FARROW'S

MILITARY ENCYCLOPEDIA

A DICTIONARY OF MILITARY KNOWLEDGE

ILLUSTRATED

WITH MAPS AND ABOUT THREE THOUSAND WOOD ENGRAVINGS

BY

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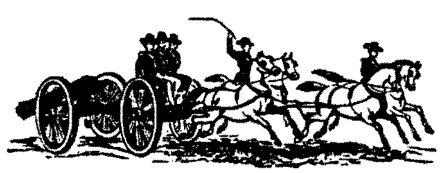
"What is obvious is not always known, and what is known is not always present."—JOHNSON.



COMPLETE IN THREE VOLUMES. VOLUME II.

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

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

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

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

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

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

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

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

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

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

HARANES.—The French designation of the Hungarian Militia.

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

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

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

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

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

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

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

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

HARD-LABOR.—A military punishment frequently awarded by Courts-Martial. This punishment is now firmly established in the United Kingdom; and by express statute, the power of adding hard-labor of peace, the citizens of a friendly Foreign State sustain a private injury at the hands of a naval or military officer serving under the orders of the British Government, but unauthorized by his commission or instructions to do the act complained of, the ordinary tribunals of England afford the same redress against him as in the case of a British subject similarly aggrieved; and this rule applies even in those cases where the violated rights of the foreigner are such as the law of England denies or prohibits to its own subjects. But if the British Government have expressly instructed the officer to commit the act which constitutes or gives occasion to the grievance, the matter becomes an affair of state which is not cognizable by the Courts of Law, and must be adjusted by diplomatic arrangement between the two Governments concerned. In such cases also it is quite sufficient, if the officer's proceedings, though not originally directed or authorized by the terms of his instructions, are afterward sanctioned and adopted by the Government; for this renders them public acts, over which courts of law have no jurisdiction.

INJURIES TO CANNON.—With the exception of the bending of the trunnions of bronze cannon by long firing, the principal injuries to which cannon are subject, are internal, and arise from the separate actions of the powder and the projectile. They increase in extent with the caliber, whatever may be the nature of the piece, but are modified by the material of which it is made.

The injuries from the powder generally occur in the rear of the projectile. They are, 1st. The *enlargement* of that portion of the bore which contains the powder, arising from the compression of the metal. This injury is more marked when a sabot or wad is placed between the powder and the projectile, and is greatest in a vertical direction. 2d. *Cavities*, produced by the melting away of a portion of the metal by the heat of combustion of the charge. 3d. *Cracks*, arising from tearing asunder of the particles of the metal at the surface of the bore. At first a crack of this kind is scarcely perceptible, but it is increased by the continued firing until it extends completely through the side of the piece. It generally commences at the junction of the chamber with the bore, as this portion is less supported than others. 4th. *Furrows*, produced by the erosive action of the inflamed gases. This injury is most apparent where the current of the gas is most rapid, or at the inner orifice of the vent, and on the surface of the bore, immediately over the seat of the projectile. The wear of the vents of bronze cannon is obviated by inserting a copper vent-piece. The effect of continuous firing on the vents of iron cannon is to produce a uniform enlargement of the inner orifice, and to seriously weaken the piece. The appearance of a vent thus enlarged, is irregular and angular, with its greatest diameter in the direction of the axis of the bore. To obviate the serious consequences that result from this injury Captain Dahlgren has placed in his naval guns two vents, each a short distance from, and on opposite sides of the vertical plane, passing through the axis of the piece. One of them is filled with melted zinc, the other is used until it becomes so much enlarged as to endanger the safety of the piece; it is then filled with zinc, and the first one opened.

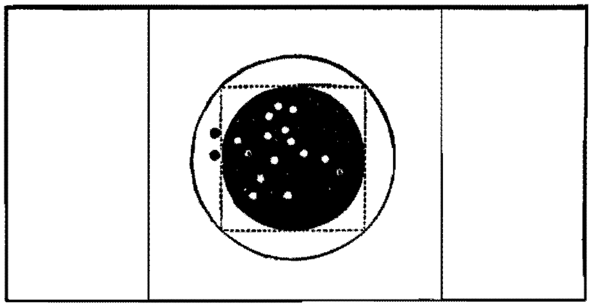
The injuries arising from the action of the projectile occur around the projectile, and in front of it. They are, 1st. *The lodgement.* This is an indentation in the lower side of the bore, produced by the pressure upon the ball by the escape of the gas through the windage, before the ball has moved from its seat. The elasticity of the metal, and the *burr*, or *crowding up*, of the metal in front of the projectile, cause it to rebound, and being carried forward by the force of the charge, to strike against the upper side of the bore, a short distance in front of the trunnions. From this it is reflected against the bottom, and re-reflected against the top of the bore, and so on until it leaves the piece. The first indentation is called the *lodgement;* the other *enlargements.* In pieces of ordinary length, there are generally three enlargements, when this injury first makes its appearance, but their number is increased as the *lodgement* is deepened and the angle of incidence increased. Bronze pieces are considered unserviceable when the depth of the lodgement is .18 in., and the depth of an enlargement is .16 in. The effect of this bounding motion, is to alternately raise and depress the piece in its trunnion-beds, and to diminish the accuracy of fire, until finally, the piece becomes unfit for service. It is principally from this injury that bronze guns become unserviceable. Mortars and howitzers are not much affected by it. The principal means used to obviate this injury, are to wrap the projectile with cloth or paper (as the cylinder-cap of the cartridge used with field-guns), and to shift the seat of the projectile. The latter may be done by a wad, or lengthened sabot, or by reducing the diameter and increasing the length of the cartridge. The last of these methods is considered the most practical as well as the most effective; and it has an additional advantage of diminishing the strain on the bore, by increasing the space in which the charge expands before the ball can be moved. The French bronze siege-guns, which formerly were rendered unserviceable in 600 service-rounds, now endure, by this method, 2,500 service-rounds. 2d. *Scratches*, or furrows made upon the surface of the bore by rough projectiles, or by case-shot. This is not a serious injury. 3d. *Cuts*, made by the fragments of projectiles which break in the bore. 4th. *Wearing away of the lands of rifle-cannon*, especially at the driving edges. 5th. *Enlargement of the muzzle*, arising from the forcing outward of the metal by the striking of the projectile against the side of the bore, as it leaves the piece. By this action, the shape of the muzzle is elongated in a vertical direction. 6th. *Cracks on the exterior.* These are formed by the compression of the metal within, generally at the chase, where the metal is thinnest. This portion of a bronze-gun is the first to give way by long firing, whereas, cast-iron cannon are burst in rear of the trunnion, and the fracture passes through the vent, if it be much enlarged.

The principal injuries to which cast-iron cannon are liable are the wearing away of the metal of the bore above and below the projectile, and at the interior corners of the vent. In guns which have seen much service the enlargements thus occasioned have been known to exceed one inch in both cases. It has been seen that the strength of cast-iron cannon is diminished by repeated firing, and that there is a limit beyond which they should not be used. For American cannon this limit has been fixed at one thousand service-rounds. The number of times which an iron piece has been fired may be approximately determined by the size of the bore, and vent if it be not bushed. The first is taken with the "star gauge," and the second by an impression in wax. Slight cracks in the surface of the bore, particularly about the seat of the charge, indicate the approaching fracture of a cast-iron gun. The injuries to which wrought-iron cannon are most subject, are the enlargement of the bore by the extension or compression of the metal around it, and the rapid enlargement of slight cracks and cavities by the flame of the powder. See *Cannon.*

INLYING PICKET.—A body of infantry or cavalry in campaign, detailed to march, if called upon, and held ready for that purpose in camp or quarters

INNER.—The name given to a certain part of a target. A shot striking in this space (a circular ring) on the Creedmoor target counts 3. On the regulation target, the smallest circle, always painted black, is called the *bull's-eye;* the ring embraced between the bull's-eye and the circumference of the next larger circle is called the *center;* the ring between the second and third circles is called the *inner;* and the space outside the larger circle is called the *outer.* In the target represented on next page, the space between the second circle and the vertical lines is the *inner*, and the space outside the vertical lines is the *outer*.

INNER FLANK.—That which is nearer the point on which a line rests, or which is farther from the enemy. In drill, it is always that flank which is nearer the point from which the line is dressed.



Inner.

INNISKILLINERS.—In the British service, officers and soldiers of the Sixth Dragoons and the Twenty-seventh Foot; so called from the two regiments having been originally raised at Inniskillen, a town of Ulster, where the inhabitants distinguished themselves in favor of King William against James II. Often written *Enniskilliners*.

INROAD.—The entrance of an enemy into a country with purposes of hostility; a sudden or desultory incursion or invasion; encroachment, notwithstanding efforts to prevent it.

INSCONCED.—In the military art, when any part of an army has fortified itself with a sconce, or small work, in order to defend some pass, etc., it is said to be insconced. *Ensconce* signifies in a general sense to cover as with a fort.

INSPECTION.—Divisions and brigades are inspected between the fifteenth and twentieth of each month by inspecting officers designated for the purpose. The Commanders of regiments and posts make an inspection of their commands on the last day of every month. Captains inspect their companies every Sunday morning, and no soldier is excused from Sunday inspection except the guard, the sick, and the necessary attendants in the hospital. Medical officers having charge of hospitals make a thorough inspection of them every Sunday morning. Troops are inspected when mustered for payment. Besides these inspections, frequent visits are made during the month by the Commanding Officer, company and medical officers, to the men's quarters, the hospital, guard-house, etc. Except when otherwise specially provided for by the Secretary of War or the General of the Army, every military post, station, and command in the Army is inspected at least once every year by Division or Department Inspectors, under the direction of their respective Commanders. In addition to these inspections, post, station, and other permanent Commanders, between the first and fifth days of September in each year, make thorough inspections of their respective commands, and forward reports thereof, through the proper military channels, to the Inspector General's Office, at the Headquarters of the Army, so as to reach that office not later than October 1st. These reports do not interfere or dispense with those of the inspecting officers.

Inspections are made under specific orders clearly defining their object, which will be exhibited to the officers whose troops or affairs are to be examined. Commanding Officers are to see that every facility is afforded for such examination. Inspectors give orders only when specially authorized to do so; and then give them in the name of the officer authorizing it. They must report with strict impartiality all irregularities. They should refrain from informal conversation on the subjects of investigation, and from all expression of approval or disapprobation. Inspectors take care that no injustice be done to organizations or individuals by reports not fully sustained by thorough personal examination. Before leaving a command, the Inspector publicly informs the troops that opportunity will be given any soldier to lay before him a well-grounded complaint without any of his officers being present.

The sphere of inquiry of Inspectors generally includes every branch of military affairs, and whether the military laws and regulations are fully complied with. In specific cases, it is defined and limited by the orders they receive. Generally, report is made as to zeal and ability of Commanding Officers, and whether they possess the requisite professional knowledge for the proper exercise of their command; whether they preserve harmony and unanimity in the command, and observe the system of instruction and treatment of subordinates enjoined by the Regulations; whether the officers are properly instructed and efficient. Special reportis also to be made in case of any officer of intemperate or immoral habits, or who has proper associates, or who is addicted to gaming, or is unfit for active service by infirmity or any other cause; whether the number of men in ranks at inspection corresponds with the returns, and how absentees are accounted for; whether the band exceeds the authorized number, and any men not musicians are mustered with it; as to the discipline, military appearance, and bearing of the troops; their instruction in all military exercises and duties; the nature and frequency of exercises and recitations in tactics; the target practice; whether they are practiced in marching with the full kit; the state of their batteries, or arms, equipments, and accouterments of all kinds; the sufficiency, uniformity, and fit of their clothing; when the troops were last paid, and, if payment be deferred, the cause of delay.

In the inspection of a post, it should be reported when and by whom the post was last inspected; whether it be sufficiently garrisoned, and the armament and supplies of all kinds sufficient in kind and quantity; the strength of the garrison and its armament; whether the Commanding Officer is familiar with the design and capacity for defense of the work, the ground in its vicinity, and the principles of defense of fortified places; in case of frontier and seacoast forts, whether the Commanders understand and properly execute the laws relating to neutrality, quarantine, etc., and the regulations prescribing international courtesy; as to the cleanliness, state of repair, and sanitary condition of barracks and quarters; as to the kitchens and messes, the sufficiency, variety, and preparation of food; of the guard-house, prisons, bake-house; of the hospital, and whether the sick are properly cared for; of the stables, harness, means of transportation and animals, the number unserviceable; in the case of Cavalry and Artillery horses, as to their grooming, shoeing, veterinary treatment, and general condition; as to the capacity of the officers conducting the Administrative and Staff services, the fidelity and economy of their disbursements, and whether payments and issues are made strictly in accordance with law and the Regulations. The regularity of issues and payments; whether supplies reported on hand are verified; whether the labor of the supply departments is performed by troops or by civilians. If by civilians, their number, the cost, and reasons in justification of their employment; as to the condition of all public property and stores, and whether any is used for private purposes; whether buildings and property are properly secured against fire, theft, exposure, and damage; whether forage, wood, and Subsistence supplies are properly protected and under sentinels; as to the neighboring Indian tribes, their number, disposition, and other information useful in a military view; as to the population, resources, routes, and means of travel, etc., of the surrounding country.

INSPECTION ARMS.—A command in the Manual of Arms, directing that the piece be placed in a prescribed position, preparatory to its inspection. The movement is executed as follows: The recruits being at order arms, bayonets fixed, the Instructor commands—

1. *Inspection*, 2. ARMS.

Commencing on the right, the Instructor inspects the pieces in succession. Each recruit, as the Instructor approaches him, tosses his piece quickly with the right hand opposite the left eye, catching it with the left hand between the rear-sight and the lower band, the thumb extended along the stock, the barrel to the right, and inclined slightly to the front, the hand at the height of the chin; he then passes his right hand quickly to the lock, placing the thumb on the hammer, the elbow raised as high as the hand, the fingers, closed together, extending in front of lock. (Two.) The recruit presses the thumb on the hammer, lowering the elbow at the same time, and brings the hammer to the half-cock; then drops the right hand by the side; the Instructor takes the piece with the right hand at the small of the stock (the recruit dropping the left hand by the side), inspects, and hands it back to the recruit, who receives it with the left hand in the position prescribed in the first motion, passes his right hand, as before, to the hammer, and the fore-finger to the trigger, which he pulls, at the same time pressing the hammer downward to free it from the half-cock notch, thus bringing the hammer to the safety-notch; the piece is then lowered with the left hand, seized near the middle band with the right, and brought to the position of *order*. As the Instructor returns the piece, the recruit next on the left throws up his piece to the position of *inspection*, and so throughout the squad. Should the piece be inspected without handling, the recruit resumes the *order* as the Inspector passes to the next man, who immediately tosses up his piece.

INSPECTION MARKS.—All cannon are required to be weighed, and to be marked as follows, viz.: the *number of the gun, the initials of the Inspector's name*, on the face of the muzzle—the numbers in a separate series, for each kind and caliber at each foundry; the initial letters of the name of the *founder* and the *foundry*, on the end of the right trunnion; the *year of fabrication*, on the end of the left trunnion; the *foundry number*, on the end of the right rimbase, above the trunnion; the *weight of the piece in pounds*, on the base of the breech; the letters U. S., on the upper surface of the piece, near the end of the reinforce. The *natural line of sight*, when the axis of the trunnions is horizontal, should be marked on the base-ring and on the swell of the muzzle, whilst the piece is in the trunnion-lathe. Cannon *rejected* on inspection, are marked XC, on the face of the muzzle; if condemned for erroneous dimensions which cannot be remedied, add XD; if by powder-proof, XP; if by water-proof, XW. Converted guns are marked as follows: The *number of the gun*; the *weight of the piece in pounds*; the *initials of the Inspector's name*, and that of the *foundry where the gun is converted*, and the *year of the conversion* on the face of the tube, in a circle concentric with the bore, in letters and figures at least one inch long. The initials of the *foundry where the tube is made*, and the *number of the tube*, in small type, on the face of the tube, under the initials of the Inspector. The results of all final measurements and examinations are noted on the inspection report of the gun. See *Inspection of Ordnance*.

INSPECTION OF ACCOUNTS.—The Inspections of Disbursing Officers' accounts, which are required by law, are made quarterly, or four times within the year, with a reasonable interval between any two examinations. Division and Department Commanders usually provide for the inspection of Disbursing Officers' accounts through the Inspectors attached to their headquarters, or by detail of suitable officers within their commands for the purpose. The law provides, in regard to Inspection of Accounts, "that no officer so detailed shall be in any way connected with the Department or Corps making the disbursement." The Inspector makes a minute and thorough inspection of the accounts of Disbursing Officers, and compares the result in each case with the officer's balance at his place of deposit; and each Inspector is held responsible for any defalcation or misapplication of the public money or property which may occur within the command to which he is assigned that an active vigilance on his part might have detected.

INSPECTION OF CONDEMNED PROPERTY.—Inspectors are the only officers authorized to inspect public property with a view to condemnation. The final disposition of condemned property, except it be worthless, can only be ordered by Commanding Generals of Departments. All surveys and reports having in view the *condemnation* of public property, for whatever cause, should be made by Inspector Generals, or Inspectors specially designated by the Commander of a Department or an army in the field, or by higher authority. Such surveys and reports having a different object from those of Boards of Survey, are required independently of any preliminary action of a Board on the same matter.

An officer commanding a Department, or an army in the field, may give orders, on the report of authorized Inspectors, to sell, destroy, or make such other disposition of any condemned property as the case may require—ordnance and ordnance stores alone excepted, for which the orders of the War Department must always be taken. But if the property be of very considerable value, and there should be reason to suppose that it could be advantageously applied or disposed of elsewhere than within his command, he should refer the matter to the Chief of the Staff Department to which it belongs, for the orders of the War Department. No other persons than those above designated, or the General-in-Chief, can order the final disposition of condemned property, saving only in the case of horses, which should be killed at once to prevent contagion, and of provisions or other stores which are rapidly deteriorating, when the immediate Commander may have to act perforce. Inventories of condemned property are made in triplicate, one to be retained by the person accountable, one to accompany his accounts, and one to be forwarded through the Department, or other superior headquarters, to the Chief of the Staff Department to which the property belongs.

Officers inspecting public property cause the destruction, in their presence, of all property found to be worthless, and which is without any money value at the place of inspection. The action of an Inspector, on property of this character, is final, and his inspection report on the same is a valid voucher for the officer responsible for the property. In the discharge of the duty devolved upon Inspectors in this regulation, they are regarded as answerable that their action is proper and judicious according to the circumstances of the case. Unserviceable arms and stores will be inspected and disposed of in like manner with other property. Their *sale* can be ordered by the Secretary of War only.

INSPECTION OF ORDNANCE.—The objects of inspecting cannon are to verify their dimensions, particularly those which affect the accuracy of fire, and the relation of the piece to its carriage, and to detect any defects of metal and workmanship, that would be likely to impair their strength and endurance. Smooth-bore cannon presented for inspection and proof are placed on skids for the convenience of turning and moving them easily. They are first examined carefully on the exterior to ascertain whether there be any flaws or cracks in the metal, whether they be finished as prescribed, and to judge, as well as practicable, of the quality of the metal. They must not be covered with paint, lacker, or any other composition. If it be ascertained that an attempt has been made to conceal any flaws or cavities by plugging or filling them with cement or any substance, the gun is rejected without further examination. After this preliminary examination, the Inspector proceeds to verify the dimensions of the piece. The interior of the bore is first examined by reflecting the sun's rays into it from the mirror, or, if the sun be obscured, by a lighted candle or a lamp placed on the end of a rod and inserted into the bore. The cylinder-gauge screwed on the staff is then pushed gently to the bottom of the cylindrical part of the bore and withdrawn; it must go to the bottom or the bore is too small. The bore of the piece is then measured with the star-gauge, beginning at bottom. Measurements should be made at intervals of ½ inch to the front of seat of shot, and at intervals of 1 inch from that point to the muzzle. In rifled guns the measurements are taken from land to land, and afterwards from groove to groove, the head of the star-gauge being fitted with the suitable "guide" to insure the proper position of the measuring points. The position of the trunnions with regard to the axis of the bore and to each other is next ascertained. To verify the position of the axis of the trunnions, set the trunnion-square on the trunnions, and see that the lower edges of its branches touch them throughout their whole length; push the slide down till it touches the surface of the piece, and secure it in that position by the thumb-screw; turn the gun over, and apply the trunnion-square to the opposite side, and if, when the point of the slide touches the surface of the piece, the lower edges of the branches rest on the trunnions, the axis of the trunnions is in the same plane with the axis of the bore; if they do not touch the trunnions, their axis is above the axis of the bore by half the space between; and if the edges touch the trunnions and the point of the slide does not touch the surface of the piece, their axis is below the axis of the bore. If the alignment of the trunnions be accurate, the edges of the trunnion-square will fit on them when applied to different parts of their surface; their diameter and cylindrical form and the diameter of the rimbases are verified with the trunnion-gauge. To ascertain the length of the bore, screw the guide-plate and measuring-point on the cylinder-staff and push them to the bottom of the bore; place a half-tompion in the muzzle and rest the staff in its groove; apply a straight-edge to the face of the muzzle and read the length of the bore on the staff. The exterior lengths are measured by the rule or by a profile, the accuracy of which is first verified; the exterior diameters are measured with the calipers and graduated by a rule. The position of the interior orifice of the vent is found from the mark made on the rammer-head by the vent-gauge inserted in the vent, while the rammer-head is held against the bottom of the bore. Two impressions are taken. The position of the exterior orifice of the vent is also verified. The vent is examined with gauges, and the vent-searcher is to ascertain if there are any cavities in it. All smooth-bore bronze ordnance should be bored under size from .04 to .05 inch, and, after proof, reamed out to the exact caliber. Whitish spots show a separation of the tin from the copper, and, if extensive, should condemn the piece. A great variation from the true weight, which the dimensions do not account for, shows a defect in the alloy. In mortars, the dimensions of the chambers and the form of the breech may be verified with patterns made of plate-iron. After the powder proof the bore is washed and wiped clean, and the bore and vent are again examined, and the bore remeasured. The results of each of the measurements and examinations are noted on the inspection report against the number of the gun. A proper discretion must be exercised in the inspection of ordnance; such slight imperfections as do not injure a piece for service may be disregarded, whilst the instructions should be strictly enforced with regard to defects which may impair its utility.

The duties of the inspection of converted guns commence with the inception of the work, and the most important are performed before the gun is completed. The breech-cup is verified by the steel templet before it is screwed into place. The different shoulders and the shape and pitch of screw-threads are similarly gauged before the parts are united; diameters of tubes are verified, and the base of the tube and recess for the muzzle-collar before the insertion. The dimensions of the casing are also proven. When the gun is presented for final inspection it is placed horizontally on the skids, and inspected as explained above for smooth-bore cannon.

That the finished bore of a bronze piece may not be injured by the proof-charge, it is bored out under size, from .04 to .05 inch, and, after proof, reamed out to the true size. When the powder-proof is finished, the bore should be cleaned and examined; the vent should be stopped up with a greased wooden plug, the muzzle raised, and the gun filled with water, to which pressure should be applied to force it into any cavities that exist; or the water should be allowed to remain in the bore twenty-four hours. The bore must then be sponged dry and clean, and viewed with a mirror or candle, to discover if any water oozes from cracks or cavities, and also, if any enlargement has taken place. The quantity that runs out of a crack or honey-comb will indicate the extent of the defect; and if it exceed a few drops, the piece should be rejected, although the measured depth of the cavity may not exceed the allowance. After the bore has been reamed out to its proper size, its dimensions are again verified, and an examination of the bore and vent is made, to detect any defects which may have been caused or developed by the proof. Whitish spots show a separation of the tin from the copper, and, if extensive, should condemn the piece. A great variation from the true weight which the dimensions do not account for, shows a defect in the alloy.

Bronze cannon should be rejected for the following sized cavities or honey-combs: *Exterior.* Any hole or cavity 0.25 in. deep in front of the trunnions, and 0.2 in. deep at or behind the trunnions. *Interior.* From the muzzle to the reinforce, any cavity 0.15 in. deep. Any cavity from the reinforce to bottom of the bore. In all other respects, the inspection of cast-iron and bronze cannon are alike. See *Calipers, Cascabel-block, Chamber-gauge, Cylinder-gauge, Disk, Impression-taker, Measuring-staff, Mirror, Profile-boards, Proof of Ordnance, Rammer-head, Searcher, Star-gauge, Template, Trunnion-gauge, Trunnion-rule, Trunnion-square, Vent-gauges, Vent-guide,* and *Vent-searcher.*

INSPECTION OF POWDER.—The Inspector of gunpowder should satisfy himself before its reception as to the purity of the ingredients employed by the manufacturer, and that their proper preparation and careful manipulation through all the various stages of manufacture have been rigidly observed. Before powder for the military service is received from the manufacturer, it is inspected and proved. For this purpose at least 50 barrels are thoroughly mixed together. One barrel of this is proved. Musket powder should be fired three rounds with service charges. Mortar and cannon powder should be fired three rounds with heaviest charges in a field and siege-gun respectively. Mammoth, hexagonal, cubical, prismatic, or other special powders, three rounds with battering charges from guns in which these powders are to be used. The density and granulation of the powder, as well as the velocity and pressure obtained in its proof, should conform to the Ordnance Regulation in these respects, for the particular service or piece for which the powder is required, within the allowed limits of variation.

Gunpowder should be of an even-sized grain, angular and irregular in form, without sharp corners, and very hard. When new, it should leave no trace of dust when poured on the back of the hand, and when flashed in quantities of 10 grains on copper plate it should leave no bead or foulness. It should give the required initial velocity to the ball, and not more than the maximum pressure on the gun, and should absorb but little moisture from the air.

The size of the grain is tested by standard sieves made of sheet brass pierced with round holes. Two sieves are used for each kind of powder, Nos. 1 and 2 for musket, 3 and 4 for mortar, 5 and 6 for cannon and 7 and 8 for mammoth powder.

A compact shape of grain approaching the cube or sphere, is desirable. Elongated flat scales are objectionable. The number of grains in the several weighed samples should be counted.

Diam. of holes for musket-powder..No. 1, 0.08 in.; No. 2, 0.06 in.
Diam. of holes for mortar-powder...No. 3, 0.10 in.; No. 4. 0.25 in.
Diam. of holes for cannon-powder..No. 5, 0.25 in.; No. 6, 0.50 in.
Diam. of holes for mammoth-powderNo. 7, 0.75 in.; No. 8, 0.90 in.
Hexagonal, Cubical, Prismatic. } Dimensions of these powders vary with the caliber of the gun in which they are used, and have not as yet been definitely determined upon in our service.

Gravimetric density is the weight of a given measured quantity. It is usually expressed by the weight of a cubic foot in ounces. This cannot be relied upon for the true density when accuracy is desired, as the shape of the grain may make the denser powder seem the lighter. Its only value is a fair idea of the value of air space in a given weight. The specific gravity of gunpowder varies from 1.65 to 1.8. It is important that it should be determined with accuracy. Alcohol and water saturated with saltpeter have been used for this purpose; but they do not furnish accurate results. Mercury only is to be relied upon. Hardness is tested by breaking the grains between the fingers; the hardness is judged of by experience. It is very necessary that the density or specific gravity of the powder should be most accurately determined. For this delicate operation a very ingenious instrument has been devised by Colonel Mallet, of the French Army, called a Mercury Densimeter.

Initial velocity is determined by any of the electro-ballistic machines available; the Boulengé chronograph is one of the simplest and most generally used for proof of powder. The strain upon the gun is determined by the Rodman pressure-gauge, or some suitable contrivance. The amount of moisture in powder is determined by drying samples in an oven with a water bottom. A vessel of tin, double-walled, except the face containing the door, is fitted at the top with an opening for the introduction of water; the door is double; the inner skin-lining has perforations at the top to allow the escape of moisture given up by the powder. Ledges on the inside of the oven support the powder-trays. Before use, the water space is filled with boiling water; a spirit lamp keeps up the heat; the supply of water is kept up to compensate for evaporation. The powder is subjected to heat as long as it loses weight, the loss indicating the percentage of moisture driven off. On being removed from the oven it should be transferred at once to perfectly clean, dry, and air-tight weighing bottles. The ability to resist moisture is determined by subjecting samples which have been dried to exposure, first in open air, then in a hygroscope containing a solution of niter at 100° cooled to 80° Fahr.

On breaking the grains, a fine ashen-gray color throughout should appear; the grain texture should be close, without white specks even when magnified. "Flashing" on glass or porcelain plates, small copper measures for fine-grain powders inverted on the plates, keeps the heap nearly the same at each trial. The powder should be in small conical heaps; if the incorporation is good, only smoke marks remain on the plate after flashing; if bad, specks of undecomposed niter and sulphur will form a dirty residue. The test requires experience to insure good judgment. The relative incorporation is determined by the balance; the greater increase of weight on the plate, the less satisfactory the powder in this respect. Moist powder flashes badly. The report of inspection should show the place and date of fabrication and of proof, the kind of powder and its general qualities, as the number of grains in 100 grains, its specific gravity; whether hard or soft, round or angular, of uniform or irregular size; whether free from dust or not; the initial velocities and pressures per square inch obtained in each fire; the amount of moisture absorbed; and, finally, the height of the barometer and hygrometer at the time of proof. Each barrel is marked on both heads, (in white oil-colors, the head painted black), with the number of the barrel, the name of the manufacturer, year of fabrication, and the kind of powder, *cannon*, *mortar*, or *musket*, *etc.*, the mean initial velocity, the pressure per square inch on the pressure-piston, and density. Each time the powder is proved, the initial velocity is marked below the former proofs, and the date of the trial opposite to it. See *Analysis of Powder*, *Densimeter*, *Gunpowder*, and *Hygroscope*.

INSPECTION OF PROJECTILES.—The principal points to be observed in inspecting shot and shells are to see that they are of the proper form and size; that they are made of suitable metal; and that they have no defects, concealed or otherwise, which will endanger their use, or impair the accuracy of their fire. As it is impracticable to make all projectiles of exact dimensions, certain variations are allowed in fabrication. They should be inspected whilst perfectly clean, and before becoming rusty, so that flaws and imperfections in the metal can be detected by the eye.

Spherical Projectiles.—The inspecting instruments required for shot are one *large* and one *small gauge* and one *cylindrical-gauge* for each caliber. The cylinder-gauge has the same diameter as the large gauge; it is Constructed of cast-iron and is five calibers long. The large and small gauges are made with a difference in diameter of 0.02 inch for projectiles turned in a lathe, and 0.04 inch for those not so turned. All these gauges should be verified from time to time, and when they have become 0.01 inch larger than their true diameter they should no longer be used. One *hammer* having a flat face and a conical point. One *searcher* of steel wire. One *cold-chisel. Steel punches. Figure-stamps.*

The shot should be inspected before they become rusty; after being well cleaned each shot should be carefully examined to see that its surface is smooth, that the metal is sound and free from seams, flaws, and blisters. If cavities or small holes appear on the surface, strike the point of the hammer or punch into them and ascertain their depth with the searcher; if the depth of the cavity exceeds 0.2 inch, the shot should be rejected. The discovery of any attempt on the part of those engaged in the fabrication of the shot to conceal such defects by filling up the holes should insure rejection. The shot must pass in every direction through the large gauge and not at all through the small one, and the mean of their diameters should be nearer that of the former gauge than of the latter.

After having been thus examined, the shot are passed through the cylinder-gauge, which is placed at an inclination of about two inches between the two ends, and supported on blocks of wood in such a manner as to be easily turned from time to time to prevent its being worn into furrows. Shot which *slide* or *stick* in the cylinder should be rejected. The average weight of shot of 10 inches and under is deduced from that of three parcels of 20 to 50 each, taken indiscriminately from the pile; some of those which appear to be the smallest should be also weighed, and if they fall short of the prescribed weight of their caliber by more than one thirty-second part, they should be rejected. Shot of larger caliber than 10 inches should each one be weighed by itself and its weight stamped upon it near one of the ears for the shell-hooks.

The dimensions of grape and canister shot are verified by means of a large and small gauge attached to the same handle. The surface of the shot should be smooth and free from seams and cavities. For the inspection of shells and case-shot, the following inspecting instruments are required in addition to those used in inspecting shot, viz: *Calipers* for measuring the thickness of the projectiles at the side. *Calipers* for measuring the thickness at the bottom. *Gauges* for the dimensions of the fuse-hole, and for the thickness of metal at the fuse-hole. *A pair of hand-bellows; wooden plugs* to fit the fuse-hole and bored through to receive the muzzle of the bellows.

The surface of the shell and its exterior dimensions are examined as in the case of shot, particular attention being paid to the hemisphere opposite the fuse-hole. Cavities and imperfections in casting are generally found about 30° from the top of the shell when in the position in which it was cast. Shells should be rejected for rough casting, projecting seams, sand-flaws, a collection of dross, cavities or honey-combs of more than two-tenths of an inch in depth, whatever their diameter, or a number of small holes giving the projectiles a spongy appearance.

The shell is next struck with the hammer to judge by the sound whether it be free from cracks; the position and dimensions of the ears are verified. The thickness of the metal is then measured at several points on the great circle perpendicular to the axis of the fuse-hole. The diameter of the fuse-hole, which should be accurately reamed, is then verified, and the soundness of the metal about the inside of the hole is ascertained by inserting the finger.

The shell is now placed upon a trivet in a tub containing water deep enough to cover it nearly to the fuse-hole; the bellows and plug are inserted into the fuse-hole, and the air forced well into the shell. If there be any holes in the shell, the air will rise in bubbles through the water. This test also gives another indication of the soundness of the metal, as the parts containing cavities will dry more slowly than the other parts. The mean weight of shells of 10 inches and under is ascertained in the same manner as that of shot, and larger ones should be weighed and stamped the same as with shot of like caliber. All projectiles rejected in the inspection should be marked with an X made with a cold-chisel; on shot near the gate; or, when turned, near one ear, and on hollow projectiles near the fuse-hole.

Elongated Projectiles — The following Table will show the points upon which the Inspecting Officer must inform himself and report before accepting shot, and the variations he is authorized to allow:

Subject of measurement.	Allowed variations	No. of—— inch —— examined......................	Weight of total number accepted......................
Projectile:		No. rejected for erroneous dimensions of head.	Mean weight of projectile.
Length of cylindrical portion of body }	±0. 4		
Length of head................................ }			
Length of base for sabot....................	±0. 5		
Total length of projectile..............	+ .15 − .1	No. rejected for erroneous dimensions of cylindric body or base..............	No. of sabots examined...
Diameter of cylindrical portion.........	±0. 2		
Diameter of base over threads...........	± . 01		
Pitch of threads..............................	0		
Radius of head................................	± . 05	No. rejected for erroneous dimensions of interior cavity........................	No. of sabots rejected for erroneous dimensions...
Thickness of bottom........................	. 1		
Length of interior cavity..................	± . 1		
Thickness of walls at—inches from—			
Thickness of walls at—inches from—		No. rejected for eccentricity of interior cavity...	No. sabots rejected for defects in material or finish
Eccentricity of axis of interior cavity at——from base.......................	0. 1		
Diameter of fuse (or screw-plug) hole.	± . 01		
Pitch of thread on fuse (or screw-plug hole)....................................	0	No. rejected for defects in material or finish.........	Total number of sabots rejected........................
Length of thread on fuse (or screw-plug) hole...............................	± . 1		
Diameter of hole for shell-hooks.........	± . 01		
Depth of hole for shell-hooks............	± . 05	Total number rejected....	No. of sabots accepted....
Distance from base of projectile..........	± . 02		
Weight of projectile, pounds............	± . 2		
Sabot:			
Height of sabot.............................	± . 02	Total number accepted....	Weight of total number accepted ....
Exterior diameter of sabot...............	± . 02		
Interior diameter of sabot.................	± . 01		
Maximum thickness of outer lip.........	± . 01	Weight of heaviest one accepted.......................	Mean weight of sabot......
Minimum thickness of outer lip.........	± . 01		
Depth of cannelure...........................	± . 03		
Maximum width.............................	± . 01		
Weight of sabot..............................		Weight of lightest one accepted........................	Weight of total number of shot and sabots accepted
Weight of sabot and projectile, pounds	± . 2		

The following instruments are required and used as indictated:

1. One large ring-gauge, with handle; interior diameter 0″.03 less than the diameter of bore of gun.
2. One small ring-gauge, with handle; interior diameter 0″.07 less than the diameter of bore of gun.
3. One cylinder-gauge made of cast-iron and five calibers in length; interior diameter same as large ring.
4. Calipers for measuring the thickness of the walls of the shot or shell and determining the eccentricity. This instrument consists of two parallel arms, formed by a continuous steel strap. One arm is terminated by a curved point, and is graduated into inches and quarters, from the end toward the center; the other arm carries a socket, at right angles to its length, through which slides a graduated measuring-rod. The zero of the scale corresponds to the position of the rod when it is in contact with the curved point, and a vernier-scale on the socket permits measurements to 0″.01. To use the instrument, the arm with the curved point is inserted into the cavity through the screw-plug hole, and the clamp is screwed fast

at the required point. Two short cylindrical arms on the clamp serve as bearers, and allow a motion of the instrument only on its own plane. The eccentricity of a spherical projectile is measured by the distance of the center of gravity from the center of figure, In oblong shot, however, it varies directly for each cross-section from the seat of the core, which is near the screw-plug hole, to the head of the cavity, and is measured by the angle made by the axis of the cavity with the axis of the projectile. To determine the axis of the cavity, the greatest and least thickness of the walls are measured at two or more depths. Half the difference between the two will give the distance between the axis of the cavity and that of the projectile for that particular section. It is ordinarily considered sufficient, however, to determine the eccentricity of but one cross-section near the center of gravity and compare it with the known results of previous experiments.

5. The first intimation of eccentricity is shown upon the *rolling-table*, which consists of a heavy cast-iron plate, beveled with great care, and two parallel rails attached to it and separated from each other by a distance slightly less than the length of the cylindrical part of the shot. When a shot is rolled upon the rails, the heaviest side must come to rest beneath, and a more or less readiness to assume a particular point of rest indicates approximately the amount of eccentricity.

6. *Measuring-rod* for determining the length of cavity; made of steel and graduated into tenths of an inch for a short distance on each side of the point indicating the proper length.

7. *Gauge*, for length of screw-plug hole; made and graduated like the preceding.

8. *Templet*, for gauging the profile of the shot; made of steel; graduated to indicate the length of head, position of shell-hook holes, length of cylindrical part, and total length.

9. *Gauge* for the Butler sabot. This is made of steel and in two parts; the one screwed upon the other when not in use. The lower part gauges the sabot as regards pitch and length of thread, length and thickness of ring; the upper part gauges the length and pitch of the thread upon the base of the shot. A *small templet* gauges the depth and width of cannelure and thickness of outer lip.

10. One *hammer*, weighing half-a-pound, having a flat face and conical point.

11. One *searcher* of steel wire No. 20, with handle; *steel punches* and a *cold-chisel*.

The shot should be inspected before it becomes rusty. It is first placed upon the rolling-table and examined with the eye for defects in material, which in shot cast with the head down, are apt to occur as cavities in and about the base. These, when discovered, are probed with the "searcher" or steel punch; if more than 0".2 deep, or of such character as to suggest weak, imperfect metal, the shot is condemned. The head of the shot is struck with the hammer at its junction with the cylindrical part, for the purpose of detecting cracks liable to be produced there in cooling chilled shot. A dull sound indicates the existence of such a defect, which is further tested by hammering with a sledge. It is then rolled, and, should the amount of eccentricity be considered doubtful as regards that allowed, is measured with the calipers. The length of cavity and of screw-plug hole are then verified, and the templet applied to the profile. Rolling it from the table, it is stood on end and the gauge screwed to the base. The sabot is then screwed to its gauge, the dimensions of the cannelure verified with the small templet, and the character of the metal examined. The sabot and screw-plug are then fitted to the shot, and it is again stood on its head and the ring-gauges are applied to it. The smaller should not pass over the shot at all; the larger should pass over its entire length. It is then passed through the cylinder-gauge, which is fastened, slightly inclined, to a block of wood; the weight is finally determined and stamped at once upon the body of the shot near the sabot. Shot and shell rejected during inspection are marked with an X made with a cold-chisel.

With each lot of shot, and from the same metal, is cast a cylindrical column about 2 feet high and 2½ inches in diameter in a sand mold, and the head of a projectile in the usual iron mold. As soon as cool and before the shot have been sent to the "finishing shop" a test specimen is cut from the column, its specific gravity determined, then broken in the testing-machine, and its fracture examined. The chilled head is split under a hammer to expose the depth of chill, and the results so determined are compared with an occasional shot cut open along its axis. Should the tenacity, density, or chill be unsatisfactory the entire lot is condemned.

Chilled shot are intended for the penetration of wrought-iron plates, and were the result of experiments to substitute for the steel projectiles first used one of cheaper material of the requisite hardness.

A fracture of the head of a chilled shot presents the following appearance: The exterior layer is white, of crystalline structure, the crystals being disposed normal to the exterior surface. The central part is dark, granular, and less compact than the rest of the mass, showing the presence of considerable graphitic carbon, while the intermediate layers show less graphite and grow harder and denser as they approach and finally blend with the exterior.

Different metallurgic processes, and among them the repeated fusion of iron, qualify it for chilling. The desired result has been obtained in England by adding to a mixture of gray iron and shot scrap four per cent. of ilmenite, an ore of iron in combination with titanic acid, and containing—

Iron oxide (equivalent to 45.3 metallic iron)	61.4
Titanic acid	33.2
Silica	4.2
Tin oxide	1.2
Manganese	Trace.

In consequence of the chilling process, the head is so hard as to resist even a file, while the cylindrical body is soft mottled iron. The head is not touched after casting in order to preserve intact the skin, which is the soundest and densest part.

The chilling power of the metal-mold, which depends upon its heat-conducting power, varies with its thickness and somewhat with its own temperature and that of the melted metal when poured into it. The specific gravity of chilled cast-iron is greater than that of gray or mottled iron, and this fact is used in discovering the depth of chill of a shot by weighing the shot first in air and then in water, and comparing the results with those obtained from a standard projectile of the same weight in air. The shot which weighs the less in water will be chilled to the less extent, since the discrepancy must be due to the lower density of its chilled head. See *Projectiles* and *Shell-gauge*.

INSPECTION OF SMALL ARMS.—All the materials used in the manufacture of arms must be of the best quality, and they should be tested by the Inspectors according to the prescribed methods. The wood for gunstocks should be seasoned at least three years and kept in a dry place two years before being worked. It must be free from knots and sap, and no wood which is brash or light or worm-eaten, or in any degree decayed, or which is cut across the grain at the handle of the stock, or which is kiln-dried, should be used or received. The following rules for inspection apply to all small-arms, whether made at the national armories or by contract at private establishments. The attention of the inspecting officers should be directed as much as possible to the operation of the workmen in the course of the fabrication of arms. Each component part is first inspected by itself and afterward the arm in a finished state. The material and the forms and dimensions of all the parts must conform strictly to those of established patterns, the workmanship and finish

Captain, are carried on the foot-boards of the limber-chests of the forge and battery-wagon, and in the baggage-wagons. The knapsacks and valises having been inspected, the officers mount; the Captain then commands: 1. *Drivers*, 2. PREPARE TO MOUNT 3. MOUNT. At the third command, all the mounted men mount. The inspection being completed, the Captain, upon some intimation from the Inspector, forms line, marches the battery to its park, and dismisses it. The battery is frequently inspected in full marching order—the men in blouses, and equipped with haversacks and canteens; knapsacks and valises packed; overcoats, when not worn, rolled and strapped to the knapsacks or saddles; horses equipped with nose-bags and halters; caissons loaded with a day's forage.

INSPECTION REPORTS.—Reports of the various kinds of inspections, for the information of the Inspector General. Inspecting officers, before transmitting their reports to their Commanders, indorse thereon the remedies that have been applied by the local Commanders for the correction of irregularities that may have been brought to their notice. All Superior Commanders in forwarding the reports, indorse them with their action, and such remarks as may be of importance for the information of the Commander of the Army.

Copies of all non-confidential Inspection Reports are forwarded to the Inspector General, through the ascending channels of communication. Commanding Officers only may forward copies of confidential reports.

INSPECTOR GENERAL.—Inspector and Inspector General are terms in military affairs, having a somewhat vague signification. There are Inspectors General of Cavalry, Infantry, Artillery, Engineers, Militia, and Volunteers, whose duties are really those which their names infer—viz., the periodical inspection of the several corps of their respective arms, and the pointing out of deficiences, the corps being under the command, however, of its own officers, and not of the Inspector General. The Inspectors General of Musketry and Gunnery Instruction in the English Army are charged with the direct superintendence and ordering of such instruction throughout the army. In the Medical Department, the Inspectors General of Hospitals constitute the highest grade of surgeons, under the Director General of the whole department. Inspectors are employed in many capacities. Inspectors of Volunteers are Staff Officers charged with the administration and organizing of the detached corps of Volunteers in their several districts. The post of Inspector General of Auxiliary Forces has lately been abolished, and his duties transferred to the Department of the Adjutant General, in order to bring the Militia and Volunteers more immediately under the supervision of the Commander-in-Chief.

INSPECTOR GENERAL'S DEPARTMENT.—In the United States, the law at present provides for one Inspector General, with the rank of Brigadier General; two Inspectors General, with the rank of Lieutenant-colonel; and two with the rank of Major. Also, that the Secretary of War may, in addition, detail Officers of the Line, not to exceed four, to act as Inspectors General. In the British service, the Inspectors Generals are officers appointed by the Horse Guards, with the exception of the Inspector General of Fortifications, to carry out, in the most searching manner, the duties of inspection in their respective branches, and to bring to the notice of the Commander-in-Chief all points with which he should be made acquainted. They are assisted in their duties by *Inspectors*, who act under their instructions.

INSUBORDINATION.—Disobedience to lawful authority, under the following phases, viz.: 1. Striking a Superior Officer; 2. Using or offering violence against a Superior Officer; 3. Offering violence in a military prison; 4. Disobeying the command of a Superior Officer; 5. Using threatening language to a Superior. For either of the above offenses an officer or soldier is to be tried by a General Court-Martial.

INSULT.—In a military sense, to attack boldly and in open day, without going through the slow operations of trenches, working by mines and laps, or having recourse to those usual forms of war by advancing gradually towards the object in view. An enemy is said to *insult* a coast when he suddenly appears upon it, and debarks troops with an immediate purpose to attack.

INSURGENTS.—Soldiers or people generally in a state of insurrection. The term, however, admits of one exception. Hungarian Insurgents (*Insurgenten die Ungarischen*) mean the Hungarian Militia, called out or summoned by general proclamation, as under the old feudal system.

INSURRECTION.—A rising of people in arms against their Government, or a portion of it, or against one or more of its laws, or against an officer or officers of the Government. It may be confined to mere armed resistance, or it may have greater ends in view. See *Civil War* and *Rebellion*.

INTELLIGENCE DEPARTMENT—A branch of the Quartermaster General's Department, presided over by the Deputy Quartermaster General. It has for its object the collecting, sifting, and arranging of all information on subjects useful to the Government or Army in peace or war. This Department in England is comparatively of recent date. Its functions comprise:—Topography; Strategical and Tactical Questions; Concentrations; Collection of all data bearing on the organization of foreign armies; Home and Colonial Defense, etc. The information to be obtained on the above subjects is gathered in time of peace, so that, when war breaks out, the General commanding an expedition may have put into his hands the most detailed information that maps can contain of the country in which operations are to be carried on, and all such other information needful for the vigorous prosecution of the war. Formerly, whatever information the General received was through the Quartermaster General's Department, then imperfectly organized for obtaining such intelligence as is now afforded, and also by reconnoisesances a day or two in advance of the Army. Now-a-days, the General is made acquainted with the country he has to traverse before he sets out, and is thus often enabled to map out his future movements before commencing operations. To the Intelligence Department may be attributed, to a great extent, the success of the German arms during the war of 1870—71. Before starting on the campaign, maps of the country the Army was to invade were largely distributed, and also handbooks containing information on many valuable points such as railways, localities, power of districts to afford food, etc.—in short, all information tending to the successful issue of the war. The Intelligence Department of England is modelled after that on the Continent, but only for defensive purposes; It is composed of Staff Officers, whose education and intelligence fit them well for the duties they have to perform. The Department may be said to be at present merely the nucleus of what will be, it is to be hoped, a still larger one. There is ample field for an increased number of Staff Officers, and in comparison with the Continental Department, the establishment is small. The following extract from a lecture given at the United Service Institution, in February 1875, by Major Brackenbury, R. A., D. A. Q. M. G. an officer of the Intelligence Department, will put the reader in possession of the information to be acquired, and the work to be performed by the Staff Officers of such a Department, as carried out in Prussia, Austria and France:—

"1. A thorough military acquaintance with the topography and resources of all lands belonging to the nation and its neighborhood.

"2. An intimate acquaintance with the armies and military institutions of foreign powers, as well as of the home armies and institutions.

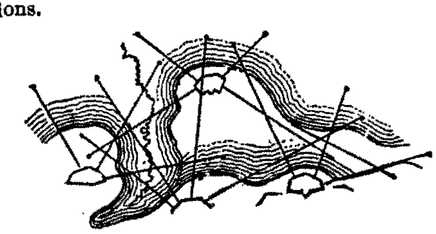
When, by the eventualities of a campaign, we find ourselves rather forced to abandon our primitive line of operations and take up some new one, the latter generally receives the appellation of an *accidental line of operations*. This term is not properly applicable to a line voluntarily taken up, to march upon a point which the enemy may have weakened by withdrawing from it troops, under the apprehension that he was threatened on some other. This change of line, so far from being an accident, is the legitimate fruit of profound combinations, and may be the cause of important successes. The primitive line was, to some extent, a feint; and the line apparently but secondary the true one; it cannot therefore be termed accidental; it will be thus simply the *new line of operations*

In like manner in a retrograde movement an army may abandon its natural line of retreat and take up another, leading off laterally from it, for the purpose of enticing the enemy into a district of country less favorable to him, and at the same time to throw him further off from his main object. The line of retreat in this special case will be sensibly parallel to our own frontier instead of being, as it is generally, perpendicular to it. This new line of retreat also cannot be classed under the head of accidental lines, since it is one voluntarily adopted, and presents advantages over the natural line of retreat. It has received the name of the *parallel retreat*, a term sufficiently expressive of the thing itself. To be successfully executed the retreating army should not be too inferior in force to the enemy, and should run no risk in being cut off from its own frontier by moving too far from it. The local features are particularly to be taken into consideration in such operations. If they are of a broken character, the movement will be the less perilous; if, on the contrary, the country is open, and without strong natural points of defence, the safest plan will be to regain our frontier by the shortest line.

When a choice between several lines of operation is offered, it will be best to adopt the one where the army can be most easily subsisted, and in which, according to the kind of troops of which it is composed, the army will be most secure from the enemy's enterprises If the army is superior to the enemy in cavalry, it will naturally prefer to move over an open district and country; if, on the contrary, its main strength lies in its infantry, it will prefer to skirt along the foot of a mountainous range, or to march through a broken country. A line of operations parallel and near to a river presents the advantage of having its wing nearest the water course perfectly secure from attack, whilst the river itself furnishes an excellent communication for bringing forward men and the supplies. The defensive position taken up by the enemy also has great weight in determining the direction of the line of of operations. If he occupies cantonments extending over a considerable line, the most natural line will be the one by which the army can throw itself into the center of the enemy's isolated corps, and thus separate them and beat them in detail. By attacking one wing of a position of this kind we should, in all likelihood, force back one corps after another upon the neighboring one, until in the end the whole would, in this way, be concentrated in their natural order of retreat. If, on the contrary, the enemy's corps are in proper supporting distance of each other, the natural point of attack is certainly one of his wings, provided that, in making the said movement, the line of operations of our own army is not left exposed; for the first of all necessities is never to place either our base or our line of operations in jeopardy. The choice to be made will also depend upon the characters and military talents of the enemy's Generals, the quality of the forces, their moral condition, etc., etc.; these are points which carry such great weight with able Commanders that they have often been known to have adopted plans the very reverse of what they would have done under contrary circumstances, according to their being in front of one or another General. Turenne, having for his opponent Condé, did not allow himself to do things which seemed to him as easy and a matter of course before the Archduke. On one occasion, in 1654, he lost some men while passing within the range of grape in front of the Spanish lines, which called forth remarks from some of the officers accompanying him. To these he replied: "The march we are making would be very imprudent before Condé's position; but it is very important that I should examine thoroughly this position; and I am so well acquainted with the Spanish service, that I feel assured that before the Archduke has been informed of it, has sent word to Condé, and called together his council, I shall have completed it and returned to camp." "See," said that Captain who more than the other was capable of pronouncing a judgment on such points, "here is something that pertains to the divine portion of the art." In truth, military genius manifests itself in just such subtle distinctions and delicate shades. See *Base of Operations*, and *Objective Point*.

LINE OF SIGHT.—In gunnery, the right line passing through the notch of the tangent-scale and tip of the trunnion-sight (at any elevation), and the object. See *Pointing*.

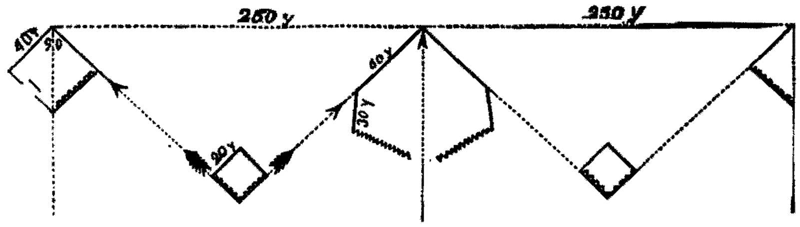
LINE OF WORKS.—When it is necessary to hold for a time a line of considerable extent by a force inferior to that which may be brought against it, the line should be fortified by intrenchments, consisting of a series of works laid out according to the approved principles. The kind of work for any particular position on the line will depend upon the nature of the locality it is to occupy and the manner in which it will combine with those adjacent in securing mutual support throughout. Such lines are frequently from fifteen to twenty, or even thirty miles in length, extending over every variety of country, and in their construction call for the highest skill in military engineering. They are constructed, usually, either for the protection of important towns, cities, and depots; or to make secure the base of operations and lines of communications of any army maneuvering in the field; or, by stretching across peninsular regions, to restrict the theater of operations of the enemy; or for surrounding and besieging a place; or for the purpose of holding the enemy in position with a part of an army while the remainder makes a flank or other strategic movement. The civil war of 1861-65 afforded numerous instances of each of these conditions.



The same general principles apply to lines as to other field-works; but, from their great extent, they usually receive only a slight relief, and the simplest angular figures are adopted for their plan. In laying them out, advantage should be taken of all the natural features presented by the position, so as to diminish the labor of erecting artificial ones. The flanks of a line or position are generally weak points. When possible, one or both should rest on natural points of support. A flank not so supported must be secured by strong works especially well garnished with artillery. A point that has not a clear field of fire is a weak point, and should be strongly intrenched, so that the enemy may not have advantage of hills, ravines, or other shelters in approaching the line. Care should be exercised in determining the kind of artillery for such positions. The field of fire being contracted, long range is not of so much importance as ability to search behind the enemy's shelter, or to throw a great mass of projectiles in a limited time. Mortars, howitzers, and machine-guns will be found serviceable. In establishing a line of works, the most important object should be to cover every portion of the front within fair range with direct or cross fire. To accomplish this, all prominent points along the line are fortified, each with a work having a trace most suited to the conformation of that particular site. The most important of these should be inclosed works upon the bastion-front principle, and of considerable size, capable of enduring an independent attack. Smaller inclosed works, such as redoubts and star forts, occupy the secondary points. Between the works thus located extend *rifle-trenches*, capable of sheltering infantry. The line is therefore composed of a series of works mutually supporting each other and covering every avenue of approach.

The artillery, of which there should be an abundance, will naturally be placed in the works occupying the most commanding and salient positions. These works should never be so far apart as to be out of mutual flanking range of the artillery with which they are armed. It is the duty of officers of artillery to co-operate with those of engineers in selecting the positions of the works that are to be armed with artillery, and to determine the kind and quantity to be placed in each. As infantry troops constitute the chief garrison of works of this nature, they will be required to construct them, leaving to the artillery the construction of magazines, embrasures, and the other accessories pertaining to their special arm. Generally these works are thrown up very hastily, and often when an immediate attack is apprehended; this, to a considerable extent, decides not only the nature of the works, but the parts of them that require the first attention. Subsequently, if time permits, they are strengthened, improved, and worked into better shape. As far as practicable, the line should be composed of inclosed works, for the reason that should the enemy concentrate and break through at any point, he will not be able to sweep the line to the right and left by taking it in flank and rear. To storm and capture each work in succession would be an operation too costly for him to undertake.

It is advisable in most instances to have in fron



Plan of a Line with Intervals of Lunettes, or Square Redoubts flanked by Retired Redans.

of the line, within easy musket range, a line of small redans or lunettes at intervals of about 1,500 yards. Each of these should be capable of holding from one to two hundred infantry and four to six field-pieces. This line of outworks would form, as it were, a species of picket-line, keeping the enemy from closely observing and harassing the main line, and would constitute an advanced line of battle, against which the first shock of the enemy is partially thrown away, and he dare not attempt to neglect them; for an endeavor to penetrate through the intervals would expose his flanks to a close and deadly flank and cross fire. The redans being open towards the main line, could not be held if captured by the enemy. A somewhat similar line of works should be established in rear of the main line. They should, however, have their gorges stockaded or otherwise closed to prevent the enemy, should he succeed in forcing his way through the main line, from obtaining easy possession of them by the rear. Sites for them should be selected with a view of obtaining from them a searching fire of the front line in reverse. This line of works, although apparently inert in rear, must be kept fully armed and manned, ready to drive the enemy from any part of the main line that he may succeed in obtaining possession of. Prominent salients in the main line are especially inviting to the enemy; behind these a second line should be prepared, so placed, if possible, that should the enemy obtain the main line he will be within musketry range of the second, and be forced with wearied troops to undertake the capture of it. See *Field Fortification*.

LINES.—The field-works known as lines are divided into several classes, according to the object for which they are constructed; or, according to some peculiar arrangement of their parts, or some other characteristic quality. They are most generally classified as *continued lines* and *lines with intervals*. There are no openings in a continued line, except those made for the use of the defense. Continued lines have been much used in past military operations, and will, in all probability, be used in the operations of the future. They may be usefully employed where a passive defense only is to be made, and where the position to be defended is limited in extent, and not exposed to flank attacks. They are not fitted for an active defense, and they have the serious disadvantage of being untenable when any part of the line has been taken by the enemy. They require a large amount of labor to construct; and it is a very doubtful question, whether the advantages they give compensate for the time and labor employed in their construction.

Lines with intervals differ from the continued lines, by leaving intervals along the front of the position, which intervals present no obstructions to an enemy moving through them, excepting so far as they may be defended by the fire of the works, or may be obstructed by natural obstacles, or by artificial ones, placed along the front. The works forming the line may be placed so close to each other as to be in defensive relations; or they may be so far apart, as to admit only of their defending the intervals between them.

If an obstinate defense is to be made, a second line should be used. It should as a general rule be placed behind the first, and distant from it, about one-fourth, and certainly not greater than one-half, of the distance between the works in the first line. When artillery is used in the second line, a good position would be about six hundred yards distant from the first. This places the second line just out of range of aimed musketry fire, but in close range of artillery fire. A third line of field-works is sometimes built. The general arrangement of the works of this third line with the works of the first and second, conforms to the principles employed in arranging the work in the second line. A third line might be useful, in case of an active defense, since the works placed along this line can be utilized as screens for the reserves and for bodies of cavalry. A fourth line would evidently be of no practical service in the defence of a position. A force, unable to retain possession of outer lines, could not hold the fourth.

time, chivalrous warfare with the Kings of Castile; but at length, weakened by internal discord, were compelled to succumb to Ferdinand the Catholic in 1492. The Moors, or at least that portion of them who refused to adopt Christianity, were then expelled from Spain, and in revenge, founded in 1518 the piratical States of Algiers Tunis, and Morocco.

MOORSOM FUSE.—The body of this fuse is made of bronze, and is screwed into the eye of the shell by means of a key fitted into two mortises made in the head. The lower part is not threaded, and projects into the chamber of the shell. In the body of the fuse two cylindrical chambers are placed, one above the other, with their axes perpendicular to each other. These chambers are both alike, with similar percussion apparatus. In each chamber is placed a solid cylinder of bronze, terminated at each end by a small projection, or piston One head of the chamber is movable, and when screwed into its place, its exterior is flush with the convex surface of the fuse. Holes are left on the exterior for the use of a key, and the head is screwed in, after the hammer is placed in the chamber and suspended. In each end of the chamber is a small recess, a vent being bored through to it from the exterior of the fuse. These are both filled with fulminating powder. A hole is drilled through the hammer at its middle point, and perpendicular to its axis, and is used to suspend the hammer, by means of a copper wire, in the center of the chamber. The wire passes through corresponding holes in the body of the fuse, and is soldered at the ends in the curved positions of the holes near the surface of the fuse. In the lower end of the fuse a third chamber is placed with a percussion apparatus similar to the preceding, acting, however, in the direction of the axis of the fuse, and having but one end of the chamber provided with percussion-powder, the vent leading from which communicates with a cross-chamber, having at each end a small chamber filled with powder. The hammer, a cylinder of bronze, with a piston like the others, on its upper end, is suspended in the same way, and has below it a copper-wire passing through holes in the fuse, and soldered like the rest. At the bottom of this last chamber stands a cylinder of lead, fixed in its position by its base, which is pressed in a little offset, between the bottom end of the fuse and the cap which closes the chamber. When the shell strikes, the suspension wire of that hammer whose axis coincides with diameter of the shell passing through the point of impact, or, is parallel to it, is torn loose, releasing the hammer, and allowing it to plunge forward and explode the fulminate, by striking it with the piston on its end. From the construction of this fuse it will be seen that there are six points on the surface of the shell, the striking of which will produce the working of the apparatus with certainty. See *Fuse*.

MOOTIANA.—In the East Indies, a term applied to the soldiers who are employed to collect the revenue.

MOPPAT.—A very early name for a cannon sponge.

MORGENSTERN.—A mace with a long handle and spiked head. See *Morning Star*.

MORGENSTERN GUN.—A breech-loading rifle having a fixed chamber closed by a movable breech-block, which rotates about a horizontal at 90° to the axis of the barrel, lying above the axis of the barrel, and in front. It is opened by drawing back the handle of the firing-bolt until the ribs on its sides are clear of the grooves in the receiver in which they slide. This cocks the piece by compressing the spiral mainspring which surrounds the firing-bolt, until it is caught and held by a sear lying well in the bottom of the breech-block. The breech-block may then be thrown upward and forward until it is stopped by striking the front part of the receiver. It is held open there by the head of the ejector-spindle, which changes its bearing on the extractor so as, through it, to support the block. The piece is closed by reversing the movement of the breech-block, and is locked by the side ribs of the firing-bolt engaging with the undercut grooves in the rear portion of the receiver. The piece is fired by a concealed spiral-spring lock the firing-bolt being released by the action of the trigger within the receiver upon the sear within the block. Extraction is accomplished by the breech-block striking the lug on the extractor above its centre of motion, and ejection is caused by the acceleration impressed on the extractor by the action of the ejector spring on the ejector-spindle, when, by the motion of opening, the direction of this latter passes below the axis of the extractor. The ejector-spring is then released from the tension caused by its compression in opening, and causes the extractor to rapidly rotate about its axis, carrying the empty cartridge against the beveled shoulders of the receiver, by which it is deflected upward and thrown clear of the gun.

MORGLAY.—An ancient and very deadly weapon, in the form of a great sword.

MORION.—Originally a Spanish helmet. It had neither vizor, nose-piece, gorget, nor neck-guard; but was surmounted by a high crest sometimes half the height of the helmet. Its edge turned up in a point in front and behind, so as to form a crescent when seen in profile. The *Morion* was worn by Arquebusiers and Men-at-Arms.

MORNE.—The head of the lance used in tilting or other peaceful encounters. It was curved so that an adversary might be unhorsed, but not wounded, by a stroke. Also written *Mortne*.

MORNING GUN.—The gun fired at the first note of reveille, at all military posts, forts, etc.

MORNING PARADE.—The daily parade at *troop*, sometimes called Troop Parade. In every garrisoned town, fortified place and camp, as well as in every town through which soldiers pass, or occasionally halt, a certain hour in the morning is fixed for the assembling of the different corps, troops, or companies, in regular order. See *Dress Parade*.

MORNING REPORT.—A report of troops, their service, condition, etc., rendered every morning to superior authority. The Morning Reports of Companies and Detachments are combined and form the *Consolidated Morning Report*. The form of Morning Report, given on page 380, used at West Point, will illustrate its purpose.

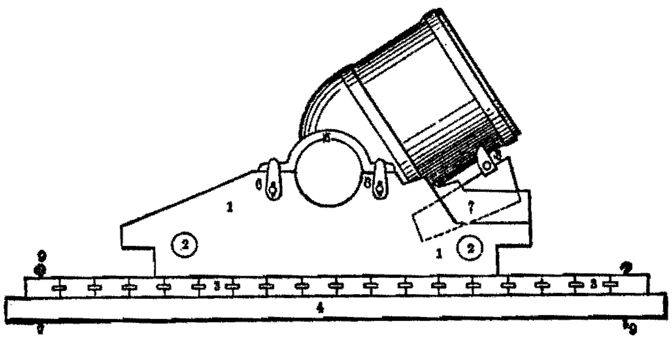
MORNING STAR.—A mace having a long handle and a head with projecting spikes. It received its name from the ominous jest of wishing the enemy good morning with the *Morning-star*, when they had been surprised in camp or city. This weapon became very popular on account of the facility and quickness with which it could be manufactured. The peasant made it easily with the trunk of a small shrub and a handful of large nails. *Morning-stars*, short in the handle, like hammers, were made especially for the Cavalry, Some were supplemented with small hand-cannon in the 15th century.

MORRIS-PIKE.—An ancient pike much used by the Moors. See *Pike*.

MORTAR.—A short and comparatively light cannon, employed to throw hollow projectiles at great angles of elevation. It is intended to produce effect by the force with which these explode. The great curvature of their fire gives them power of reaching objects behind works which would be secure from direct fire. As the projectile has a large diameter, and, except in rare instances, a very great range is necessary, a comparatively small charge of powder is requisite. To give this its utmost power and concentration, it is confined in a hemispherical chamber at the lower end of the bore, but of less diameter. The shell completely closes this chamber; and when the explosion ensues receives its full force on its center. Ordinary mortars range in diameter of bore from 5 to 13 inches. Large mortars have, however, been tried at times, as at the siege of Antwerp citadel in 1832, when the French brought one of 24 inches bore to the attack. This monster, owing to its unwieldiness and other causes, was a failure, Larger still than this, though perhaps more manageable, is Mr. Mallet's great 36-inch mortar, constructed in 1855, of iron parts welded together. and now at Woolwich, rather as a curiosity than for use. As loaded shells are of immense weight, so heavy, indeed, as in larger calibers to involve the apparatus to deposit them in their places, and the mortar is fired at high elevations, the recoil is so great and so nearly vertical that no carriage could withstand the shock; it is necessary, therefore, that the mortar should be mounted on a solid iron or timber bed, by the trunnions, which are placed behind the breech, and supported in front by massive blocks of wood. This arrangement renders the apparatus so heavy that mortars of large size are rarely used in field operations, their ordinary positions being in defensive or siege works, and in mortar-vessels. More wieldy, however, are the Coehorn mortars, invented by the Dutch engineer of that name, for clearing the covert-way or ditch of a fortress. This mortar is sufficiently small to be managed by one man, and is accounted useful in siege or defense operations. The French use a similar Lilliputian ordnance under the denomination of pierriers, or stone-throwers. Small mortars are likewise constructed for mountain warfare; a mule carries the mortar, another the bed, and a third is laden with the projectiles. The use of mortars is diminishing at the present time, elongated shells of great weight being now thrown from rifled cannon.

Vertical fire is effective when it is desirable to prevent an enemy from occupying certain anchorage. The deck of a ship is as completely vulnerable to falling shells as the bottom is to submarine mines and torpedoes. Judiciously-placed batteries, if armed with a sufficient number of mortars throwing shells, would make it perilous for an enemy to remain within their reach. But mortar-firing from smooth-bore mortars is at best somewhat wild, and depends on quantity for its effectiveness. It is, however, safe to say that no fleet nor vessel can remain under well-directed fire from heavy mortars. A battery of one hundred heavy mortars will keep at bay all the iron-clads that can maneuver or anchor within their range. The moral effect of mortar-firing is appalling, and increases vastly with the numbers of mortars used. The armor that a vessel is capable of carrying on her deck, in addition to that upon other parts, is not sufficient to resist the crushing power of a 13-inch shell with maximum velocity —419 feet per second. The 10-inch mortar is serviceable only against unarmored decks, or those very slightly protected. In firing at iron-clads the shells should not burst before striking; in fact, it is best to fill the shells with sand instead of powder. Solid shot would be preferable to either. Mortars mounted on the center-pintle traversing chassis, and provided with complete pointing apparatus, are capable of following the course of a moving vessel with the same facility as a gun.

Mortars, like other cannon, are aimed by first giving the direction and then the elevation. The elevation, which is usually that of the greatest range of projectiles in *vacuo*, viz., 45°, is determined by applying the quadrant to the face of the piece, and raising and lowering the breech until that number of degrees is indicated. The charge of powder is varied to suit the required range. To give the shell, for the same range, a greater velocity in the descending branch of its trajectory, the mortar is sometimes fired at an angle of 60°, in which case the charge of powder must be increased accordingly. As mortars are usually masked from the object to be bombarded by an epaulment or parapet, different means from those used with guns become necessary for giving them their direction. There are several processes employed, all of which, however, are reduced to determining practically two fixed points which shall be in line with the piece and the object, and sufficiently near to be readily distinguished by the person pointing the mortar. These points determine a vertical plane which when including the line of metal becomes the plane of fire. See *Bob*, *Coehorn Mortar*, *Dyer Pointing Apparatus*, *Ordnance*, *Paddock Interpolater*, *Plummet*, *Sea-coast Mortar*, and *Siege Mortar*.



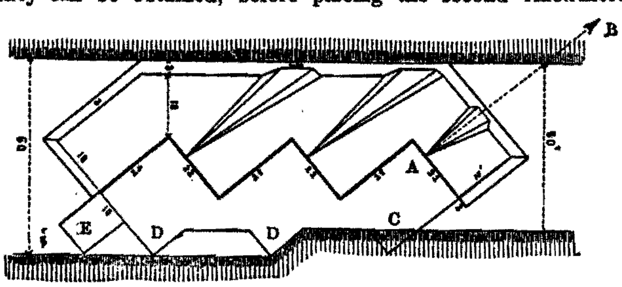
1. Cheeks. 2. Maneuvering bolt. 3. Deck plank. 4. Sleeper. 5. Cap square. 6. Cap straps. 7. Bolster. 8. Quoin. 9. Eye bolts.

MORTAR BATTERIES.—Mortar batteries have principal features of batteries for guns. It is desirable that they should be located where good views of the enemy's position may be had: this, in order that the gunner may himself see the effect of his shot, and not, as is too frequently the case, have to depend upon the imperfect report of a distant observer. For siege mortars, the platforms are placed the same distance apart as for siege guns, viz., 16 feet; for sea-coast mortars, the distance is the same as for sea-coast guns, viz., 18 to 22 feet. They are usually placed in pairs, with traverses between each set of pairs. Embrasures are not required, and as the platform must be at such distance from the parapet that the blast will not injure the interior crest, it is not necessary to revet the interior slope, the earth being allowed to assume its natural slope.

There are two kinds of mortar batteries used in the attack: those for mortars throwing shells; and those for mortars throwing baskets of stones, or other like projectiles. Besides these, there is the Coehorn mortar, which, from its small size, may be placed in any unoccupied corner of the trenches within their range from the besieged works. The first kind of batteries may be in front of the first and second parallels, or any other points farther back. The positions chosen for them should be such as to bring as great a portion of the defences under the direction of their fire as practicable, to increase the chances of destructibility of each shell thrown. The second kind are usually placed in front of the third parallel, mainly with a view to annoy the coveredways and parts adjacent. These batteries are usually sunk below the natural surface, since even several feet difference of level in the position of a mortar will have but little effect on the range, or the trajectory. The profile suitable for such positions, under the ordinary circumstances, is the following. Width of trench at bottom, 13 feet 6 inches. Depth in front, 3 feet 6 inches. Depth in rear, 4 feet. Reverse slope, ¼. Front slope, 2 feet base. Height of parapet, 4 feet. Thickness of parapet, 18 feet. Berm, 1 foot. The earth for the epaulement is taken from an exterior ditch; and, when splinter-proof traverses are required, portions of ditches are made opposite to their position to furnish the requisite earth.

The siege-mortar platform furnished for field-purposes is too light to sustain much firing. For fixed batteries, they should be constructed of heavy timbers, and to insure anything like accuracy in firing, must be both level and stable. The sea-coast platforms when properly laid, are in every respect efficient. A good kind of rail platform may be made by using two pieces of timber, 12 to 15 inches square and 9 feet long for the rails, to which planks 2 or 3 inches thick and 8 or 9 feet long are spiked. The rails are parallel, and have their centres 28 inches apart for the 10-inch mortar, and 22 inches for the 8-inch. A pit is dug large enough to receive this structure, and the bottom being made perfectly level, it is placed in it with planks *down*. Earth is filled in on top of the planking. This kind of platform is particularly well adapted to sandy localities. If the mortar is intended to be fired in various directions, a sufficient number of rails are used to extend over the whole surface, the planks being spiked to all of them. Mortar and other batteries for firing loaded shells, are provided with bomb-proof shelters for the men who load the shells, and others also for the loaded shells. These shelters may be placed in the epaulements of the batteries, under thick traverses, or in any position most convenient for the service of the battery.

When the site of the battery is marshy, the construction of the parapet and the laying of the platforms require great care to give them the requisite strength and firmness. Each of these parts should receive a firm bottoming of two layers of long fascines, 12 inches in diameter, the border for a breadth of 2 or 3 feet receiving a thickness of 3 or 4 layers, the first well covered with sand or rammed clay, if they can be obtained, before placing the second

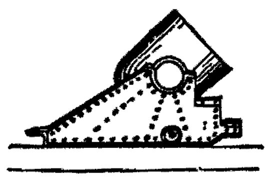


layer, which should cross the first at right angles, and be well picketed to it. On this bed the parapet is raised, and, if the adjacent soil of which it is formed is very wet, layers of smaller fascines may be advantageously used at different heights to prevent the wet soil from running. The site of the guns should be covered, to a depth of at least 6 inches, with moist sand, or good loam well rammed, to receive the platforms; which, like those at the sieges of Forts Pulaski and Wagner, should rest on a bed of plank, over which the weight of the guns should be well distributed by the under timbers of the platform.

On a site of solid rock the only means that can be well employed for constructing the parapet is sand-bags. If the surface of the rock on which the platforms are to rest, is too uneven or too much inclined to be easily leveled by hammers, it will be necessary to fill in the space required for the service of the guns with earth or sand, and to use a cribwork if necessary around the border of the interior to confine the soil, which, as in the case of a marshy soil, should be well rammed and levelled before laying the platforms.

The drawing shows a plan of an indented sunken battery on a causeway from 50 to 60 feet wide. A.B. is the line of direction of fire; C, contraction of rear of battery; D D, enlargement of rear of battery; E, ramp.

MORTAR BEDS.—Mortar beds serve the same purpose as gun-carriages. The beds for the smaller



mortars are made of one solid block. The larger beds are constructed and put together in a manner similar to the top-carriages for guns. At the ends of each cheek are projections, called front and rear notches, underneath which the cannoneers embar with their handspikes to move the carriage. On those for siege mortars there are also two front and two rear maneuvering bolts for the same purpose. The bottom part of each cheek, resting on the platform, is called the shoe; the front and rear ends being designated the toe and heel, respectively. Carriages for siege mortars are without truck-wheels, and rest directly on the platform. Sea-coast mortars have two truck-wheels on an eccentric axle, for maneuvering the carriage on the platform, and maneuvering bolts are omitted. See *Mortar Carriages* and *Thirteen-inch Mortar*.

MORTAR CARRIAGES.—The application of the principle of rifling to mortars, in common with guns of all kinds, has had the effect to obliterate to a great degree the sharply-defined lines of distinction which formerly divided the different classes of cannon, and to reduce them more closely to a common model, adapted more nearly to a common use. The rifled mortar, to give it the desired efficiency, has been increased in length until it differs in no respect from a howitzer or short gun, and is no longer confined as formerly to a vertical fire exclusively, but may be used with effect for direct or curved fire, with solid or hollow shot, as well as shell. The carriages for the different guns have had to undergo necessarily corresponding changes to adapt them to the new conditions of service; and as the guns have been modified till they bear a resemblance to each other, so the carriages on which mounted are less distinctive in appearance and more nearly approach the same pattern. The mortar, in place of being mounted as formerly on its bed, must in its changed condition be provided with a carriage constructed so as to enable it to deliver its fire at any angle from 0° to 60°, and be turned with promptness on any object within a wide field of fire.

United States.—The Coehorn mortar carriage is simply a block of wood, weighing 132 pounds; the total weight of piece, equipments, and carriage being 311 pounds. The carriage or block upon which the mortar is mounted, is provided with two handles on each side, by means of which the mortar is readily carried by four men from one part of the work to another. They accompany troops in the field for use against an enemy covered by intrencha half face to the left so as to bring the right side toward the horse's flank; carry the right foot three inches to the rear; take the reins with the right hand aided by the left, and place the right hand on the pommel, the reins coming into the hand between the thumb and fore-finger, and held so as to feel lightly the horse's mouth. (Two.) Each recruit places a third of the left foot in the stirrup, with the assistance of the left hand if necessary, and supports it against the forearm of the horse; rests upon the ball of the right foot; places the left hand on top of the neck, well forward, and grasps a lock of the mane, the lock coming out between the thumb and fore-finger. The Instructor then commands: 2. MOUNT. At this command, spring from the right foot, holding firmly to the mane, and keeping the right hand on the pommel; bring the heels together, the knees straightened and resting against the saddle, the body erect. (Two.) Pass the right leg extended over the croup of the horse without touching him; let the body come gently down into the saddle; let go the mane, insert the right foot in the stirrup, pass the reins into the left hand and adjust them. At the commands, 3. *Form*, 4. RANK, the even numbers move up upon reaching the saddle, a position should be assumed with the buttocks bearing equally upon the saddle, and as far forward as possible; the reins coming into the left hand on the side of the little finger, and leaving it between the thumb and fore-finger; the little finger between the reins, the other fingers closed, the thumb pressing the reins firmly on the second joint of the fore-finger; the left forearm horizontal, the fingers six inches from the body and turned toward it; the little finger a little nearer the body than the upper part of the hand; the right hand behind the thigh, the arm falling naturally, the feet inserted one-third of their length in the stirrups, the heels slightly lower than the toes.

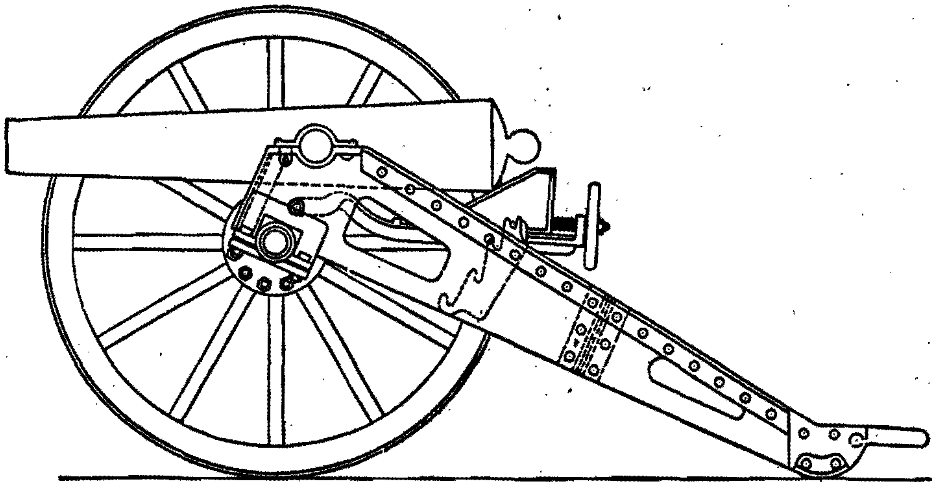
MOUNTAIN ARTILLERY.—Mountain artillery is designed to operate in a country destitute of carriage-roads, and inaccessible to field artillery. It must, therefore, be light enough to be carried on pack-animals. The piece used for mountain service in the United States is a short, light 12-pdr. howitzer, weighing 220 lbs. The form of the chamber is cylindrical, and suited to a charge of ½ lb. of powder. The projectiles are shells and case-shot. It is discharged from a low, two-wheel carriage, which serves for transportation whenever the ground will permit. When the piece is packed, the carriage is packed on a separate animal The mountain howitzer is also employed for prairie service, and in defending camps and frontier forts against Indians, in which case it is mounted on a light, four-wheel carriage, called "the prairie carriage." In the Mexican war, the mountain howitzer was found useful, from the facility with which it could be carried up steep ascents, and to the tops of flat-roofed houses, in street-fighting. See *Field Artillery*.

MOUNTAIN ARTILLERY CARRIAGE.—The carriage for the mountain-rifle is similar in material and general construction to that of the field-gun, and combines strength, simplicity, and lightness. The axle is without an axle-body, and the wheels have metal naves.

The mountain-howitzer carriage should be light enough to be carried on the back of a pack animal, and the axle-tree should be short enough to permit it to pass through very narrow defiles. It differs in construction from the field-carriage, inasmuch as the stock and cheeks are formed of the same piece, by hollowing out the head of the stock. The wheels are thirty-eight inches in diameter, and the axle-tree is made of wood, the arms being protected from wear by *skeans*, or strips of iron. The distance between the wheels is about equal to their diameter. It is arranged for draught by attaching a pair of shafts to the trail. The pack-saddle and its harness are constructed to carry severally, the howitzer and shaft, the carriage, or two ammunition chests, or it enables an animal to draw the carriage, with the howitzer mounted upon it. A portable forge accompanies each mountain battery, and is so constructed that it can be enclosed in two chests, and carried, with a bag of coal, upon the pack-saddle.

The Russian carriage has very short cheeks, the front ends of which are cut off obliquely instead of vertically; the trunnion-beds are let into this oblique face, and the trunnions are held by cap-squares and keys. Krupp makes two sizes of carriages for the 8-centimeter and 6-centimeter guns, respectively. The elevating-screw admits of 18° of elevation and 10° depression. The ammunition-chests are made of wood, with iron angle-pieces.

The English have two carriages, as shown in the drawing, for the two 7-pounder guns, one of which weighs 150 pounds when made of steel, and 200 pounds if made of brass; the other weighs 200 pounds when made of steel, and 224 if made of bronze. The wheels are 30 inches and 36 inches in diameter, respectively, and have a track of 27 inches. The elevating apparatus consists of a movable bed, which hooks on a cross-bar between the cheeks over the axle, and has two studs, one on each side, to rest in racks riveted to the inside of the trail-pieces. A sliding-quoin rests on the bed, and is worked by a screw which passes through a collar in the end of the bed and enters a nut in the quoin. A light iron limber is made for the heavier carriage, and carries two ammunition-chests, which contain ten rounds of ammunition each.



In transportation the gun is carried in Russia and

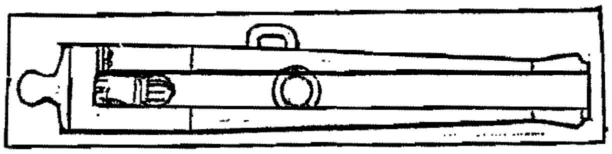
Naissant.

NAISSANT.—A term applied in heraldric blazon to an animal depicted as coming forth out of the middle—not like *issuant* or *jessant* out of the boundary line—of an ordinary.

NAKED BULLET.—A grooved or cannelured bullet as distinguished from the patched bullet. See *Bullet*.

NANA.—In the East Indies, the title which is given to a Chief of the Mahrattas. It more properly signifies the acting head of the Government, and General of the forces.

NAPOLEON GUN.—In 1856 it was proposed to increase the power of the light and diminish the weight of the heavy field artillery, by the introduction of a single piece of medium weight and caliber. The form of the new piece is shown in the drawing. It has no chamber and should therefore be classed as a gun. Its exterior is characterized by the entire absence of molding and ornament; and in this respect it may be at once distinguished from the old field cannon. The first reinforce is cylindrical; and it has no second reinforce, as the exterior tapers uniformly with the chase from the extremity of the first reinforce. The size of the trunnions and the distance between the rimbases are the same as in the 24-pdr. howitzer, in order that both pieces may be transported on the same kind of carriage. The *diameter of the bore* is that of a 12-pdr. The *length of bore* is just 13¾ calibers. The *weight* is one hundred times the projectile, or 1,200 lbs. The *charge of powder* is exactly the same as that for the heavy 12-pdrs. (pattern of 1840), or 2½ lbs. for solid and case shot, and 2lbs.



for canister shot. It has, therefore, as great range and accuracy as the heaviest gun of the old system; and, at the same time, the recoil and strain on the carriage are not so severe. The new gun and carriage weigh about 500 lbs. more than the 6pdr. and carriage; still it has been found to possess sufficient mobility for the general purposes of light artillery. The effect of this change is to simplify the *matériel* of field artillery, and to increase its ability to cope with the rifle-musket, principally by the use of larger and more spherical case-shot. The principal objection to an increased caliber for light field-guns is the increased weight of the ammunition, and the reduction of the number of rounds that can be carried in the ammunition chests. See *Field Artillery*.

NASAL.—A kind of peak or visor, on ancient helms for the protection of the nose.

NASIR-JUNG.—An Indian term expressing victorious or triumphant in war.

NATION.—A word used in two distinct senses. 1. A State or Independent Society united by common Political Institutions. 2. An aggregate mass of persons connected by ties of blood and lineage, and sometimes of language. The modern dogma of nationalism, as maintained by a class of Continental Politicians, starts from an assumption that a nation in the latter sense ought necessarily to be also a Nation in the former, and endeavors to assign limits to the several races of Europe, with the view of erecting each into a distinct State, separated from other States or Nationalities. The extreme Politicians of the National School seem to consider the supposed rights of Nationalities as paramount even to the obligations of treaties, and the political conjunction of one Nationality with another is looked on by them as an adequate ground for a revolt or separation, apart altogether from the question whether the Nationality is well or ill governed. In point of fact, the different races in Europe are so commingled, that any reconstruction of the political map of Europe, on ethnological principles, would be impossible, even if desirable. The blood of nine-tenths of Europe has been mixed within the historical period. The test of language, on which Nationality has sometimes been based, is a deceptive one, in so far as it is indefinite and perpetually fluctuating. The people on the frontier between two races, as in the South Tyrol, generally speak two languages. Then we have dialects, like the Walloon, the Grödnerisch of the Tyrol, and the Romansch of the Grisons—as also the Breton, Welsh, Gaelic, and Irish languages, which could hardly be made the basis of independent communities. The well-being of the people governed is properly the end of all government, and it has practically not been always found that a State is better governed when it consists of one race only, than when it includes an aggregate of races. Highly diversified Nationalities may be united in one political system, provided only that the Government respects and consults the peculiarities of the several races and does not attempt to force the usages, habits, or language of one on the rest.

NATIONAL ANTHEM.—A selection of music set to words, and common to all nations. In England the national anthem is "God save the Queen," which is played when troops pay the prescribed honors to the Sovereign and members of the Royal Family; in the latter case only six bars of the anthem are played. The first part of the national anthem may also be played at the salute of a Viceroy, at state ceremonials, and at the trooping of colors. The playing of the national anthem is only due to those personages who are entitled, under the regulations, to a royal salute.

NATIONAL ARMORY.—A national establishment for the manufacture of small-arms, etc. The manufacture of United States small-arms and small-arm ammunition for the present armies and militia, and for the reserve supply, is one of the greatest importance, and the Springfield Armory is a model one of the world in the perfection of its fabrications, the extent and completeness of its arrangements and the facilties for the production of this class of war-like stores.

NATIONAL ARMORY CIRCULAR CUTTER.—A modification of the Adams cutter, from which it differs only in the details of its form and dimensions. The diameter of the circle which forms the cutting-edge is 3″; the angle formed by the elements of the two right cones whose intersection forms that edge is 60° instead of 61° 20′. The altitudes of these cones are the same, and are equal to 0″.866. The thickness of the disk is 0″.25 The angle of 60° was adopted for the edge as being an angle which could be accurately formed in a turning-lathe without difficulty, as almost every machinist possesses an equilateral triangular gauge by which he can verify at any instant the angle included between the legs of the striding-gauge that he uses to guide him in turning the bevels. The diameter and thickness of the disk-plate were chosen with reference to retaining the angle of 60°, and with reference to ease of exact measurement by practical mechanics. By assuming these dimensions the strength of the cutter is not impaired; it is rendered a little more sensitive to small differences of pressure than the Adams cutter; and its dimensions, both linear and angular, are easily preserved in fabrication by any one of ordinary mechanical skill. The limits of these linear dimensions, whether expressed in hundredths or thousandths of an inch, can always be made to fall upon the larger and more common divisions of almost any English scale of inches. The special advantage of the circular cutting or indenting edge is that it can be readily pressed into the indentation, previously made in the copper block or disk while

ORDNANCE.—The term ordnance includes cannon of all kinds fired from carriages, slides, beds, tripods, etc. Cannon are classified according to their nature, as guns, howitzers, mortars, and machine-guns, and according to their uses as field, mountain, siege, and sea-coast. Guns are further classified as to their construction, as smooth-bore and rifle; as muzzle-loading and breech-loading; and as cast and built up cannon. All ordnance for land service in the United States is made by private Contractors, under the direction of officers of the Ordnance Department. Rifled howitzers and mortars, and guns with chambers for large charges, are now under consideration. Rifled breech-loading field-guns are also under trial. For the present, until superior armament can be provided, guns of obsolete patterns and kinds are retained in service. Standard guns, howitzers, and mortars take their denomination from the caliber in inches.

Heavy modern ordnance dates properly from the casting of the great Rodman smooth-bores in the United States. To the impetus thus given may be ascribed the origin of the powerful guns of the present day. In Rodman's study of gunpowder and the improvements introduced by him, lay the germ of all subsequent progress in ordnance. His most important invention, *perforated cake powder*, was transplanted bodily to the Continent of Europe, where, under the name of *prismatic powder*, it has been used ever since. So perfect is the theory of this powder, that invention and science toiling over the subject for twenty years has produced nothing better. Since the first half of the decade—1860-70—the United States has fallen behind the nations of Europe in the power of her armament. Having been committed by her two great inventors, Rodman and Dahlgren, to cast-iron smooth-bores, which were fabricated in great numbers, her attitude has been that of Micawber—"waiting for something to turn up." England occupies the other extreme,—of all the powers she has ventured the greatest sums upon the theories of her gun-makers. Her private manufacturers have received such encouragement at home or abroad that they are now able to supply the whole world. Their only great rival on the Continent is Krupp, who finds his market principally in Germany, Russia and Turkey.

The early adoption of the rifle principle by all European powers placed them at once on a plane of advancement. The vexed questions of breech and muzzle-loading and of gun construction have been decided by each nation in the manner most satisfactory to itself. Opinions differ widely, and it is probable that many changes may be made in these matters. Still they all possess powerful guns which have certain features in common, essential to heavy ordnance in the present stage of its development. Large-grained powder, the first of these requisites, is universally used. Great length of bore, to utilize the whole force of the powder, is another characteristic. Great power is secured by immense charges of powder and weight of shot. A caliber of at least 12 inches, giving an oblong shot of about 700 pounds, seems to be regarded as a *sine qua non* for all armaments. England has taken the lead in all these improvements, and though it would appear from recent events that her choice of gun systems is unfortunate, there is no question that all great advances since Rodman's day have been based upon her expensive experiments. The work of the celebrated "Committee on Explosives," 1875, of which Col. Younghusband and Capt. Noble (now a member of Sir Wm. Armstrong's firm), were members, did more to this end than any other investigation since General Rodman's experiments in gunpowder. Acting upon the obvious idea that the peril to the life of the gun is relieved by air-space, the Committee recommended the enlargement of the bore at the seat of the charge, or the use of a chamber larger than the bore. This simple expedient led at once to an increase in the power of guns while the pressure endangering them was kept at a point lower than before. Every good thing can be pushed too far. The immense charges made possible by the English chamber have been continually added to by the Italians in their 100-ton Armstrong monsters and the vital air-space greatly reduced till a charge of about 552 pounds of powder has recently (1880) burst one of these magnificent guns.

The following table gives an interesting comparison between the largest guns at present existent:

Type of Gun.	Calibre.	Length of gun.	Weight.			Initial velocity.	Total energy at the muzzle per kilogramme of the weight of gun.
			Gun.	Shot.	Charge.		
	Mm.	Met.	Kilogrammes.			Met.	
Krupp, 35-cal. 30.5 c. m.	305	10.70	48,550	455	141	530	.104
Krupp, 35-cal. 35.5 c. m.	355	12.40	81,350	725	225	530	.103
German, 30.5 c. m. mar.	305	6.70	36,600	325	72	488	.103
Russian, 12 in. (long)	305	9.14	43,341	344	128	597	.14
French, pat. 1870, 32 c. m.	320	6.70	39,000	341	86	470	.104
English, 80-ton m. l.	406	8.15	82,300	771	204	498	.114
English, 63-ton b. l.	343	10.97	64,000	567	283	624	.175
Italian, 100-ton b. l.	432	11.89	103,100	908	300	558	.118
French, pat. 1875, 34 c. m.	340	6.7	48,340	420	117	480	.101
Bange, 34 c. m.	340	11.20	37,500	450	180	600	.221

Tables I, II, III, and IV, on pages 443, 444, 445, and 446, embody the principal dimensions and weights of ordnance and ammunition of the United States Land Service. The tables, pages 447-456, together with the descriptions of ordnance referred to in this Encyclopedia, at the close of this article, will enable the reader to trace the history of ordnance, ancient and modern, and at the same time, to make comparisons of that pertaining to the various military services. See *Armstrong Guns, Artillery, Blakely Gun, Breech-insertion, Bronze Guns, Built-up Guns, Cannon, Cannon Metals, Cast-iron Guns, Cast-steel Guns, Converted Guns, Cooling of Castings, Dahlgren Gun, Elswick Gun Works, Fabrication of Tubes, Fifteen-inch Gun, Fraser Gun, French Army Ordnance, Gun Construction, Inspection of Ordnance, Mann Gun, Moffatt Gun, Mortar, Palliser Gun, Parrott Gun, Parsons Gun, Rifled Howitzers, Rodman Gun, Schultz Wire Gun, Sutcliffe Gun, Systems of Artillery, Thompson Gun, Uchatius Gun, Whitworth Guns, Wire Guns,* and *Woolwich Gun.*

Table I.—Standard Ordnance.

Nature of ordnance.	Material.	Caliber.	Weight.	Preponderance.	Windage	Lengths.			Diameters.			Rifling.					Venting.				
						Of entire piece.	Of bore in inches.	Of trunnions.	At base line.	At muzzle.	Maximum.	Twist in feet.	Number of grooves.	Width of grooves.	Depth of grooves.	Width of lands.	Diameter of vent.	Dis. from bottom of bore.	Dis. fr'm ver. plane thro' axis of bore.	Height of head.	Diameter of head.
SEA-COAST PIECES.																					
Guns.		*In.*	*Pounds*	*Lbs.*		*Inch.*		*In.*	*Inch.*	*Inch.*	*Inch.*			*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*In.*	*In.*
12 inch rifle (model 1874)	Cast iron, wrought iron lined.	12	89,600	0	0.09	262.8	227	6.3	55	27.50	55	70	21	0.8976	0.09	0.8976	0.2	9.5	3.0	0.75	1.75
12-inch rifle (model 1870)	Cast iron.....	12	82,878	0	0.09	240	209	5	54	28	54	80	21	1.045	0.1	0.75	.2	4	3	0.75	1.75
10-inch rifle	Cast iron, wrought iron lined.	10	40,681	0	0.08	180	158.5	4.5	45	21	45	50	17	0.924	0.08	0.924	.2	3	2	0.75	1.75
8-inch rifle (converted).............	......do	8	16,160	0	0.05	136.66	117.25	3.25	32	16.2	32	40	15	0.8377	0.075	0.8377	.2	3.5	2.5	0.75	1.75
20-inch smooth bore...	Cast iron	20	115,200	0	0.19	243.5	210	6.5	64	34	64	......	......	....	....	....	.2	7.5	4	0.75	1.75
15-inch smooth bore (model 1874)	......do	15	70,778	......	0.15	215	190	4.5	51	24.7	51	......	......	....	....	....	......	......	....	0.75	1.75
15-inch smooth bore (model 1861)	......do	15	49,099	0	0.15	190	165	4.5	48	25	48	......	......	....	....	....	0.2	4	3	0.75	1.75
13-inch smooth bore	......do	13	38,500	0	0.14	177.61	155.85	4.5	45	21	45	......	......	....	....	....	.2	3	....	0.75	1.75
Mortars.																					
15-inch smooth bore	Cast iron.....	15	33,675	0	0.13	75	51.25	5	......	50	52	......	......	....	....	....	0.2	3	3.5	......	......
13-inch smooth bore	......do	13	17,250	0	0.13	56.5	35	4.5	......	43	43	......	......	....	....	....	.2	3	2	......	......
SIEGE PIECES.																					
Guns.																					
4.5-inch, rifled	Cast iron	4.5	3,450	300	0.05	133	120	4	15.6	9	16	15	9	0.97	0.075	0.6	0.2	1.75	0	0.62	1.25
Howitzers.																					
8-inch smooth bore	Cast iron.....	8	2,600	380	0.12	60	46.5	5	17.5	15	17.5	......	......	....	....	....	0.2	2	0	......	......
Mortars.																					
10-inch smooth bore	Cast iron	10	1,900	0	0.13	29.25	20.5	3.25	20	20	20	......	......	....	....	....	0.2	2	1.5	......	......
8-inch smooth bore..................	......do..	8	1,050	0	0.12	23.25	16	3.25	16	16	16	......	......	....	....	....	.2	1	1.5	......	......
5.82-inch smooth bore, Coehorn	Bronze........	5.82	164	0	0.14	16.32	13.07	2.5	......	7.65	8.65	......	......	....	....	....	.2	.4	0	......	......
FIELD PIECES.																					
Guns.																					
4.62-in.(12-pounder)smooth bore	Bronze........	4.62	1,230	105	0.10	72.55	63.6	3.25	11	7.5	11	......	......	....	....	....	0.2	1.15	0	......	......
3.5-inch rifle	Wro'ght iron	3.5	1,156	0	0.05	73.84	65	3.25	......	6.7	11.2	12	7	1.07	0.075	0.5	.2	1.5	0	......	......
3-inch rifle..............................	......do	3	830	40	0.05	72.65	65	2.8	9.27	6	9.7	10	7	0.84	0.075	0.5	.2	1.25	0	......	......
1.65-inch rifle (breech-loader), mountain	Steel..........	1.65	116.85	......	0	45.86	41.35	1.77	......	2.55	5.03	4.1	10	0.362	0.012	0.157	......	0	....	0.98	0.70
1.45-in. cannon-revolver, Hotchkiss	......do	1.457	1,212.605	......	0	66.75	50.39	......	......	......	......	4.1	6	0.314	0.019	0.447	......	......	....	......	......
0.45-inch Gatling......................	....	0.45	195.5	......	0	49.7	32	......	......	5.82	6.56	1.16	......	0.1413	0.010	0.1418	......	......	....	......	......
0.45-inch Gatling (cavalry)	....	0.45	....	......	0	....	....	......	......	......	......	......	......	....	....	....	......	......	....	......	......
Howitzers.																					
4.62-inch smooth bore, mountain	Bronze........	4.62	220	30	0.10	37.21	30.91	2.25	......	6.9	7.6	......	......	....	....	....	......	0.4	0	......	......

Table II.—Ammunition.

Nature of ordnance.	Charge.			Projectiles.*						
	Windage.	Kind of powder.	Weight, maximum.	Shot.	Shell, empty.	Bursting charge.	Initial velocity.	Muzzle energy.	Elevation.	Range.
	Inches.		*Pounds.*				*Feet.*	*Ft-tons.*	° ″	*Yards.*
SEA-COAST PIECES.—*Guns.*										
12-inch rifle (model 1874)	0.09	Hexagonal	110	700			1,396	9,443		
11-inch rifle (model 1870)	0.05	do.	100	600			1,310	7,182		
10-inch rifle	0.05	do.	80	400	360		1,430	5,670		
8-inch rifle (converted)	0.05	do.	35	180	150		1,414	2,510		
10-inch rifle (Parrott, 300-pounder)		Cannon	25	300	250				13 30	4,920
8-inch rifle (Parrott, 200-pounder)		do.	16	200	150				11 47	4,272
6.4-inch rifle (Parrott, 100-pounder)		do.	10	100	80 to 100		1,222 to 1,335		35 00	8,453
7-inch rifle (banded, 42-pounder)										
6.4-inch rifle (banded, 32-pounder)										
20-inch smooth bore	0.13	Mammoth	200	1,080	725				25 00	8,000
15-inch smooth bore (model 1874)	0.13			450	330	17				
15-inch smooth bore (model 1861)	0.13	Hexagonal	125	450	330	17	1,735	9,449		
13-inch smooth bore	0.13	Mammoth No 5	70	283 to 300	224	7	1,597	5,837		
10-inch smooth bore	0.13	Cannon No. 5.	25	128	100	3	1,500	1,996		
8-inch smooth bore	0.13	Cannon	15	68	48	1.8				
Mortars.										
15-inch smooth bore	- 0.13	Mortar			330					
13-inch smooth bore	0.13	do.	20		216	7			45 09	4,636
10-inch smooth bore	0.13	do.	12		101.67	2			45 00	4,536
SIEGE PIECES.—*Guns.*										
4.5-inch rifle	0.5	New mortar	7	35	25		1,420	503.2		
4.2-inch rifle (Parrott, 30-pounder)		do.		25 to 30	29		1,293		25 00	6,700
Howitzers.										
8-inch smooth bore	0.12	Mortar	4		45	1.8	1,070		12 30	2,280
5.82-inch smooth bore (flank defense)	0.14	do.	2		17	0.75			5 00	1,322
Mortars.										
10-inch smooth bore	0,13	Mortar	4		88	3			45 00	2,064
8-inch smooth bore	0.12	do.	2.25		44	1.8			45 00	2,225
5.82-inch smooth bore, Coehorn	0.14	do.	0.5		17	0.75			45 00	1,200
FIELD PIECES.—*Guns.*										
3.5-inch rifle	0.05	New Mortar	3	16.75			1,314			
3-inch rifle	0.05	do.	2	10	9.5		1,418			
3-inch rifle (Parrott, 10-pounder)		do.	1	10.5	9.75		1,232		20 00	5,000
1.65-inch rifle (breech-loader) mountain, Hotchkiss	0									
1.457-inch cannon revolver, Hotchkiss			1,851 grs.		7,716 grs.	617 grs.	1,476			
4.62-inch (12-pounder) smooth bore	0.10	Mortar	2.5	12.3	8.34	.702	1,495		10 00	2,000
1-inch Gatling		Musket	325 grs.	3,500 grs.						1,200
0.5-inch Gatling		do.	70 grs.	450 grs.			1,350		4 45	1,000
0.45-inch Gatling		do.	70 grs.	405 grs.						
Howitzers.										
6.4-inch smooth bore	0.10	Mortar	3.25	Case, 30.75	23.03	1.4	1,182		15 00	2,344
4.62-inch smooth bore mountain	0.10	do.	0.5	Canister, 12.17	8.34	1.10			5 00	1.005

* Except for machine-guns and the Hotchkiss mountain breech loading gun, shot and shell for rifled guns are fitted with an expanding sabot, to communicate to the projectile the rotation due to the rifling. No special sabot, however, has as yet been adopted as standard. The Butler, Parrott, Arrick, and Dana all give good results.

Table III.—Retained Ordnance.

Nature of Ordnance.	Material.	Caliber.	Weight.	Preponderance.	Windage.	Lengths.				Distances.			Diameters.			Rifling.			
						Of bore.	Of rifled part of bore.	Of semi-axis of ellipse, bottom of bore.	Of trunnions.	From axis of trunnions to face of muzzle.	Between rimbases.	From base line to face of muzzle.	At muzzle.	Maximum.	Of trunnions.	Twist.	Number of grooves.	Width of grooves.	Depth of grooves.
SEA-COAST PIECES.																			
Guns.		*In.*	*Lbs.*	*Lbs*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*Ft.*	*In.*	*In.*	*In.*
10-inch rifle (Parrott, 300-pounder)	Cast-iron with wrought-iron jacket.	10	26,500	0	......	144	....	5 rad.	4.5	105	36	......	20	40	10	......	15	1.0472	0.1
8-inch rifle (Parrott, 200-pounder)	......do	8	16,300	0	......	136	....	4 rad.	4.5	96	26	......	16.2	32	10	......	11	1.1424	0.1
6.4-inch rifle (Parrott, 100-pounder)	......do	6.4	9,700	0	......	130	....	3.2 rad.	5	91.8	22	......	13	25.9	8	......	9	1.1170	1.1
7-inch rifle (banded, 42-pounder) .	Cast-iron	7.018	....	....	......	109	106	....	6.5	70.491	22	......	12.4	25.9	7.018	35	15	0.869	0.075
6.4-inch rifle (banded, 32-pounder)	......do	....	....	....	......	107.59	104.59	....	6	68.595	21	......	11.75	25.9	6.41	30	13	0.946	0.075
10-inch smooth bore, Rodman......	......do......................	10	15,059	0	0.13	120	....	7.5......	3.25	87.76	32.1	110	16.2	32	10	......	......	....	....
8-inch smooth bore, Rodman......	......do......................	8	8,490	0	0.12	110	....	6	3.25	79.83	25.7	101	13.2	25.6	8	......	......	....	....
Mortars.																			
10-inch smooth bore	Cast-iron	10	7,300	0	0.13	32.5	....	7.5	3.25	22	30.4	......	30	30	12	......	......	....	....
SIEGE PIECES.																			
Guns.																			
4.2-inch rifle (Parrott, 30-pounder)	Cast-iron with wrought-iron jacket.	4.2	4,200	....	......	120	....	2.1 rad.	2.75	82.15	16.8	......	8.6	18.3	5.3	.. ...	5	1.319	0.1
Howitzers.																			
5.82-in. smooth bore, flank-defense	Cast-iron	5.82	1,476	70	0.14	58	....	....	3.25	35	12.8	......	11.17	13.8	4.62	......	......	....	....
FIELD PIECES.																			
Guns.																			
3-inch rifle (Parrott, 10-pounder)...	Cast-iron	3	890	....	......	70	....	1.5 rad.	2.8	46.1	9.5	......	5.8	11.32	3.67	6	3	1.5708	0.1
1-inch Gatling	Steel	1	1,008	110	0	33	....	....	......	....	......	......	....	6.8	....	3.6	6	....	0.01
0.5-inch Gatling.........................	......do......................	0.5	365	45	0	32	....	....	......	——...	......	......	....	6.0	....	......	6	....	0.01
Howitzers.																			
6.4-inch smooth bore	Bronze	6.4	1,920	160	0.15	71	....	....	3.5	41.99	12	......	11.2	13.8	4.62	......	......	....	....

Table IV.—Obsolete Ordnance.

Nature of Ordnance.	Material.	Weight.	Preponderance.	Natural angle of sight.	Lengths: Of bore, exclusive of chamber.	Lengths: Of chamber.	Distances: From rear base-ring to muzzle.	Distances: From axis of trunnions to face of muzzle.	Distances: Between rim-bases.	Diameters: Maximum.	Diameters: At swell of muzzle.	Diameters: Of trunnions.	Diameters: Chamber: Maximum.	Diameters: Chamber: Minimum.	Windage.
SEA-COAST PIECES.															
Guns.		*Lbs.*	*Lbs.*	° ″	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
10-inch smooth-bore columbiad, model 1844....	Cast-iron.	15,400	740	1 21	99	12	120	73.5	31	32	21.5	10	8	....	0.13
8-inch smooth-bore columbiad, model 1844.....	do....	9,240	635	1 23	100	11	119	73.5	25	26	17	8	6.4	....	0.13
7 inch smooth-bore 42-pounder, model 1841....	do....	8,465	600	....	110	....	117	70.3	22	24.4	16.8	7	....	....	0.16
6.4-inch smooth-bore 32-pounder, model 1841..	do....	7,200	695	....	107.6	....	114	68.6	20.7	23.4	15.4	6.4	....	....	0.15
Howitzers.															
10-inch smooth-bore, model 1841....................	Cast-iron.	9,500	475	....	96	9.5	112	67	25	26.5	20.25	8	7	....	0.13
8-inch smooth-bore, model 1841.....................	do....	5,740	462	....	85.5	7.5	98	57.4	20.7	22.2	16.5	6.4	6.4	....	0.12
Mortars.															
13-inch smooth-bore, model 1841....................	Cast-iron.	11,500	....	....	26	13	....	47		36	35.5	12	9.5	7.25	0.13
10-inch smooth-bore, model 1841....................	do....	5,775	....	....	25	10	....	41.5	27.5	27.5	27.5	9	7.15	5.64	0.13
SIEGE PIECES.															
Guns.															
5.82-inch smooth-bore 24-pounder, model 1839.,	Cast-iron.	5,790	395	1 30	108	....	114	68.09	18	21.4	15.586	5.82	....	....	0.14
5.3-inch smooth-bore 18-pounder, model 1829...	do....	4,913	305	1 30	108.5	....	114	67.85	16.8	19.75	13.87	5.3	....	....	0.13
4.62-inch smooth-bore 12-pounder, model 1829.	do....	3,590	270	1 30	103.4	....	108	63.69	14.8	17.4	11.864	4.62	....	....	0.10
Howitzers.															
8-inch smooth-bore, model 1841.....................	Cast-iron.	2,614	420	1 00	38.5	8	52	25.09	18	18.25	16.45	5.82	4.62	....	0.12
Mortars.															
10-inch smooth-bore, model 1841....................	Cast-iron.	1,852	....	....	15	5	....	24	20.5	20.75	20.75	8	7.6	5	0.13
8-inch smooth-bore, model 1841.....................	do....	930	....	....	12	4	....	19.5	16.25	16.5	16.5	6	6.08	4	0.12
FIELD PIECES.															
Guns.															
4.62-inch smooth-bore, 12-pounder, model 1841.	Brass....	1,757	108	1 00	74	....	78	44.99	12	13	10.34	4.62	....	....	0.10
3.67-inch smooth-bore 6-pounder, model 1841..	do.. .	884	47	1 00	57.5	....	60	34.91	9.5	10.3	8.25	3.67	....	....	0.09
Howitzers.															
5.82-inch smooth-bore 24-pounder, model 1844.	Brass....	1,318	146	1 00	56.25	4.75	65	35.4	11.5	12	9.75	4.2	4.62	....	0.14
4.62-inch smooth-bore 12-pounder, model 1841.	do....	788	95	1 00	46.25	4.25	53	27.91	9.5	10	8.2	3.67	3.67	....	0.10

ORDNANCE.

VII.—Comparative table of fire of European 10 and 11-inch rifled howitzers and mortars.

Approximate

ORDNANCE AND ORDNANCE STORES.—The general denomination "Ordnance and Ordance Stores" comprehends all cannon and artillery carriages and equipments; all apparatus and machines for the service and maneuver of artillery; all small-arms, accouterments and horse equipments; all ammunition and all tools, machinery, and materials for the Ordnance service; and all horse equipments and harness for the artillery; and, in general, all property of whatever nature supplied to the military establishment by the Ordnance Department.

It is a duty of the Chief of Ordnance to furnish estimates, and, under the direction of the Secretary of War, to make contracts and purchases, for procuring the necessary supplies of Ordnance and Ordnance Stores; to direct the inspection and proving of the same, and to direct the construction of all cannon and carriages, ammunition-wagons, traveling forges, artificers' wagons, and of every implement and apparatus for ordnance, and the preparation of all kinds of ammunition and Ordnance Stores constructed or prepared for the service.

ORDNANCE BOARD.—In the United States Army, a Board composed of such officers of the Ordnance Department as the Secretary of War may designate, and which is advisory to the Chief of Ordnance and is charged with the investigation of such subjects and the performance of such duties, and at such times and places as the Chief of Ordnance may direct. No changes are made in the established models or patterns of Ordnance and Ordnance Stores for the service of the United States except on the recommendation of the Ordnance Board, approved by the Secretary of War. See *Board of Ordnance.*

ORDNANCE DEPARTMENT.—In the United States Service, the Ordnance Department of the Army consists of one Chief of Ordnance, with the rank of Brigadier-General, three Colonels, four Lieutenant-colonels, ten Majors, twenty Captains, sixteen First Lieutenants, ten Second Lieutenants, and thirteen Ordnance Store-keepers. The Ordnance Store-keeper at Springfield Armory has the rank of Major of Cavalry. All other Ordnance Store-keepers have the rank of Captain of Cavalry. No Officer of the Army is commissioned as an Ordnance Officer until he shall have been examined and approved by a Board of not less than three Ordnance Officers, senior to him in rank. If an Officer of the Army fail on such examination he is suspended from appointment for one year, when he may be re-examined before a like Board. In case of failure on such re-examination he can not be commissioned as an Ordnance Officer. Any number, not exceeding six, of the Ordnance Store-keepers may be authorized to act as Paymasters at armories and arsenals. The Ordnance Department was first established in the United States in 1812. It was not provided for in the reduction of the army in 1815, but continued in the service. In 1821, the Department was merged into the Artillery, attaching to each regiment of Artillery one supernumerary Captain, and giving to each Company four subaltern officers. The Ordnance Corps was re-established April 5, 1832.

In the British service, the Ordnance Department was abolished by an Order in Council of May 25, 1855, after an existence of at least 400 years. Its constitution, its important functions, and the causes which led to its dissolution, will be found under BOARD OF ORDNANCE. The early history of the Department is lost in the Middle Ages; but it appears to have risen gradually under the Lancastrian kings. A Master of the Ordnance is mentioned in the time of Richard III.; but we read of John Louth being Clerk of the Ordnance as early as 1418. Henry VII. constituted the Board, adding a Lieutenant, a Surveyor, and a Store-keeper, to whom a Clerk of the Cheque, was subsequently joined. With the exception of the last, whose office was abolished in the beginning of the present century, this organization was maintained until the abolition of the whole. In 1604 James I. dignified the Master and Lieutenant with the respective titles of Master-General and Lieutenant-General. The history of the Ordnance Office is of importance in British history, as in all wars it has been responsible not only for the management of the *matériel* of the armies, but also for the direction of the *personnel* of the artillery and engineers. By an Order in Council of June 23, 1870, the Department of Ordnance in a very modified form was revived under the Surveyor-General of the Ordnance, as a section of the War Offiee, responsible for all supplies and *matériel* of War. See *Board of Ordnance.*

ORDNANCE OFFICE.—Before the invention of guns, this office was supplied by officers under the following names: the Bowyer, the Cross-Bowyer, the Galeater, or Purveyor of Helmets, the Armorer, and the Keeper of the Tents. Henry VIII. placed it under the management of a Master-General, a Lieutenant, Surveyor, etc. The Master-General was chosen from among the first Generals in the service of the Sovereign. The appointment was formerly for life; but since the restoration, was held *durante bene placito*, and not unfrequently by a Cabinet Minister. The letters patent for this office were revoked May 25, 1855, and its duties vested in the Minister of War. The last Master-General was Lord Fitzroy Somerset, afterwards Lord Raglan.

ORDNANCE PROJECTILE.—A projectile having a cast-iron body, with a sabot composed of an alloy of lead and tin, which is cast on the base of the projectile, and held in position by undercuts and dovetails; the action of the charge being to force the sabot on the cast-iron body and to make it take the grooves.

ORDNANCE SELECT COMMITTEE.—A Committee composed of scientific officers, to advise the Secretary of State for War on all inventions in war *matériel*. It had its officers at Woolwich, in the midst of the manufactories of the Royal Arsenal, and near the head-quarters of the Royal Artillery, by whom most of the designs had to be practically tested. The President of the Committee was usually a General Officer of Artillery; and a Captain in the Royal Navy served as Vice-President. Since 1870 these functions have been fulfilled by officers of the Department of the Director of Artillery and Stores, who has his head-quarters at the War office.

ORDNANCE SERGEANTS. — Non-commissioned Staff Officers appointed, by the Secretary of War, from Sergeants who have faithfully served eight years in the Line, four of which shall have been in the grade of Non-commissioned Officers. Sergeants receiving these appointments are dropped from the rolls of the regiment or company in which they have been serving. Captains report to their Colonels such Sergeants as, by their conduct and service, merit appointments as Ordnance Sergeants, setting forth the description and length of service of the Sergeant; the portion of his service he was a Non-commissioned Officer; his general character as to fidelity and sobriety; his qualifications as a clerk, and his fitness for the duties of the position for which he is recommended.

The duties of Ordnance Sergeants relate to the care of the ordnance, arms, ammunition, and other military stores at the post, under the direction of the Commanding Officer. Should the post be evacuated, he remains at the station, under the direction of the Chief of Ordnance, in charge of Ordnance and Ordnance Stores, and of such other public property as is not in charge of some Officer or agent of other Departments; and for this property he accounts to the Chief of the Department to which it belongs. If in charge of stores at a post where there is no Commissioned Officer, he is responsible for the safe keeping of the property, and is governed by the Regulations of the Ordnance Department in issuing and accounting for the same. If the means at his disposal be insufficient for the preservation of such property, he reports the circumstances to the Chief of Ordnance.

ORDNANCE STORE-KEEPER.—An Officer of the Ordnance Department who holds the rank of Captain of Cavalry, excepting the Ordnance Store-keeper at Springfield Armory who, by law, has the rank of Major of Cavalry. There are, at present, five Ordnance Store-keepers in the service; but the grade has been abolished by a recent Act of Congress, and henceforth the duties appertaining to the office will be performed by other officers of the Ordnance Department.

In the British service, the Ordnance Store-keeper is a civil officer in the Artillery who has charge of all the stores, for which he is accountable to the Ordnance Office. See *Ordnance Department*.

ORDNANCE SURVEY.—By this term is understood the various operations undertaken by the Ordnance Department of the British government for preparing maps and plans of the whole kingdom and its parts. The idea of a general map of the country to be executed by the government was first proposed after the Rebellion in 1745, when the want of any reliable map of the northern parts of Scotland was much felt by the officers in command of the Royal troops. A drawing, on a scale of one inch and three-fourths to the mile, was completed in 1755; but in consequence of the war which broke out in that year, was never published. In 1763 it was proposed to extend the survey to the whole kingdom; but the first steps to effect this were taken only in 1784, when Major-General Roy commenced measuring a base-line on Hounslow Heath, near London, This principal triangulation was designed partly for astronomical purposes, and partly as a basis for a map on a small scale. The base-line was remeasured with great care in 1791; and detailed plans were commenced by officers of the Royal Engineers, partly for practicing them in military drawing, and partly for the purpose of forming plans of some portions of Kent for the use of the Ordnance. The principal object was, however, the instruction of a Corps of Military Surveyors and Draughtsmen, the plans themselves being regarded as of secondary importance. In 1794 the survey for the one-inch map was begun, and some sheets were published in 1796. As the series of principal triangles were extended westward towards the Land's End, it was thought right to measure another base, for fortification, on Salisbury plain in 1704; and two other base-lines were subsequently measured—one in 1801 at Misterton Carr, and the other in 1806 on Ruddlan Marsh. Though first intended chiefly as a military map, the publication of the survey soon created a desire on the part of the public for better maps, and surveyors were then hired to hasten its progress. This, however, was very slow, the map being at one time entirely suspended during the war in the beginning of this century, and even the parts which were executed, having been done by contract, were found very inaccurate. In this condition the survey of England continued during the first quarter of the present century, sometimes delayed by the government from motives of economy, at other times urged on by the county gentlemen, who wished the map either as a hunting-map or for local improvements.

In Scotland, the principal triangulation was begun in 1809, but was discontinued in the following year, to enable the persons who had been employed there to carry forward the subordinate triangulation required for constructing the detail maps in England. In 1818 it was resumed, and continued steadily up to 1819; a new base line having been measured on Belhelvie Links, near Aberdeen, in 1817, and the great sector used at various stations, both on the mainland and in the islands. It 1820 it was again suspended, was resumed in 1821 anp 1822, and anew broken off in 1823, the large theodolite being wanted in order to proceed with the principal triangulation in South Britain. In 1824 the survey of Ireland was begun, and nothing more was done in Scotland till 1838, except that some detail surveying for a one-inch map was continued for a few years in the southern Counties. The chief strength of the surveying corps was now transferred to Ireland. A map of that country was required for the purpose of making a valuation which should form the basis of certain fiscal arrangements and other improvements which the social evils and anomalies of Ireland urgently demanded. For this map a scale of 6 inches to the mile was adoped, as best suited for the purposes in view. On this scale the whole map was completed, and published in 1845, though the first portions were in an imperfect form, and needed revision which was proceeded with in 1873.

This great national undertaking has been conducted at different times on different scales and plans, and the system now pursued was only adopted after much discussion both in Parliament and out of doors. The map was originally begun as a military map, and the scale of one inch to the mile chosen, without considering whether some other scale would not offer greater advantages. Many now think that a scale a little larger, and an aliquot part of nature such as 1-50,000, or about 1¼ inch to the mile, would have been preferable for the small map; in which case a scale of 1-10,000 of nature, or about 6¼ inches, might have been chosen for the intermediate, instead of the six-inch scale selected at first for mere local purposes in Ireland. Be this as it may, the arguments in favor of the one-inch map are that it is the most convenient both as a general and traveling map. For general views of the structure of the country, the distribution and relations of its mountains, plains, valleys, and rivers, the one-inch is admitted to be superior to the six-inch, and thus better adapted in the first instance for laying roads, railways, or other extensive public works, or for the publication of a general geological survey. Such a map, on the other hand, is on too small a scale to admit of correct measurement of small distances; it is in some respects a generalized picture, and not a correct plan. The six-inch maps were at first selected in Ireland as the smallest size on which correct measurements of distances and areas could be made. On them every house and field, and almost every tree and bush might be laid down. Hence they are superior for working out details, as in minute surveys of railways and roads, or the complex geological structure of rich mineral districts. On such sheets, too, a proprietor or farmer may find every field laid down, and the relative heights indicated by contour lines, and may therefore use them for drainage and other improvements. It has also been proposed to use these six-inch maps as a record of sales or encumbrances of land, thus lessening the cost and simplifying the transfer of property. On the other hand, their size unfits them for most of the purposes for which the one-inch map is useful, and the contour lines give a far less vivid and correct impression of the physical features of a country than the hill sketching of the one-inch map. Most of the purposes of the six-inch plans are attained in a still more perfect manner from the 25-inch plans or cadastral survey. The last name is taken from the French *cadastre* (a register of lands), and is defined as a plan from which the area of land may be computed, and from which its revenue may be valued. The purposes to which these large plans may be applied are, as estate plans, for managing, draining, and othewise improving land, for faciliating its transfer by registering sales or encumbrances; and as public maps according to which local or general taxes may be raised, roads, railways, canals, and other public works, laid out and executed.

Nearly all the States of Europe have produced trigonometrical surveys, many of them of great excellence as scientific works. All of these have been published, or are in course of publication, on convenient scales; generally smaller than one inch to a statute mile.

The greatest extra European work of this kind is the Trigonometrical Survey of India, which was begun over seventy years ago, and has been conducted with great ability. The work is drawing to a close, but will still occupy several years. The maps are published on a scale of $\frac{1}{250000}$ or $\frac{1}{4}$ of an inch to the mile. In America, the Coast Survey of the United States, a map of great accuracy and minute detail, has been going on for many years. The general charts are published on a scale of $\frac{1}{80000}$ or $\frac{4}{5}$ of an inch to a mile; the harbors and ports $\frac{1}{20000}$ or $3\frac{1}{6}$ of an inch to a mile. No systematic survey has yet been undertaken for the interior of the country.

ORDNANCE TIMBER.—Timber and wrought iron are the principal materials used in the construction of artillery carriages and machines. Timber for the arsenal is usually purchased in pieces of the size required to make each part. A list of the pieces for a certain kind of carriage, including the contents of each piece, in board-measure, is called a *bill of timber*. None but the best wrought iron should be employed in ordnance constructions. Large and peculiar-shaped pieces, as *axle-trees*, *trunnion-plates*, etc., as well as those requiring great strength, are made from *hammered shapes*, furnished by the iron manufacturer, according to prescribed patterns; other parts are made of rolled iron. The following varieties of timber are briefly noticed as being most frequently required in the various ordnance constructions: *White oak*—The bark of white oak is white, the leaf long, narrow, and deeply indented; the wood is of a straw-color, with a somewhat reddish tinge, tough, and pliable. It is the principal timber used for ordnance purposes, being employed for all kinds of artillery-carriages. *Beech*—The white and red beeches are used for fuzes, mallets, plane-stocks, and other tools. *Ash*—White ash is straight-grained, tough, and elastic, and is therefore suitable for light carriage-shafts; in artillery, it is chiefly used for sponge and rammer staves, sometimes for handspikes, and for sabots and tool-handles. *Elm*—Elm is used for felloes and for small naves. *Hickory*—Hickory is very tough and flexible; the most suitable wood for handspikes, tool-handles, and wooden axle-trees. *Black walnut.*—Black walnut is hard and fine-grained; it is sometimes used for naves, and the sides and ends of ammunition-chests; it is exclusively used for stocks of small arms. *Poplar*—White poplar, or tulip-wood, is a soft, light, fine-grained wood, which grows to a great size; it is used for sabots, cartridge-blocks, etc., and for the lining of ammunition-chests. *Pine.* White pine is used for arm-chests and packing-boxes generally, and for building purposes. *Cypress*—Cypress is a soft, light, straight-grained wood which grows to a very large size. On account of the difficulty of procuring oak wood of a suitable kind in the Southern States, cypress has been used for sea-coast and garrison carriages. It resists better than oak the alternate action of the heat and moisture to which sea-coast carriages are particularly exposed in casemates; but being of inferior strength, a larger scantling of cypress than oak is required for the same purpose; and on account of its softness, it does not resist sufficiently the friction and shocks to which such carriages are liable. *Basswood.*—Basswood is very light, not easily split, and is an excellent material for sabots and cartridge-blocks. *Dogwood.*—Dogwood is hard and fine-grained, suitable for mallets, drifts, etc.

The principal circumstances which affect the quality of growing trees are *soil*, *climate*, and *aspect*. In a moist soil, timber grows to a larger size, but is less firm and decays sooner, than in a dry, sandy soil; the best is that which grows in a dark soil, mixed with stones and gravel; this remark does not apply to the poplar, willow, cypress, and other light woods which grow best in wet situations. In the United States the climate in the Northern and Middle States is most favorable to the growth of timber used for ordnance purposes, except the cypress. Trees growing in the center of a forest, or on a plain, are generally straighter and freer from limbs than those growing on the edge of a forest, in open ground, or on the sides of hills, but the former are, at the same time, less hard. The aspect most sheltered from prevalent winds is generally most favorable to the growth of timber. The vicinity of salt water is favorable to the strength and hardness of white oak. The selection of timber trees should be made before the fall of the leaf. A healthy tree is indicated by the top branches being vigorous and well covered with leaves; the bark is clear and smooth, and of uniform color. If the top has a regular, rounded form; if the bark is dull, scabby, and covered with white and red spots, caused by running water or sap, the tree is unsound. The decay of the topmost branches, and the separation of the bark from the wood, are infallible signs of the decline of the tree.

The most suitable season for felling timber is that in which vegetation is at rest, which is the case in midwinter and midsummer. Recent experiments incline to give preference to the latter season, say the month of July; but the usual practice is to fell trees for timber between the first of December and the middle of March. The tree should be allowed to attain full maturity before being felled; this period, in oak timber, is generally at the age of seventy-five to one hundred years, or upward, according to circumstances. The age of the hard wood is determined by the number of rings which may be counted in a section of a tree. The tree should be cut as near the ground as possible, the lower part being the best timber; the quality of the wood is, in some degree indicated by the color, which should be nearly uniform in the heart-wood, a little deeper toward the center, and without any sudden transitions. Felled timber should, as a rule, be immediately stripped of its bark, and raised from the ground. The white wood next to the bark, which very soon rots, should never be used, except that of hickory. There are sometimes found rings of light-colored wood surrounded by good hard wood; this may be called the *second sap;* it should cause the rejection of the tree in which it occurs. *Brashwood* is a defect generally consequent on the decline of the tree from age; the pores of the wood are open, the wood is reddish-colored, it breaks short, without splinters, and the chips crumble to pieces. This wood is entirely unfit for artillery carriages. Wood which died before felling should, generally, be rejected; so should *knotty trees*, and those which are covered with tubercles and excrescences. Wood in which the grain ascends in a spiral form is unfit for use in large scantlings; but if the defect is not very decided, the wood may be used for naves and for some light pieces. Splits, checks and cracks extending toward the center, if deep and strongly marked, make wood unfit for use, unless it is intended to be split. *Wind-shakes* are cracks separating the concentric layers of wood from each other; if the shake extends through the entire circle, it is a serious defect. The *center-heart* is also to be rejected, except in timber of very large size, which cannot, generally, be procured free from it. As soon as practicable, after the tree is felled, the sapwood should be taken off, and the timber reduced, either by sawing or splitting, nearly to the dimensions required for use. Pieces of thickness, or of peculiar form, such as those for the bodies of gun-carriages and for chassis, are got out with a saw; smaller pieces, as spokes, are split with wedges. Naves should be cut to the right length, and bored out, to facilitate seasoning and to prevent cracking. Timber of large dimensions is improved by *immersion in water* for some weeks, according to size, after which it is less subject to warp and crack in seasoning. To season or dry timber, it should be piled under shelter, in such manner as to allow a free circulation, but not a strong current of air, around to force it forward *into* the mortise in the lug, 6. For the purpose of cleaning, it can be very easily removed by taking off the locks and removing the small screw, 4, from the end of bolt, 5, then press down on trip, 7, which will allow the lifter to be withdrawn without removing either stock, guard, or trigger-plate. The improved roll, 13, gives great strength to the joint. This gun has been issued by the United States Government for arming Paymasters' escorts, etc., when light shooting and rough usage were anticipated.

PARKHURST MACHINE-GUN.—In machine-guns the heating of the barrels has limited the number of charges that could be rapidly fired before they become too hot for use, so that after a period of rapid firing the gun would become dangerous if not allowed to cool. The Parkhurst gun has a device for keeping the barrels cool by surrounding them with water under atmospheric pressure, thus preventing the temperature from rising above the boiling point of water. A temperature not exceeding 212° Fahrenheit does not impair the action of the gun. The barrels are inclosed in a metallic water-tight casing having a vent for the escape of steam. The casing is filled from time to time during the firing, as may be required. The mechanism for rapidly loading and firing is also improved.

PARKINSONIA. — A shrub found commonly in Bengal. It has been stated to yield a very fair charcoal for gunpowder purposes; but from trials made of it, of late years, at the Government Powder Works at Ishapore, it was not found to be equal to that made from *urhur* or *dhall stalk*. Nevertheless it might be used if the latter crop failed.

PARK PALING.—A very inferior gun-material, from which vast numbers of very inferior guns were made during the existence of the slave-trade.

PARK PICKETS.—Small wooden posts which support the rope line round the artillery park. They are carried either on carts or camels in India when on the march. Dimensions—length 53 inches, and diameter 3 inches.

PARLEY.—In military language, an oral conference with the enemy. It takes place under a flag of truce, and usually at some spot—for the time neutral—between the lines of the two armies. *To beat a parley*, is to give a signal for such conference by beat of drum or sound of trumpet.

PARMA.—A kind of round buckler used by the Velites in the Roman Army. It was 3 feet in diameter, made of wood, and covered with leather. Its form was round, and its substance strong; but Servius on the Aeneid, and even Virgil, say that it was a light piece of armor in comparison with the clypeus, though larger than the pelta.

PAROI.—A stout wooden frame having long, sharp-pointed stakes driven into it horizontally. It is placed upon the parapet to oppose scaling parties.

PAROLE.—1. A watch-word differing from the countersign in that it is only communicated to Officers of Guards, while the countersign is given to all the members. The *parole* is usually the name of a person, generally a distinguished officer, while the countersign is the name of a place, as of a battle-field. 2. A declaration made on honor by an officer, in a case in which there is no more than his sense of honor to restrain him from breaking his word. Thus a prisoner of war may be released from actual prison on his *parole* that he will not go beyond certain designated limits; or he may even be allowed to return to his own country on his *parole* not to fight again, during the existing war, against his captors. To break *parole* is accounted infamous in all civilized nations, and an officer who has so far forgotten his position as a gentleman, ceases to have any claim to the treatment of an honorable man, nor can he expect quarter should he again fall into the hands of the enemy he has deceived. The following rules in regard to *paroles* are established by the common law and usages of war: An officer who gives a *parole* for himself or his command on the battle-field is deemed a deserter, and will be punished accordingly. For the officer, the pledging of his *parole* is an individual act, and no wholesale paroling by an officer, for a number of inferiors in rank, is permitted or valid. No prisoner of war can be forced by the hostile Government to pledge his *parole*; and any threat or ill treatment to force the giving of the *parole* is contrary to the law of war, and not binding.

No prisoner of war can enter into engagements inconsistent with his character and duties as a citizen and a subject of his State. He can only bind himself not to bear arms against his captor for a limited period, or until he is exchanged, and this only with the stipulated or implied consent of his own Government. If the engagement which he makes is not approved by his Government, he is bound to return and surrender himself as a prisoner of war. His own Government cannot at the same time disown his engagement and refuse his return as a prisoner.

No one can pledge his *parole* that he will never bear arms against the Government of his captors, nor that he will not bear arms against any other enemy of his Government, not at the time the ally of his captors. Such agreements have reference only to the existing enemy and his existing allies, and to the existing war, and not to future belligerents.

While the pledging of the military *parole* is a voluntary act of the individual, the capturing power is not obliged to grant it, nor is the Government of the individual paroled bound to approve or ratify it.

Paroles not authorized by the common law of war are not valid till approved by the Government of the individual so pledging his parole.

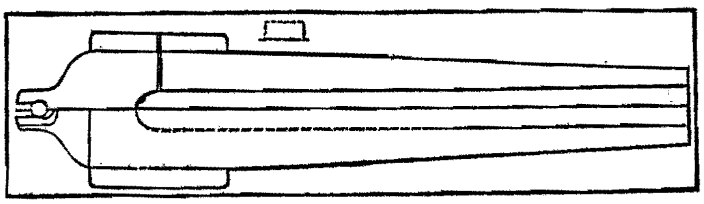
The pledging of any unauthorized military *parole* is a military offense, punishable under the common law of war.

PAROLE EVIDENCE.—In law, it is such evidence as is given by witnesses by word of mouth at a trial or hearing of a cause. Parole agreement, in English law, means any agreement made either by word of mouth or by writing not under seal. If the agreement is made by writing under seal, it is called a deed, or indenture, or covenant, according to the nature of its contents.

PARRAIN.—In military orders, the person who introduces or presents a newly-elected Knight. The term is also used to signify the comrade who is selected by a soldier who is condemned to be shot to bind the handkerchief over his eyes.

PARROT-BEAKED.—A term applied to a battle-axe and the like when very short in the handle and resembling a parrot's beak.

PARROTT GUN.—The Parrott rifle-gun is a cast-iron piece of about the usual dimensions, strengthened by shrinking a coiled band or barrel of wrought-iron over that portion of the reinforce which surrounds the charge. The bodies of the larger Parrott



guns are cast hollow, and cooled from the interior on the Rodman plan. The barrel is formed by bending a rectangular bar of wrought-iron spirally around a mandrel and then welding the mass together by hammering it in a strong cast-iron cylinder, or tube. In bending the bar, the outer side being more elongated than the inner one, is diminished in thickness, giving the cross section of the bar a wedge shape, which possesses the advantage of allowing the cinder to escape through the opening, thereby securing a more perfect weld. The barrel is shrunk on by the aid of heat, and for this purpose the reinforce of the gun is carefully turned to a cylindrical shape, and about one-sixteenth of an inch to the foot larger than the interior diameter of the barrel in a cold state. To prevent the cast-iron from expanding when the barrel is slipped on to its place a stream of cold water is allowed to run through the bore. At the same time and while the bands hang loosely upon it, the body of the gun is rotated around its axis to render the cooling uniform over the whole surface of the barrel. A large number of these guns were used in the late war, both on sea and land; and the amount of work done by them, especially in breaching masonry, is probably not exceeded by the rifle-guns of any other system. While a few of them have failed in the service, others have shown very great endurance. The cause of this failure has been attributed to the bursting of shells in the bore, the presence of sand in the bore, etc., but late investigations show that the Parrott projectiles were frequently broken at the bottom by the force of the powder in such manner as to wedge the body against the bore. It is quite probable that this cause had much to do with the bursting of the guns. The inventor thinks he has corrected this evil.

The following table gives the more important dimensions, etc., of Parrott guns; ranging from the 10-pounder to the 10-inch.

Gun.	Length of Bore.	Diam. of Bore.	Diam. of Barrel	Weight.	Number of Grooves.	Depth of Grooves.	Twist Increasing.	Charge.	Weight of Projectile.
	Inches.	Inches.	Inches.	Lbs.		Inches.	1 turn in ft. at Muzzle.	Lbs.	Lbs.
10-pounder	70	3.	11.3	890	3	0.1	10	1	10
20-pounder	79	3.67	14.5	1,750	5	0.1	10	2	19
30-pounder	120	4.20	18.3	4,200	7	0.1	12	3	28
100-pounder	130	6.4	25.9	9,700	9	0.1	18	10	86
8-inch	136	8.	32.	16,300	11	0.1	23	16	150
10-inch	144	10.	40.	23,500	15	0.1	30	25	250

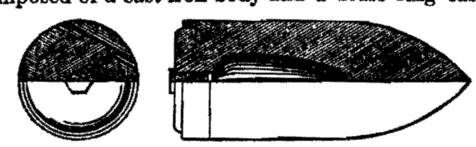
The proof of these guns consists in firing each piece *ten* rounds with service charges. The table given below shows the ranges of the 100-pounder Parrott gun; charge, 10 pounds of cannon powder; projectile, Parrott shell, filled, 100 pounds; initial velocity being 1,080 feet. See *Cast-iron Guns* and *Ordnance*.

Range.	Elevation.	Time of Flight.	Angle of Fall.	Remaining Velocity.	Range.	Elevation.	Time of Flight.	Angle of Fall.	Remaining Velocity.
Yards.	° ′	Seconds.	° ′	Ft.-secs.	Yards.	° ′	Seconds.	° ′	Ft.-secs.
100	0 14	0.28	0 14	1066	1700	4 36	5.15	5 09	923
200	0 29	0.56	0 29	1053	1800	4 54	5.48	5 24	916
300	0 44	0.85	0 44	1041	1835	5 00	5.59	5 33	914
400	0 59	1.14	1 00	1029	1900	5 12	5.81	5 47	910
405	1 00	1.16	1 01	1029	2000	5 31	6.14	6 10	903
500	1 14	1.44	1 16	1019	2100	5 50	6.47	6 33	897
600	1 30	1.73	1 33	1009	2158	6 00	6.67	6 45	893
700	1 46	2.08	1 50	1000	2200	6 09	6.81	6 56	891
788	2 00	2.29	2 06	992	2300	6 28	7.15	7 19	885
800	2 02	2.33	2 08	991	2400	6 47	7.49	7 42	879
900	2 18	2.63	2 26	983	2470	7 00	7.73	7 59	875
1000	2 34	2.94	2 44	974	2500	7 07	7.83	8 08	873
1100	2 51	3.25	3 03	966	2600	7 27	8.18	8 34	867
1151	3 00	3.41	3 13	962	2700	7 47	8.53	9 00	861
1200	3 08	3.56	3 22	959	2767	8 00	8.76	9 13	857
1300	3 25	3.87	3 41	951	2800	8 07	8.88	9 26	855
1400	3 42	4.19	4 00	944	2900	8 27	9.23	9 52	850
1500	4 00	4.51	4 21	937	3000	8 48	9.58	10 18	844
1500	4 00	4.51	4 21	937	3056	9 00	9.78	10 32	841
1600	4 18	4.83	4 42	930	3100	9 09	9.94	10 47	839

PARROTT LIFE-SAVING MONSTER.— A mortar made of cast-iron and lined with a steel tube. The piece is cylindrical about the seat of the charge, gradually tapering to the face of the muzzle. The breech is hemispherical. The trunnions are placed near the breech; their projection upon a plane through the vent and axis of the bore, being in front of and tangent to a plane perpendicular to that axis and containing the front end of the chamber. The chamber has the form of the frustum of a cone. The projectile is of cast-iron, cylindrical, with the ends rounded. An eye-bolt is screwed into the base for the attachment of the line. The eye of this bolt is close to the base of the shot. The cylindrical portion is turned in a lathe so as to be almost a perfect fit for the bore.

This apparatus is provided with a safety attachment, consisting of a piece of rubber, rectangular in cross-section, about 1′ long, 0″.75 wide, and 0″.5 thick, and of three or four galvanized-iron wires about 6′ long, laid parallel to each other, loosely twisted and coiled into a helix of from 18 to 19 turns. The rubber strap is sometimes placed inside the coil, and at others outside of it. This combined strap and spring is interposed between the shot and line in firing. The object of the combination is to absorb the shock of the discharge and thus prevent the breakage of the line, by letting the first jerk come upon the rubber, which will generally break, and then upon the coiled wire spring. The wires will be straightened out before the full strain falls upon the line. See *Life-saving Rockets.*

PARROTT PROJECTILES.—These projectiles are composed of a cast-iron body and a brass ring cast



into a rabbet formed around the base. The flame presses against the bottom of the ring and underneath it, so as to expand it into the grooves of the gun. To prevent the ring from turning in the rabbet the latter is recessed at several points of its circumference.

Parrott's incendiary shell has two compartments formed by a partition at right angles to its length. The lower and larger space is filled with a burning composition; the upper one is filled with a bursting charge of powder, which is fired by a time or concussion fuse. The burning composition is introduced through a hole in the bottom of the shell, which is stopped up with a screw-plug.

A more recent form of the Parrott Projectile for large calibers shown in the drawing. The sabot is cast on to the projectile, and is provided with a lip and cannelure. It is prevented from turning on the projectile and from stripping by means of recesses and undercuts upon the base of the projectile, into which the metal when liquid enters. See *Expanding Projectiles* and *Projectiles.*

PARRY.—A defensive movement in bayonet and saber exercises, executed as follows: *With the bayonet*—The Instructor commands: 1. *Tierce,* 2. PARRY. Move the point of the bayonet five or six inches to the right. 1. *Quarte,* 2. PARRY. Move the piece quickly to the left, the small of the stock passing under the left elbow, the piece covering the left shoulder; the barrel to the left, bayonet in front of, and higher than the shoulder, the left forearm on the right of the piece, the elbow touching the right wrist, the fingers on the stock. 1. *Seconde,* 2. PARRY. Move the point of the bayonet quickly to the left, describing a semi-circle from left to right, the point of the bayonet at the height of and in front of the right knee, barrel to the left; the left elbow in front of the body, the flat of the butt under the right forearm, the elbow two or three inches higher than the right shoulder. 1. *Butt,* 2. PARRY. Move the piece quickly to the left, covering the left knee and shoulder; the barrel to the right, the butt three inches above, and to the left of the left knee; the left hand and arm as in quarte parry. 1. *Prime.* 2. PARRY. Lower the point of the bayonet and describe a semi-circle to the left, carry the piece to the left, covering the left shoulder; the barrel downward, the left fore-

Fig. 1.

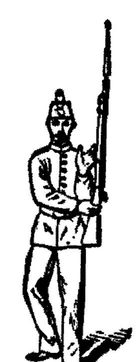


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6

Fig. 7.

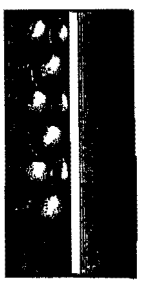
Fig. 8

Fig. 9.

Fig. 10.

upon different days, so as to permit the members to practice at any distance by coming at a certain time. Whether the targets should be placed in pairs or upon a line depends upon the ground, and also how it is to be used. If the range is to be used for military class-firing, the targets should be so placed as to allow of their being used simultaneously at the same distances, without one firing party being in front of another. For other practice the firing parties may be placed in front of one another, provided an interval of at least 150 feet is preserved.

A moving target adds interest to the range. At Wimbledon it consists of a running deer; at Toronto of a running man. In both cases the target is of iron, and runs upon a railway about 60 feet long, and rising at each end about 5 feet. The markers are placed behind a shot-proof butt at each end, and start the figure at a signal from the firing-point. The descent gives it a speed of about 5 miles an hour, and it must be hit while moving. To shoot at a mark of this description with success requires the best qualities of a rifleman, and much experience. See *National Rifle Association*.



RIFLE-CANISTER.—These are very similar in general appearance to those used in smooth-bore cannon. As shown in the drawing, the case is of sheet-iron or tin, with fringed ends which are turned over and soldered or riveted to iron or zinc discs. The balls are of iron or zinc packed in rozin or coal-dust, sometimes in discs of wood. They are fitted with solder studs or rings of lead on the outside to take the rifling, or with an expanding cup. See *Canister-shot*, *Case-shot*, and *Projectiles*.

RIFLE-CANNON.—The general adoption of rifled small-arms necessitated the introduction of rifled cannon. It is plain that the principle has application to all sizes of projectiles, and would therefore be used for the heaviest ordnance as well as for the smallest. Contemporaneous attempts so to adapt it have not been wanting, but they are in many cases isolated in point of time and connection. The first persevering and rational efforts to apply the rifle principle to cannon were initiated some twenty years since; and the names of Wahrendorff, Cavalli, Lancaster, and others, are identified with the first efforts to overcome the difficulties—of no ordinary character—that beset the question. The yielding nature of lead renders the application of the rifle principle of easy accomplishment in the case of small-arms; but such is not the case with rifle-cannon, where the projectiles are made of iron. The application of this principle to cannon also required an increase of strength in the piece. The greater the weight and the length of a projectile, the greater is the opposition from inertia and friction which it offers in the bore to the expansion of the ignited charge, and this opposition is considerably augmented if the projectile is constrained to travel through the bore in a spiral course. Hence it is not difficult to comprehend why a rifled gun must be of a stronger, tougher, and more elastic material than is necessary for a smooth-bore gun in which the spherical projectile yields promptly to the first impulse of the powder-gas to which it presents half its surface, and bounds freely forward through the bore, almost unimpeded by friction; while the strain on the gun is immensely relieved by the comparatively great windage. Again, as the explosive power of a cartridge, and the inertia and friction of a projectile, increase as the cubes of their respective weights, while the surface of the chamber and the base of the projectile against which the powder-gas acts increases only as the squares, it follows that the larger the charge and the heavier the projectile, the harder and stronger must be the inner barrel.

The progress of the art of war depends essentially upon that of the sciences and manufactures, for the manner of fighting depends upon the character of the arms which we possess. These will be more effective, as their mode of construction is more perfect, and as the means employed in their manufacture produce greater strength and precision. This is particularly the case with reference to cannon, in evidence of which we have only to call to mind the great revolution in warfare which has taken place since their introduction, and which is continually taking place as the means of perfecting cannon increase. It is only in recent years that our knowledge of the metallurgy of iron, and also our ability to manufacture and handle, with any degree of skill, large masses of that metal, have rendered possible the fabrication of the enormous pieces of the present day. But now the great improvements which have been introduced in the manufacture of iron, in the fabrication of cannon, and in the facilities for the transportation and handling of heavy guns, render possible the success of cannon of mammoth proportions. In designing rifle-cannon, the practicability of manufacture and the durability of structure must be ascertained. The weight, caliber, length, system of rifling, weight and shape of projectile, etc., etc., must be all scientifically calculated so as to insure excellence in range, accuracy, and penetration; and then each and all of these constructional details are liable to alteration, should the thorough trial of a specimen gun render any amendment advisable. The first comprehensive experiment with rifled cannon appears, from all accounts, to have been made in Russia, about 1836, on the invention of a Belgian, but did not prove successful. In 1845, Cavalli, a Sardinian officer, experimented with a breech-loading cannon which was rifled with two grooves, for a plain iron projectile, adapted to fit them. In the next year, Wahrendorff, of Sweden, fitted heavy projectiles to take the rifling by affixing lead to their elongated sides by means of grooves cut in them. And not long after this, Timmerhaus, of Belgium, invented an expanding *sabot*, which, being fitted to the base of the projectile, was forced into the rifle-grooves, and thus gave rotation. In these early experiments we find the germs of the leading systems of the present day. The solid projectile, fitted to enter the grooves of the gun; the compression of a soft covering on the projectile by the lands of the gun; and the expansion of the rear of the projectile by the pressure of the powder to fill the grooves of the gun.

The object of rifling a gun is to increase its accuracy of fire, and, by enabling elongated to be substituted for spherical projectiles, to obtain from it longer ranges. Rifling diminishes the deviations of ordinary projectiles, due to the following causes: 1st. Want of uniformity in figure and weight around the longitudinal axis of the projectile passing through the center of gravity.

2d. Position of the center of gravity, before or behind the center of figure. 3d. Resistance of the air. I. By rotating the projectile around its longitudinal axis, the direction of these deviations is so rapidly shifted from side to side, that the projectile has no time to go far out of its course either way. II. The velocity of this rotation is such as to make the axis stable on leaving the bore, and to counteract the pressure of the air tending to turn the projectile over, or render it unsteady in flight. III. A given weight of projectile can be put into such a form as to oppose the least practicable cross-sectional area to the air, and thus to receive the least practicable retardation of velocity. Certain peculiar advantages follow from the rotation of the projectile, causing it to present the same part to the front throughout its flight. It becomes possible to make a much simpler percussion-fuse, because it is only necessary to provide for action in one direction in place of every possible direction. Shells required to act towards the front in any peculiar way have their bursting-charge and metal placed with a view to this object. So, again, the center of gravity may be brought to any desired part or the shell, and this is an important feature in the construction of projectiles. Rifling gives the power of altering the form of projectiles at will. The head may be made of any desired shape for penetration or flight. The projectile may be elongated so as to give a diminished surface for any resisting medium to act upon; thus in flight, velocity is kept up and the range extended, or on impact greater penetration is obtained. Weight for weight, the same effect may generally be produced with an elongated projectile by using a smaller charge of powder than with a spherical one. It follows from the flight of an elongated projectile meeting with less resistance from the air, and keeping up its velocity better, that at all but very short ranges the trajectory is flatter; hence the probability of hitting an ordinary object is greater. The power to vary the length of the elongated projectile enables all those for the same gun to be made of the same weight, and hence to require the same elevations with the same charge of powder. Or it is possible to make a projectile specially heavy if required. This obviously cannot be the case with spherical projectiles, which must be of the same size. The chief disadvantages are, bad ricochet, increased complication, and expense of manufacture, liability to injury arising from the necessity of soft studs, expanding rings, or a soft lead coat; increased strain on the gun, besides greater probability of jamming and injury to the bore, uncertainty of time-fuses.

RIFLED HOWITZERS.—In consideration of the satisfactory results obtained with the 3.07-inch Moffatt breech-loading field-piece, and also of the evident advantages to be secured by the substitution of a breech-loading rifled howitzer for the 8-inch muzzle-loading smooth-bore howitzer, of at least equal power to the latter gun—for flank defense and siege purposes—a result believed to be attainable with this system by a 6-inch caliber, it was decided to construct such a howitzer on the Moffatt plan for experiments and tests, the slight changes in construction resulting either from some observed imperfection in the working of the mechanism in the field-piece or from the employment of a different nature of ammunition in the howitzer. A brief description here will therefore suffice. The howitzer consists of a steel body, to which is adapted the Moffatt breech-mechanism, a conical breech-plug closing the bottom of the bore through the agency of a strap or yoke, which locks into lugs on the sides of the breech for the support necessary to resist the shock of discharge, and which is attached to the trunnions as an axis of motion. The chamber is opened by tilting up the breech of the howitzer with a lever, whereby the block falls back upon the strap and uncovers the bore. In place of a leather strap to insure the opening of the breech, a heel is attached to the hinge of the breech-block, which, coming in contact with the strap as the breech is raised, throws down the block, and by the same movement turns with the hinge so as to clear the strap. The locking-bolt is bored through axially for the reception of a firing-pin, with which to explode the charge when primed metallic cartridges are employed. An ordinary vent is also provided by means of which the charge can be ignited by a friction-primer. The gun-body was made from a steel block furnished by Thomas Firth & Sons, of Sheffield, England. It was cast in an ingot, forged to dimensions, and bored by them to within one-quarter inch of its finished diameter. The steel contained about 0.64 of 1 per cent. of carbon. The breech-strap and block were made in Boston, and were of low steel, containing 0.44 of 1 per cent. of carbon.

The following are the principal dimensions of the gun:

Diameter of bore across lands.........	6 inches.
Diameter of bore through chamber...	6. 2 inches.
Diameter of breech-block cavity at seat of gas-check........................	6. 8 inches.
Diameter of breech-block cavity at outer edge.................................	8. 5 inches.
Exterior diameter of piece at muzzle	12 inches.
Maximum diameter........................	16 inches.
Diameter of trunnions...................	5. 875 inches.
Diameter of rimbases.....................	8. 6 inches.
Distance between-rimbases.............	16 inches.
Diameter of loop (over trunnions) in breech-straps — vertical	5. 875 inches.
Diameter of loop (over trunnions) in breech-straps — horizontal.	6. 075 inches.
Length of gun body......................	78 inches.
Total length of gun........................	88 inches.
Length of bore..............................	69. 625 inches.
Length of rifled portion of bore......	64. 625 inches.
Length of bevel joining lands to chamber..................................	1 inch.
Pitch of rifling, uniform, one turn in	30 feet.
Number of grooves and lands, each	17
Width of lands..........	0. 50 inch.
Width of grooves..........................	0. 6088 inch.
Depth of grooves..........................	0. 075 inch.
Length of trunnions......................	5. 875 inch.

The principal European Artilleries have produced rifled howitzers and mortars throwing shells of 80 kilos, with sufficient accuracy to render them formi-

Elements.	France.	England.	Prussia.	Austria.
	Howitzer of 22 c. m.	Howitzer of 8 inch.	Mortar of 21 c. m.	Mortar of 8 po.
Nature of the metal of the piece..............	Cast iron. banded.	Wrought iron with steel tube	Bronze	Cast iron.
Method of loading................................	Muzzle	Muzzle	Breech	Breech.
Caliber of the bore ....millimeters	223.3	203.2	209.3	209.3
Length of rifled portion (in calibers).........	9.8	4.4	5.5	4.1
Number of grooves	3	4	30	30
Twist (in calibers,) about	....	16	25	60
Inclination of the grooves to the generatrices of the bore	0° to 6°	1° 6′ 31″	7°	3° 1′ 16″
Weight of the piece ....kilos	3,700	2,350	3,025	4,655
Weight of the loaded shell......................	79.8	81.4	80.0	87.0
Weight of the interior charge of shell.......	4.0	5.9	5.0	4.0
Maximum firing-charge..........................	6.0	4.53	3.5	5.6
Ratio of the weight of the maximum charge to the weight of the projectile...........	1 to 13	1 to 18	1 to 23	1 to 13
Ratio of the weight of the projectile to the weight of the piece........	1 to 46	1 to 29	1 to 38	1 to 53
Maximum initial velocity ....meters	257	....	215	
Maximum range........................... do	5.220	4.480	4,000	4,500

dable to covered arches or blinds, such as exists at present.

On page 693 are some elements for a comparison of these different pieces.

It will be seen from this table that the French howitzer and the Austrian mortar of 8 po. permit of the attainment of the greatest ranges, but also that their weights are very considerable; the Austrian mortar, particularly, appears to have an exaggerated weight relatively to the effects attainable with it; it is possible by the system of banding to reduce this weight, say, at least 800 kilos., and to give the piece a greater length of bore, which would permit the use of larger charges and of a more progressive powder, by means of which ranges of 5,000 meters should be obtained.

In order to compare the accuracy of fire, we have calculated the ration of R and q of the mean deviations, longitudinal and lateral, to the ranges. The above table indicates the limits between which these ratios vary for the different angles of fire, in proportion as the range increases.

Piece.	30°.		40°.		45°.		60°.	
	R	q	R	q	R	q	R	q
French howitzer of 22 c. m.	$\frac{1}{37}$ to $\frac{1}{67}$	$\frac{1}{525}$ to $\frac{1}{385}$	$\frac{1}{40}$ to $\frac{1}{66}$	$\frac{1}{450}$ to $\frac{1}{363}$				
English howitzer of 8 inches.*	$\frac{1}{90}$ to $\frac{1}{169}$	$\frac{1}{880}$ to $\frac{1}{1400}$	$\frac{1}{44}$ to $\frac{1}{380}$	$\frac{1}{194}$ to $\frac{1}{1488}$				
Prussian mortar of 21 c. m.	$\frac{1}{376}$ to $\frac{1}{394}$	$\frac{1}{578}$ to $\frac{1}{588}$	....	....	$\frac{1}{150}$ to $\frac{1}{321}$	$\frac{1}{1588}$ to $\frac{1}{443}$	$\frac{1}{356}$	$\frac{1}{432}$
Austrian mortar of 8 po.	$\frac{1}{118}$ to $\frac{1}{78}$	$\frac{1}{980}$ to $\frac{1}{1482}$	....	....	$\frac{1}{148}$ to $\frac{1}{75}$	$\frac{1}{780}$ to $\frac{1}{1482}$	$\frac{1}{81}$ to $\frac{1}{150}$	$\frac{1}{411}$ to $\frac{1}{765}$
Austrian mortar of 6½ po.	$\frac{1}{96}$ to $\frac{1}{116}$	$\frac{1}{770}$ to $\frac{1}{938}$	....	....	$\frac{1}{58}$ to $\frac{1}{140}$	$\frac{1}{400}$ to $\frac{1}{533}$	$\frac{1}{67}$ to $\frac{1}{144}$	$\frac{1}{782}$ to $\frac{1}{285}$

*A 20°, R=$\frac{1}{84}$ to $\frac{1}{281}$; q=$\frac{1}{880}$ to $\frac{1}{1700}$.

It will be seen, from a study of the figures in this table, that the French howitzer has above all a notable inferiority in point of accuracy of range. The Prussian mortar has a sensible superiority over the Austrian mortar in point of accuracy of range; but the accuracy in direction of the Austrian mortar is very much greater than the Prussian. This latter fact would tend to prove that the Prussians, notwithstanding the modifications successfully introduced in the plan of their shell, have not yet succeeded in giving to it a stability upon its trajectory comparable to that of the Austrian shell. In respect to this, however, it should be observed that the inclination of the rifling in the Prussian mortar is 7°, while in the Austrian mortar the inclination is only 3°; it is generally admitted in France that the inclination of the rifling for large pieces should but little exceed 4°.

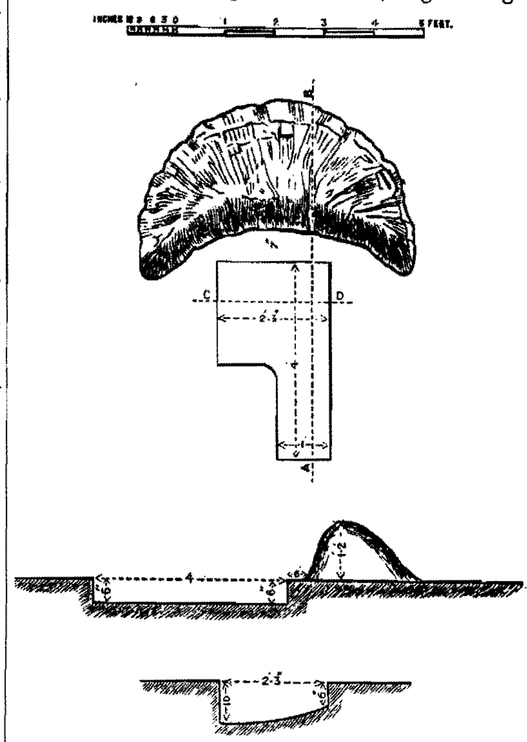
In respect to the effects of fire, the difference of weights of projectiles thrown by the pieces examined is too small to give rise to the supposition that there would be any appreciable difference in the effects of penetration for the same angles of fire and the same ranges; in point of the effects of explosion, the English shell, owing to its greater bursting charge, ought to be the most powerful.

From what precedes it is to be concluded that the French howitzer, which was remarkable enough at the time of its adoption, has not to-day a sufficiently accurate fire to warrant its introduction into siege-trains; for the armament of places, and the provisional armament of coast-batteries, it may possibly do good service, because, in these two cases, the effects of isolated shots may be very formidable, notwithstanding that, in order to obtain serious effects against the very solidly constructed shelters of a place, it is necessary to group the shots upon a small surface. See *Howitzer*, *Moffatt Gun*, and *Ordnance*.

RIFLED MUSKET.—A musket of which the bore is rifled. In 1855, Austria adopted for her infantry of the line, the *rifled musket*, with a barrel 37 inches long, and having four wide grooves equal to the land, making one turn in 83 inches. See *Rifle*.

RIFLEMEN.—Troops armed with rifles, and employed more or less as sharpshooters. The name has nearly lost all meaning, for the whole infantry are now riflemen; but as late as 1854, the riflemen were quite the exception, the army generally having the smooth-bore "Brown Bess." There were at that time only two English line regiments of Rifles, with two colonial regiments of infantry, and one Hottentot regiment of mounted infantry. The establishment of Rifle regiments was suggested to the British by the Americans and French, from the sharp-shooters of which nations the British armies suffered severely. During the French war, the 60th and 95th Regiments were armed as riflemen, taught light infantry drill, and clothed in dark green, to be as invisible as possible. The 95th became the Rifle brigade. Experiment has since shown that gray is less conspicuous than green as a uniform—hence it was at first adopted by many volunteer corps.

RIFLE-PIT—A *hasty intrenchment*, large enough



SHELTER-PIT FOR SKIRMISHERS.

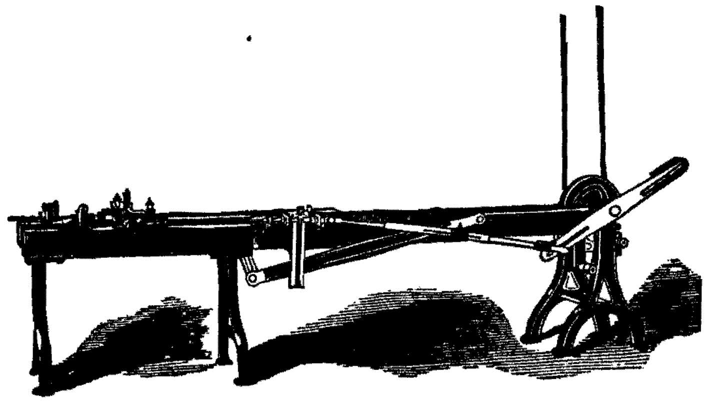
charge fits into the chamber *on the shoulder* of which rests a wrought-iron disk. The shell is lined with paper, and filled with balls embedded in rosin. A wrought-iron tube passes down the middle of the shell and through a hole in the center of the iron disk, to lead the flame from the fuse to the bursting charge. A hard disk is placed over the top of the bullets. The wooden head is ogival in form, and made of elm covered with thin wrought-iron, which is riveted to the shell. This head contains a socket and bouching for the fuse. See *Case-shot*, *Projectiles*, and *Shrapnel*.

RIFLING.—This operation is performed by means of the rifling machine. The machine is horizontal, and the gun to be rifled is fixed in front of it and in line with the rifling bar, to which a stout head carrying the cutter is fixed. Only a single groove is cut at a time, and that as the cutter is coming down, the bore bringing the chips of metal before it. All the grooves in the gun are first cut out roughly in succession, and then finely. The distance between the grooves is regulated by a disk fixed to the breech of the gun, having its periphery equally divided by as many notches as there are to be grooves. The gun is fixed each time by a pawl, and when a new groove has to be cut is turned round to the next notch. The gun remains stationary while the head carrying the cutter works up and down the bore, so it is necessary to make the bar to which the head is attached turn round more or less at the same time that it advances and returns, otherwise we should merely have a straight groove cut along the bore, instead of the spiral we require to give rotation to the projectile. The gun-metal in which the cutter is fixed fits the bore accurately by means of burnishers. It is fastened to a stout hollow iron bar termed the rifling bar. This bar is fixed to a saddle capable of sliding backward and forward on an endless screw.

The movement of the slide to which the outer end of the rod is attached (and consequently of the cutting tool) is regulated by another copying arrangement on the other side of the machine. This arrangement consists of two horizontal bars, one higher than the other, along which travels a weighted lever attached to a pinion which works the slide. When the rifling head is passing down the bore, this weighted lever travels along the upper bar; but when the machine is reversed, the lever is prevented by a small movable piece from returning on the same bar, so that the weight falls over on the lower one, and in doing so draws back the slide and spindle and forces the tool out. By varying the form of the upper surface of this lower bar the depth of the various parts of the groove can be regulated and altered as required.

The drawing shows a light machine used in armories for rifling gun-barrels with a uniform twist, from one turn in 20 inches to one in 36 inches. The cutter-rod carries from one to three cutters, as the rifling is four, five, or six to the circumference. An adjustable feed-stop gauges the depth of the rifling, and the racks, which are of steel, are double, to take up all back-lash, so that the cutters cannot ride on the lands. An oil-pump feeds automatically at each end of the stroke. The carriage is gibbed on the outside of the long slide, allowing free access to its working parts. Weight, 1,600 pounds. This machine rifles by the filing process, which is more correct than the planing process, and will turn out about one gun-barrel an hour. See *Grooves*, and *System of Rifling*.

RIGHT SHOULDER ARMS.—A position in the Manual of Arms, executed as follows: Being at a carry, the Instructor commands: 1. *Right shoulder*, 2. ARMS. Raise the piece vertically with the right hand; grasp it with the left at the lower band, and raise this hand



Although the rifling bar is fixed to the saddle and moves with it, it can revolve independently of it; and toward the end farthest from the gun is fixed a pinion which gears into a rack sliding in the saddle at right angles to the bar itself. The outer end of this rack is fitted with two small rollers or friction wheels which run along a copying bar fixed to one side of the rifling machine. This copying bar is inclined at a certain angle to the side of the machine, and the greater this angle, the more the rack is pulled out by the friction rollers, and the greater the twist given to the rifling bar and so to the grooves in the gun. The angle can be altered if required; and we can also take away the straight copying bar and use a curved one, as is done when a gun is to be rifled with increasing twist. By thus changing the copying bars, or their position, we can use a single machine for any description of rifling. The cutting tool itself is of steel and works in and out of the head, being drawn in or forced out by means of a cam attached to one end of an iron rod passing through the hollow rifling bar.

till it is at the height of the chin; at the same time embrace the butt with the right hand, the toe between the first two fingers, the other fingers under the plate. (Two.) Raise the piece and place it on the right shoulder, the lock-plate up, the muzzle elevated and inclined to the left; so that, viewed from the front, the line of the stock from the toe to the guard, shall appear parallel to the row of buttons; slip the left hand down to the lock-plate. (THREE.) Drop the left hand by the side. 1. *Carry*, 2. ARMS. Carry the butt slightly to the left, and lower the piece with the right hand; grasp it with the left at the lower band, the hand at the height of the chin, the barrel to the rear, and vertical. (Two). Resume the carry with the right hand. (THREE). Drop the left hand by the side. Being at a support, to come to a right shoulder, the Instructor commands: 1. *Right shoulder*, 2. ARMS. Grasp the piece with the right hand at the small of the stock, and carry it in front of the center of the body, grasping it with the left hand at the lower band, the hand at the height of the chin. (Two). Carry and place the piece on the right shoulder, the wounded men, suspended between two oxen. The drawing shows the manner of its construction and use. It is too large and unwieldy to be of prac-

tical or any general application; and, moreover, the movements of all oxen are very slow, and this unfits them for purposes of military transport. See *Litter*.

RODMAN CUTTER.—An instrument used for making indentations in castings. The indenting part of the tool is in the form of a pyramid, having a rhombus for its base, the diagonals of which are respectively one inch and two-tenths of an inch; the height of the pyramid one-tenth of an inch. In late experiments the form of the pyramid has been changed and improved somewhat by causing it to make a longer line, and mark minute differences more accurately. The volume of an indentation made with this tool is taken as the measure of the work required to produce it, and is inversely proportional to the hardness of the specimen, that is (denoting by H the hardness of any specimen), $H = \frac{k}{v}$,...(1) k denoting any convenient constant, and v the volume of the indentation corresponding to H.

It has been found by experiment that a pressure of 10,000 on the base of the pyramid makes an indentation, in the softest metals used in guns, about nine-tenths of an inch long. The maximum indentation, one inch in length, of the instrument is therefore assumed as the unit of hardness; and denoting by V the volume corresponding to an indentation one inch in length, we obtain from equation (1),

$$1 = \frac{K}{V}, \text{ or } K = V;$$

and, in general,

$$H = \frac{V}{v};$$

or, putting l = the number of tenths of an inch in the length of any given indentation,

$$H = \frac{V}{v} = \frac{1000}{l^3};$$

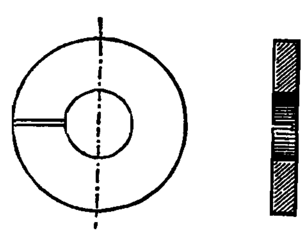
since pyramids are to each other as the cubes of any similar dimensions.

A pressure of less than 10,000 will probably be found better suited to the purpose, with the improved tools. A better standard of comparison may be found in some metal of an uniform density and hardness, easily obtainable in all places. The silver coin of the country will best fulfill these conditions. The volume of the cavity made in this, by the adopted unit of pressure, may be assumed as the unit of hardness; and this, divided by the volume of the cavity in any sample tested, will denote the hardness of that sample as compared with that of silver coin. See *Circular Cutter*.

RODMAN GUN.—The principal difficulty formerly experienced in manufacturing very large cast-iron cannon was the injurious strains produced by cooling the casting from the exterior. As far back as the year 1844, General Rodman, of the Ordnance Department, sought to discover the means to overcome this difficulty. After much observation and study, he developed his theory of the strains produced by cooling a casting like that of a cannon, and as a remedy for them he proposed that cannon should be cast on a hollow core, and cooled by a stream of water, or air, passing through it. After an elaborate series of experiments the truth of his theory was established, and his new mode of casting was adopted by the War Department. As a result of General Rodman's theory, he claimed that he could cast cannon of any practicable size, and asked that a 15-inch cast-iron gun might be made. This was done in 1860, and the gun was successfully tested shortly afterwards. General Rodman then projected a 20-inch gun, which was made at the Fort Pitt Foundry in 1863, under his directions.

Formerly it was customary to use but one kind or size of grain of powder for all cannon, whatever their size. General Rodman proposed for his large cannon that there should be a proportional increase in the size of the grain, expecting thereby to get as high a velocity for the projectile without a corresponding increase in the strain on the breech or weak part of the piece; this led to the introduction of our present mammoth powder. He also thought that the powder which would produce the least strain on the gun, giving certain initial velocity to the projectile, would be that which should develop its gas as the space behind the projectile increased; or in other words, that the powder should burn on an increasing instead of a decreasing surface. With this object in view he proposed to compress the substance of the powder into short hexagonal prisms, which could be easily fitted together without loss of space. These prisms were perforated with longitudinal holes, from which the combustion of the powder spread. While this idea has to a certain extent been confirmed by experiment, this powder has not been officially adopted in this country; it is understood that it has been to a certain extent in Russia for service in heavy rifle-guns.

The several operations in the manufacture of this gun are *molding*, *casting*, *cooling*, and *finishing*. These are noticed in detail under the separate headings. When these several operations have been complied with, a ring, about three inches thick, is taken off the gun-head parallel to the face of the muzzle, and as near thereto as is practicable. This ring is not reamed out or turned upon the exterior, but is a section of the rough casting. When two rings are taken from the same head, the one nearer to the muzzle is marked number 1, the other number 2. In the 15-inch gun the distance of ring No. 1 from the face of the muzzle measured to the center of the ring is 3.7 inches; and of ring No. 2, 7.5 inches. In a 10-inch gun the distance of No. 1 is three inches; of No. 2, 6$\frac{5}{8}$ inches. Each ring is cut through by planing a groove 0.5 inch wide from the exterior to the core



until the initial strain breaks the unplaned part, and the ring springs open. The width of the groove at the exterior is now measured, and its increase over 0.5 inch divided by the original circumference of the ring will be the extension per inch of the metal on the exterior. This extension per inch is then compared with the extension per inch obtained by actual experiment with a specimen of the same iron, and the corresponding stress required to produce it will be the initial tension.

For example, the ring from a 15-inch gun head is, say, 38 inches in diameter; the width of the groove before the bursting of the ring is 0.5 inch, and afterwards 0.65 inch, showing a total extension on the exterior of 0.15 inch, then

$$\frac{0.15}{\pi 38} = \frac{0.15}{119.38} = .00127$$

for the extension per inch of metal on the exterior. Upon examination of the tests of this metal we find the stress corresponding to this extension per inch to be 20,000 pounds per square inch, which will be the initial tension of the ring, supposing the iron to possess the same tenacity and elasticity, and that the breaking of the ring entirely relieved it of strain, which it cannot probably do. To illustrate the effect of this initial strain upon the strength of the gun, let us suppose that the initial strain of extension upon the exterior of a gun one caliber thick—and of which the tenacity of iron is 30,000 pounds per square inch —is 15,000 pounds per square inch, the metal at the surface of the bore will be subjected to a compressive strain of 15,000 pounds per square inch.

Now if we suppose the tangential strain due to the action of a central force, such as fired gunpowder, to decrease directly as the distance from the axis of the bore increases, and that an interior force just sufficient to relieve the metal at the surface of the bore from compression has been applied, then will the exterior of the gun be brought to a strain of extension of 20,000 pounds per square inch. Now increase the interior pressure of gas until the metal at the surface of the bore is under a tensile strain of 30,000 pounds per square inch, and the tensile strain of the metal on the exterior of the gun will be increased to 30,000 pounds per square inch also, and the whole thickness of the walls of the gun would be brought to the breaking strain at the same instant, which is the object of initial strain. But in practice we know that the strain due to a central force diminishes in a higher ratio than directly as the distance from the axis, and this would require an increase of initial strain in order to bring the outer portions of metal to the breaking point at the same time, while on the other hand the fact that a given increase of load or strain will produce a much greater extension when applied to a specimen near to its breaking strain than when applied to the same specimen when strained within, or even considerably above the limits of its permanent elasticity, causes the maximum resistance of a gun, having too little initial strain, to approach more nearly than it would otherwise do to what its maximum resistance would be with a proper initial strain.

The law of diminution of tangential strain from the bore outward in a gun is not and cannot be accurately known, nor, therefore, can the exactly proper initial strain be determined. But, as the foregoing reasoning shows, after the initial strain shall be equal to that estimated on the hypothesis that this strain is inversely as the distance from the axis of the bore, it may vary considerably above that point without affecting to any considerable degree the maximum resistance of the gun; and we therefore know that we are safe in fixing the initial strain at, or a little above, that which the law of diminution of strain as the distance from the axis increases, would give.

The initial tension-rings for Rodman guns, on being planed through, should open on the exterior 0.25 inch for 20-inch guns; 0.17 inch for 12-inch rifles; 0.15 inch for 10-inch rifles. The properties of iron employed and the rate of cooling should be so regulated as to produce these openings. If the rings do not open sufficiently, add more water and fire longer, which will insure a higher tension. If the rings open too much diminish the quantity of water and the length of time the fire is kept up in the pit. The gun should not in any case be "steamed"; but, if necessary, the water may leave the casting at 200° or 205°. The more rapid the cooling the higher the iron, and the more rapidly the interior is cooled over the exterior the greater the tension. If a higher density of the metal is required a less fire will be required in the pit. Cold iron should not be put into a pool of melted iron. If the iron is not high, it should be kept in fusion and evenly stirred till a satisfactory result is obtained. In planing through the rings for initial tension they should be so clamped in the planing-machine that one-half should be free to spring open when the thickness is so far reduced by planing that the initial strain will break the metal thus left. In other words, the planing should be continued till the ring parts. The thickness of the metal broken should be accurately measured, as also the amount of opening in its exterior. For 10-inch guns the thickness of the broken part of the ring should be about one-tenth of the whole thickness of the ring. Should it be less, more water and a longer continued fire in the pit will correct the defect. The amount of initial tension on the exterior, which General Rodman thought should obtain in a properly constructed gun, was about one-half the ultimate tenacity of the metal. Bloomfield gun-iron, when employed in 20-inch guns, should be so far decarbonized as to have a density of 7.24 to 7.26, with a tenacity of 32,000 pounds. When employed in 12-inch rifles it should have a density of from 7.26 to 7.28, with a tenacity of 32,000 pounds. When employed for 12-inch shot to be chilled at the point it should have a density of from 7.32 to 7.35. Richmond gun-iron, when for 10-inch rifles, should have a density of from 7.28 to 7.30, with a tenacity of 32,000 pounds.

In the manufacture of 4.5-inch siege rifles the application of the water-cooling process is impracticable, owing to the great length and small size of the bore. These guns are, therefore, cooled from the exterior. The best quality of gun-iron should be employed in these guns, with a density not to exceed 7.25, say from 7.22 to 7.25. The guns should be cooled slowly in covered pits. The following are some of the particulars and charges of Rodman guns:

Name of Gun.	Length.	Length of Bore.	Maximum Diameter.	Weight.	Service Charge.	Bursting Charge. Shell.	Weight of Shot.	Weight of Shell.
Smooth Bores.	In.	In.	In.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs
20-inch gun	243.5	210.	64.	15200	100	...	1080	
15-inch do.	190.	165.	48.	49100	50 mammoth.	17	{ 440 } { 425 }	330
13-inch do.	177.6	155.94	41.6	32731	30 cannon.	7	{ 300 } { 280 }	224
10-inch do.	136.66	105.5	32.	15059	{ 15 for shell. } { 18 for shot. }	3	127	100
8-inch do.	123.5	110.	25.6	8465	10	1	68	48

See *Casting*, *Cast-iron Guns*, *Cooling*, *Finishing*, *Molding*, *Ordnance*, and *Sea-coast Artillery*.