on the subject of their possessions on the Neva and the Gulf of Finland. As they had helped the natives to resist the Latin faith, King John obtained the promise of Gregory the Ninth that a crusade, with plenary indulgences, should be preached against the Great Republic and its protégés, the pagans of the Baltic. His son-in-law, Birger, with an army of Scandinavians, Finns, and Western Crusaders, took the command of the forces, and sent word to the Prince of Novgorod, "Defend yourself, if you can: and know that I am already in your provinces." The Russians on their side, feeling that they were fighting for orthodoxy, opposed the Latin crusade with a Greek one. Alexander humbled himself in Saint Sophia, received the benediction of the Archbishop Spiridion, and addressed an energetic harangue to his warriors. He had no time to await reinforcements from Suzdal. He attacked the Swedish camp, which was situated on the Ijora, one of the southern affluents of the Neva, which had given its name to Ingria. Alexander won a brilliant victory, which gained him his surname of Nevski, and the honor of becoming one of the patrons of Saint Petersburg under Peter the Great, the second conqueror of the Swedes. By the orders of his great successor, his bones repose in the Monastery of Alexander Nevski. The battle of the Neva was preserved in a dramatic legend. An Ingrian chief told Alexander how, on the eve of the combat, he had seen a mysterious barque, manned by two warriors with shining brows, glide through the night. They were Boris and Gleb, who came to the rescue of their young kinsman. Other accounts have preserved to us the individual exploits of the Russian heroes—Gabriel, Skuilaf of Novgorod, James of Polotsk, Sabas, who threw down the tent of Birger, and Alexander Nevski himself, who with a stroke of the lance "imprinted his seal on his face." Notwithstanding the triumph of such a service, Alexander and the Novgorodians could not agree; a short time after he retired to Pereiaslavl-Zalieski. The proud republicans soon had reason to regret the exile of this second Camillus. The Order of the Swordbearers, the indefatigable enemy of orthodoxy, took Pskof, their alley: the Germans imposed tribute on the Vojané, vassals of Novgorod, constructed the fortress of Koporié on the territory of the Neva, took the Russian town of Tessof in Esthonia, and pillaged the merchants of Novgorod within seventeen miles of their ramparts. During this time the Tchudi and the Lithuanians captured the peasants, and the cattle of the citizens. At last Alexander allowed himself to be touched by the prayers of the Archbishop and the people, assembled an army, expelled the Germans from Koporié, and next from Pskof, hung as traitors the captive Vojané and Tchudi, and put to death six knights who fell into his hands. This war between the two races and two religions was cruel and pitiless. The law of nations was hardly recognized. More than once Germans and Russians slew the ambassadors of the other side. Alexander Nevski finally gave battle to the Livonian knights on the ice of Lake Peipus, killed four hundred of them, took fifty prisoners, and exterminated a multitude of Tchudi. Such was the Battle of the Ice, which took place in twelve hundred and forty-two. He returned in triumph to Novgorod, dragging with him his prisoners loaded with irons. The Grand Master expected to see Alexander at the gates of Riga, and implored help of Denmark. The Prince of Novgorod, satisfied with having delivered Pskof, concluded peace, recovered certain districts, and consented to the exchange of prisoners. At this time Innocent the Fourth, deceived by false information, addressed a bull to Alexander, as a devoted son of the Church, assuring him that his father Iaroslaf, while dying among the Horde, had desired to submit himself to the throne of Saint Peter. Two Cardinals brought him this letter from the Pope in twelve hundred and fifty-one.

It is this hero of the Neva and Lake Peipus, this vanquisher of the Scandinavians and the Livonian knights, that we are presently to see grovelling at the feet of a barbarian. Alexander Nevski perceived that in presence of this immense and brutal force of the Mongols, all resistance was madness, all pride ruin. To brave them was to complete the overthrow of Russia. His conduct may not have been chivalrous, but it was wise and humane. Alexander disdained to play the hero at the expense of his people, like his brother Andrei of Suzdal, who was immediately obliged to fly, abandoning his country to the vengeance of the Tatars. The Prince of Novgorod was the only prince in Russia who had kept his independence, but he knew Batui's hands could extend as far as the Ilmen. "God has subjected many peoples to me," wrote the barbarian to him: "will you alone refuse to recognize my power? If you wish to keep your land come to me; you will see the splendor and glory of my sway." Then Alexander went to Sarai with his brother Andrei, who was disputing the Grand Principality of Vladimir with his uncle, Sviatoslaf. Batui declared that fame had not exaggerated the merit of Alexander, that he far excelled the common run of Russian Princes. He enjoined the two brothers to show themselves, like their father Iaroslaf, at the Great Horde; they returned from it in twelve hundred and fifty seven. Kuiuk had confirmed the one in the possession of Vladimir, and the other in that of Novgorod, adding to it all South Russia and Kief. The year twelve hundred and sixty put Alexander's patience and also his politic obedience to the Tatars to the proof. Ulavtchi, to whom the Khan Berkai had confided the affairs of all Russia, demanded that Novgorod should submit to the census and pay tribute. It was the hero of the Neva who was charged with the humiliating and dangerous mission of persuading Novgorod. When the posadnik expressed in the vetché the opinion that it was necessary to submit to the strongest, the people raised a terrible cry and murdered him. Vasili himself, Alexander's son, declared against a father "who brought servitude to free men," and retired to the Pskovians. It needed a soul of iron temper to resist the universal disapprobation and counsel the Novgorodians to the commission of the cowardly though necessary act. Alexander arrested his son, and punished with death or mutilation the boyars who had led him into the revolt. The vetché decided to refuse the tribute, and sent back the Mongol ambassadors with presents. However, on the rumor of the approach of the Tatars, they repented, and Alexander could announce to the enemy that Novgorod submitted to the census. But when they saw the officer of the khan at work, the population revolted again, and the Prince was obliged to keep guard on the officers night and day. In vain the boyars advised the citizens to give in: assembled around Saint Sophia, the people declared they would die for liberty and honor. Alexander then threatened to quit the city with his men, and abandon it to the full vengeance of the khan. This menace conquered the pride of the Novgorodians. The Mongols and their agents were allowed to go, register in hand, from house to house in the humiliated and silent city to make the list of the inhabitants. "The boyars," says Karamsin, "might still be vain of their rank and their riches, but the simple citizens had lost with their national honor their most precious possession."

In Suzdal also Alexander found himself in the presence of insolent victors and exasperated subjects. In twelve hundred and sixty-two the inhabitants of Vladimir, of Suzdal, and of Rostof all arose against the collectors of the Tatar impost. The people of Iaroslavl slew one renegade named Zozim a former monk, who had become a Moslem fanatic. Terrible reprisals were sure to follow. Alexander set out with presents for the Horde at the risk of leaving his head there. He had likewise to excuse himself for having refused the Mongols a body of the auxiliary Russians, wishing at least to spare the blood and the religious scruples of his subjects. It is a remarkable fact that, over the most profound humiliations of the Russian nationality, the contemporary history always throws a ray of glory. At the moment that Alexander went to prostrate himself at Sarai, the Suzdalian army, united to that of Novgorod, and commanded by his son Dmitri, defeated the Livonian knights, and took Dorpat by assault. The Khan Berkai gave Alexander a kind greeting, accepted his explanations, dispensed with the promised contingent, but kept him for a year near his Court. Alexander's health broke down; on his return he died before reaching Vladimir. When the news arrived at his Capital, the Metropolitan Kirill, who was finishing the liturgy, turned towards the faithful, and said: "Learn, my dear children, that the Sun of Russia is set." "We are lost," cried the people, breaking forth into sobs. Alexander by this policy of resignation, which his chivalrous heroism does not permit us to despise, had secured some repose for exhausted Russia. By his victories over his enemies of the West he had given it some glory, and hindered it from despairing under the most crushing tyranny, material and moral, which a European people had ever suffered.

The Mongol khans, after having devastated and abased Russia, did not introduce any direct political change. They left to each country its laws, its courts of justice, its natural chiefs. The house of Andrei Bogoliubski continued to reign in Suzdal, that of Daniel Romanovitch in Galitch and Volhynia, the Olgovitchi in Tchernigof, and the descendants of Rogvolod the Variag at Polotsk. Novgorod might continue to expel and recall its princes, and the dynasties of the South to dispute the throne of Kief. The Russian states found themselves under the Mongol yoke, in much the same situation as that of the Christians of the Greco-Slav peninsula three centuries later, under the Ottomans. The Russians remained in possession of all their lands, which their nomad conquerors, encamped on the steppes of the East and South, disdained. They were like their Danubian kinsmen, a sort of rayahs, over whom the authority of the khans was exerted with more or less rigor, but whom their conquerors never tried in any way to Tatarize. Let us see in what consisted the obligations of the vanquished, and their relations with their conquerors, during the Mongol yoke.

The Russian Princes were forced to visit the Horde either as evidence of their submission, or to give the khan opportunity of judging their disputes. We have seen how they had to go, not only to the khan of the Golden Horde, but often also to the Grand Khan at the extremity of Asia, on the borders of the Sakhalian or Amur. They met there the chiefs of the Mongol, Tatar, Thibetan, and Bokharian hordes, and sometimes the ambassador of the Caliph of Bagdad, of the Pope, or of the King of France. The Grand Khans tried to play off against each other these ambassadors, who were astounded to meet at his Court. Mangu Khan desired Saint Louis to recognize him as the master of the world, "for," said he, "when the universe has saluted me as sovereign, a happy tranquillity will reign on the earth." In the case of refusal, "neither deep seas nor inaccessible mountains" would place the King of France beyond the power of his wrath. To the princes of Asia and Russia he displayed the presents of the King of France, affecting to consider them as tributes and signs of submission. "We will send for him to confound you," he said to them, and Joinville assures us that this threat, and "the fear of the King of France," decided many to throw themselves on his mercy. This journey to the Grand Horde was terrible. The road went through deserts; or countries once rich, but changed by the Tatars into vast wastes. Few who went returned. Planus Carpinus, envoy of Innocent the Fourth, saw in the steppes of the Kirghiz the dry bones of the boyars of the unhappy Iaroslaf, who had died of thirst in the sand Planus Carpinus thus describes the Batui's Court on the Volga: "It is crowded and brilliant. His army consists of six hundred thousand men, one hundred and fifty thousand of whom are Tatars, and four hundred and fifty thousand strangers, Christians as well as infidels. On Good Friday we were conducted to his tent, between two fires, because the Tatars pretend that a fire purifies everything, and robs even poison of its danger. We had to make many prostrations, and enter the tent without touching the threshold. Batui was on his throne with one of his wives; his brothers, his children, and the Tatar lords were seated on benches; the rest of the assembly were on the ground, the men on the right, the women on the left.... The khan and the lords of the Court emptied from time to time cups of gold and silver, while the musicians made the air ring with their melodies. Batui has a bright complexion; he is affable with his men, but inspires general terror." The Court of the Grand Khan was still more magnificent. Planus Carpinus found there a Russian named Kum, who was the favorite and special goldsmith of Gaiuk or Kuiuk, and Rubruquis discovered a Parisian goldsmith, named Guillaume. Much money was needed for success either at the Court of the Grand Khan or of Batui. Presents had to be distributed to the Tatar Princes, to the favorites above all, to the wives and the mother of the khan. At this terrible tribunal the Russian Princes had to struggle with intrigues and corruption; the heads of the pleaders were often the stakes of these dreadful trials. The most dangerous enemies they encountered at the Tatar Court were not the barbarians, but the Russians, their rivals. The history of the Russian Princes at the Horde of Sarai in twelve hundred and forty-six, and Mikhail of Tver in thirteen hundred and nineteen, the one assassinated by the renegade Doman, the other by the renegade Romanets, at the instigation and under the eyes of the Grand Prince of Moscow.

The conquered people were obliged to pay a capitation tax, which weighed as heavily on the poor as on the rich. The tribute was paid either in money or in furs; those who were unable to furnish it became slaves. The khans had for some time farmed out this revenue to some Khiva merchants, who collected it with the utmost rigor, and whom they protected by appointing superior agents called *baskaki*, with strong guards to support them. The excesses of these tax-gatherers excited many revolts: in twelve hundred and sixty-two, that of Suzdal; in twelve hundred and eighty-four, that of Kursk; in thirteen hundred and eighteen, that of Kolomna; in thirteen hundred and twenty-seven, that of Tver, where the inhabitants slew the baskak Shevkal, and brought upon themselves frightful reprisals. Later, the Princes of Moscow themselves farmed not only the tax from their own subjects, but also from neighboring countries. They became the farmers-general of the invaders. This was the origin of both their riches and their power.

Besides the tribute, the Russians had to furnish to their master the blood-tax, a military contingent. Already at the time of the Huns and Avars, we have seen Slavs and Goths accompanying the Asiatic hordes, forming their vanguards, and being as it were the hounds of Baian. In the thirteenth century the Russian Princes furnished to the Tatars select troops, especially a solid infantry, and marched in their armies each at the head of his drujina. It was thus that in twelve hundred and seventy-six Boris of Rostof, Gleb of Biélozersk, Feodor of Iaroslavl, and Andrei of Gorodets followed Mangu Khan in a war against the tribes of the Caucasus, and sacked Dediakof in Daghestan, the capital of the Iasui. The Mongols scrupulously reserved to them their part of the booty. The same Russian Princes took part in an expedition against an adventurer named Lachan by the Greek historians, formerly a keeper of pigs, who had raised Bulgaria. The descendants of Monomakh behaved still more dishonorably in the troubles in the interior of Russia. They excited the Mongols against their countrymen and aided the invaders. Prince Andrei, son of Alexander Nevski, in twelve hundred and eighty-one, in concert with the Tatars, pillaged the provinces of Vladimir, Suzdal, Murom, Moscow, and Pereiaslavl, which he was disputing with Dmitri, his elder brother. He helped the barbarians to profane churches and convents. In thirteen hundred and twenty-seven it was the Princes of Moscow and Suzdal who directed the military execution against Tver. In twelve hundred and eighty-four two of the Olgovitchi reigned in the land of Kursk; one of them, Oleg, put the other to death in the name of the khan. Servitude had so much abased all characters, that even the annalists share the general degradation. They blame, not Oleg the murderer, but Sviatoslaf the victim. Was it not his unbridled conduct that caused the anger of the khan? No prince could ascend the throne without having received the investiture and the *iarluik*, or letters-patent, from the khan. The proud Novgorodians themselves rejected Mikhail, their Prince, saying, "It is true that we have chosen Mikhail, but on the condition that he should show us the iarluik." No Russian State dared to make war without being authorized by the khan. In twelve hundred and sixty-nine the Novgorodians asked leave to march against Revel. In thirteen hundred and three, in an assembly of princes, and in the presence of the Metropolitan Maximus, a decree of the Khan Tokhta was read, enjoining the princes to put an end to their dissensions, and to content themselves with their appanages, it being the will of the Grand Khan that the Grand Principality should enjoy peace. When the Mongol ambassadors brought a letter from their sovereign, the Russian Princes were obliged to meet them on foot, prostrate themselves, spread precious carpets under their feet, present them with a cup filled with gold pieces, and listen, kneeling, while the iarluik was being read.

Even when the Tatars had conquered the Russians, they respected their bravery. Matrimonial alliances were contracted between their princes. About twelve hundred and seventy-two Gleb, Prince of Biélozersk, took a wife out of the khan's family, which already professed Christianity, and Feodor of Riazan became the son-in-law of the khan of the Nogais, who assigned to the young couple a palace in Sarai. In thirteen hundred and eighteen the Grand Prince Iuri married a sister of Uzbek Khan, Kontchaka, who was baptized by the name of Agatha. Towards the end of the fourteenth century the Tatars were no longer the rude shepherds of the steppes. Mingled with sedentary and more cultivated races, they rebuilt fresh cities on the ruins of those they had destroyed: Kruim in the Crimea, Kazan, Astrakhan, and Sarai. They had acquired a taste for luxury and magnificence, honored the national poets who sang their exploits, piqued themselves on their chivalry and even on their gallantry. Notwithstanding the difference of religion, a reconciliation was taking place between the aristocracy of the two countries, between the Russian and the Tatar Princes. The Russian historians are not entirely agreed as to the nature and degree of influence exerted by the Mongol yoke on the Russian development. Karamsin and M. Kostomarof believe it to have been considerable. "Perhaps," says the former, "our national character still presents some blots which are derived from the Mongol barbarism." M. Soloviof, on the contrary, affirms that the Tatars hardly influenced it more than the Petchenegi or Polovtsui. M. Bestujef-Riumin estimates the influence to have been specially exerted on the financial administration and military organization. On one side the Tatars established the capitation-tax, which has remained in the financial system of Russia; on the other, the conquered race had a natural tendency to adopt the military system of the victors. The Russian or Mongol Princes formed a caste of soldiers henceforth quite distinct from Western chivalry, to which the Russian heroes of the twelfth century belonged. The warriors of Daniel of Galitch, it is said, astounded the Poles and Hungarians by the Oriental character of their equipment. Short stirrups, very high saddles, a long caftan, or floating dress, a sort of turban surmounted by an aigret, sabers and poniards in their belts, a bow and arrows,—such was the military costume of a Russian Prince of the fifteenth century. On the other side, many of the peculiarities in which the Mongol influence is thought traceable may be attributed as well or better to purely Slav traditions, or imitations of Byzantine manners. If the Muscovite Princes inclined to autocracy, it was not that they formed themselves on the model of the Grand Khans, but that they naturally adopted imperial ideas of absolutism imported from Constantinople. It is always the Roman Emperor of Tsargrad, and not the leader of Asiatic shepherds, who is their typical monarch. If from this time the Russian penal law makes more frequent use of the pain of death and corporal punishment, it is not only the result of imitation of the Tatars, but of the ever-growing influence of Byzantine laws, and the progressive triumph of their principles over those of the ancient Code of Iaroslaf. Now these laws so very easily admitted torture, flogging, mutilation, and the stake, that there is no need to explain anything by Mongol usages. The habit of prostration, that of beating the forehead, of affecting a servile submission, is certainly Oriental, but it is also Byzantine. The seclusion of women was common in ancient Russia, the customs of which were moulded by Greek missionaries, and the Russian terem was derived from the Hellenic plan of women's quarters, rather than from the Oriental harem; all the more because the Tatar women, before the conversion of the Mongols to Islamism, do not appear to have been secluded. If the Russians of the seventeenth century seem strange to us in their long robes and Oriental fashions, we must remember that the French and Italians of the fifteenth century, dressed by Venetian merchants, displayed the same taste. But in France fashions made advances, while in Russia, isolated from the rest of Europe, they remained stationary.

From a social point of view, two Russian expressions seem to date from the Tatar invasion: *tchernui*, or the black people, to designate the lower orders; and *krestianin*, signifying the peasant, that is, the typical Christian, who was always a stranger to the Mongol customs adopted for a short time by the aristocracy. As to the amount of Mongol or Tatar blood mixed with the blood of the Russians, it must have been very small: the aristocracy of the two countries may have contracted marriages, a certain number of Tatar Princes may have become Russian Princes by their conversion to orthodoxy, but the two races, as a whole, remained strangers. Even to-day, while the native Finns continue to be Russified, the Tatar cantons, even though converted to Christianity, are still Tatar. If the Mongol yoke influenced Russian development, it is very indirectly. By separating Russia from the West, by making it a political dependency of Asia, it perpetuated in the country that Byzantine half-civilization whose inferiority to European civilization became daily more obvious. If the Russians of the seventeenth century differ so much from Western nations, it is above all because they have remained at the point whence all set out. Again, the Tatar conquest also favored indirectly the establishment of absolute power. The Muscovite Princes, responsible to the kahn for the public tranquility and the collection of the tax, being all the while watched and supported by the baskaki, could the more easily annihilate the independence of the towns, the resistance of the subordinate princes, the turbulence of the boyars, and the privileges of the free peasants. The Grand Prince of Moscow had no consideration for his subjects because no man had any consideration for him, and because his life was always at stake. The Mongol tyranny bore with a terrible weight upon all the Russian hierarchy, and subjected more closely the nobles to the princes and the peasants to the nobles. "The Princes of Moscow," says Karamsin, "took the humble title of servants of the khans, and it was by this means that they became powerful monarchs." No doubt under any circumstances the Russian principalities would have ended by losing themselves in the same dominion, but Russian unity would have been made like French unity, without the entire destruction of local autonomies, the privileges of the towns, and the rights of the subjects. It was the crushing weight of the Mongol domination that stifled all the germs of political liberty. We may say, with Mr. Wallace, that "the first Tsars of Muscovy were the political descendants, not of Russian Princes, but of Tatar khans." The third indirect result of the conquest was the growth of the power and riches of the Church. In spite of the saintly legends about the martyrdom of certain princes, the Tatars were a tolerant nation. Rubruquis saw in the presence of the Grand Khan Mangu, Nestorians, Mussulmans, and Shamans celebrating their own particular form of worship. Kuink had a Christian chapel near his palace; Khubilai regularly took part in the feast of Easter. In twelve hundred and sixty-one the Khan of Sarai authorized the erection of a church and an orthodox bishopric in his Capital. The Mongols had no sectarian hatred against bishops and priests. With a sure political instinct, the Tatars, very like the Sultans of Stambul, understood that all these men could excite or calm the people. After the first fury of the conquest was passed, they applied themselves to gaining them over. They excepted priests and monks from the capitation-tax; they received them well at the Horde, and gave pardons at their intercession. They settled disputes of orthodox prelates, and established peace in the Church as well as in the State. In thirteen hundred and thirteen the Khan Uzbek, at the prayer of Peter, Metropolitan of Moscow, confirmed the privileges of the Church, and forbade that it should be deprived of its possessions, "for," says the edict, "these possessions are sacred, because they belong to men whose prayers preserve our lives and strengthen our armies." The right of justice was formally granted to the Church. Sacrilege was punished by death. The convents also increased in numbers and riches. They filled enormously: were they not the safest asylums? Their peasants and servants multiplied: was not the protection of the Church the surest? Gifts of land were showered on them, as in France in the year ten hundred. It was thus that the great ecclesiastical patrimony of Russia was founded, a wealthy reserve of revenues and capital, on which more than once in national crises the Russian sovereigns were glad to draw. The Church, which, even in its weakness, had steadily tended to unity and autocracy, was to place at the service of the crown a power which had become enormous. The Metropolitans of Moscow were almost always the faithful allies of the Grand Princes. See *Russian Army*, *Russian Government*, and *Russian Principalities*.

RUSSIAN RIFLING.—The Russians have adopted the French rifling for heavy ordnance. They have, however, had rifled several of their smaller fortress-guns with six grooves, and their field-pieces have been rifled in a similar manner; but, instead of placing the studs in pairs, and having twelve of them, they use only six placed alternately. Their rifling has an equal twist, and the grooves are slightly narrowed at the bottom. In the field-pieces they are sloped off, on one side to allow the projectile, the bearings of which are also sloped off, to wedge itself tightly; but these slight modifications possess no advantage over the fittings adopted for the French service.

More recently the Russians have adopted both the centering and the compressing systems of rifling with their steel ordnance.

RUST.—Oxide of iron, which forms on the surface of iron from exposure to atmospheric influence or contact with acid. The following forms a good preservative against rust, and is a good composition for guns when packed in boxes for transit, viz., one part white lead, seven parts tallow.

Among metal-workers and particularly among the skilled artisans engaged in the production of small-arms the perfection of a cheap, simple and, at the same time, reliable, process of coating the smaller parts—as for instance, in the guns, the functional pieces of the systems—for the prevention of rust, has been the subject of study and experiment for very many years. When it is considered that so inconsiderable a War Establishment as that of the United States demands the manufacture of some 30,000 Springfield rifles *per annum* to keep up the reasonable complement in reserve, and that private manufactures year by year average an aggregate of ten times that number of military and sporting arms, the value of the suggested improvement is most sensibly appreciated. The essays which have been made in this country and Europe, in the direction of protecting steel and iron against the corroding effects of air and moisture, have involved experiments with paints, varnishes, glazes, enamels, galvanizing, electro-depositing, and finally, the magnetic-oxide coating process, which up to the present time seems to claim the best results. This last named process was the discovery, some ten years back, of Prof. Barff, and is generally termed the "Barff-ing." The Barff theory subjects the parts to be treated to the action of super-heated steam, in a retort or chamber, until such a temperature is reached as will assure the oxydization demanded. The discovery is now controlled by the Bower-Barff Co., an English organization which has an agency in the United States. Besides the Bower-Barff there have been two or three processes, in the direction of anti-rust coating by oxide, practically developed in this country, but, we understand, without satisfactory results. Though there is no question of the value of the Barff-ing process as applied to large bodies of iron and steel, its difficulties and uncertainties in treating small pieces, like the action and the limb-work of gun systems, have thus far, we believe, deterred the manufacturers from its adoption. The interchangeable theory of small-arms production demands a mathematically correct and uniform preservation of the contour, proportion and volume of each part, and such possible incidents as the erection of scale on the metal, the distortion of lines, or the expansion or shrinkage of volume, through too great heat or inexpert handling, are of course not to be entertained. For some months past it has been not altogether a secret in ordnance circles that the very vexatious problem of coating gun parts with oxide, in such manner as to assure not only an excellent color but entire protection against corrosive influences, has been solved through the very intelligent and patient experimenting of Colonel A. R. Buffington, Commandant of the National Armory at Springfield.

The information in our possession at present as to Colonel Buffington's process, from the *Army and Navy Journal*, is derived from a correspondent who has been for many years a manufacturer of machine plant and special tools for gun-making and an expert in the selection and treatment of metals. We learn that the experiments, which have proceeded by slow degrees from the plane of investigation to that of practical application, have been of long continuance, and that the testing has been of a character exceptionally severe and thorough. In pursuing his experiments Colonel Buffington has always kept in view the practical rather than the theoretical, and the result of his work is the formulated system of an industrial expert rather than the more ambitious but less available scheme of a consulting engineer. "Every one skilled in the art of ash or baked bluing processes and the time and care required for the acid process of barrel browning," says the correspondent, "will be pleased to learn that by immersing and keeping the parts in such a condition for six minutes, in a bath of saltpeter, 10 parts, and of black oxide of manganese, 1 part, heated to about 600 degrees Far., a beautiful blue black color will be secured which will wear equal to, if not better than, the best acid process." The operation requires no skilled labor, a cast-iron pot deep enough to cover the parts to be treated, arranged in such manner that a uniform heat can be maintained, being the only apparatus needed. At the National Armory, they are using this process for all the gun-parts formerly blued—such as butt-plates, trigger-guards, bands, tips, etc. They are also treating the bayonets, and are about to try the process with the barrels. Especially notable is the fact that this process will not prejudicially affect the spring temper, and will draw case-hardened parts, requiring toughness, to the proper spring temper. The economical advantage is thus differentiated between the old process and the new—the old barrel browning by acid requires at least four and better six days time, while the new process consumes six minutes—the former demanding an expert and the latter a laborer. The Bartling process, as is well known, takes from ten to fourteen hours, with the constant liability of doing a positive or permanent damage to pieces thus treated.

It will be seen from the foregoing that, though Colonel Buffington's process is applicable both for browning and anti-corrosive purposes, it has not yet been applied to the parts of the action, other than the springs. The very economical results of the new process are thus far most pronounced, the saving of time and labor being considerable. We now look for a trial of the anti-rust virtues or the process upon the bolt-action and limb-work of the several repeating rifles. Should Colonel Buffington have merely succeeded in substituting a new formula for the old uncertain bluing and browning processes, he will have scored a success; if he has at last hit upon a real anti-rust treatment he has gained a victory.

Rustre.

RUSTRE.—In Heraldry, one of the subordinaries, consisting of a lozenge with a circular opening pierced in its center. Ancient armor was sometimes composed of rustres sewed on cloth.

RUSTRED ARMOR.—Armor of the Middle Ages, composed of flat oval rings sewed on quilted leather or linen and overlapping each other half way.

RYSWICK.—The Peace of Ryswick was a treaty concluded in 1697 at Ryswick, a Dutch village between Delft and the Hague, which was signed by France, England, and Spain on Sept. 20, and by Germany on Oct. 30. It put an end to the sanguinary contest in which England had been engaged with France. It has been often said that the only equivalent then received by England for all the treasure she had transmitted to the Continent, and for all the blood which had been shed there, was an acknowledgment of William's title by the King of France; but it must not be forgot how much the Allies were benefited by the check given to the gigantic power and overweening ambition of France.

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