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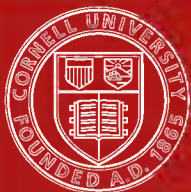
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THE
ELEMENTS OF FIELD-ARTILLERY

THE
ELEMENTS OF FIELD-ARTILLERY

DESIGNED FOR THE USE OF
INFANTRY AND CAVALRY OFFICERS

BY
HENRY KNOLLYS

CAPTAIN ROYAL ARTILLERY

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WILLIAM BLACKWOOD AND SONS
EDINBURGH AND LONDON
MDCCCLXXVII



P R E F A C E.

OFFICERS of infantry and cavalry, especially those belonging to the Staff, to whom some elementary knowledge of the practical working of field-artillery is absolutely necessary, have frequently requested me to recommend to them a text-book, wherein they might study the subject. Of standard, scientific works of this nature there is no lack—amongst them Colonel Owen's 'Modern Artillery' is pre-eminent; and I beg leave to express my acknowledgments to this officer for the assistance I have received from his treatise, from which I have ventured to borrow largely, and which I strongly recommend to those who wish to obtain a thorough knowledge of the science.

For amateur artillerists, however, who enter on this subject as a collateral, not a main object of their profession, the standard books supply

information in excess of what is required. They are a little too lengthy, and a great deal too abstruse. The student is at a loss to sift what will be of practical use to him from what is intended for highly-trained Artillery officers, and to draw the line between the departments of field and garrison artillery. He is puzzled with the technical expressions, and dismayed at the introduction of highly interesting but intricate calculations; and in nine cases out of ten he gives up the task in despair, believing that it can be grappled with successfully by members of "the scientific corps" only.

With a view of obviating these difficulties, I have compiled the present volume. The bulk of it is old matter, and well-informed artillerists are warned off; but I have endeavoured to put it in such a shape that it may be easily understood by non-artillery officers, and to insert nothing but what is of direct, practical utility to officers of other branches of the service, or what is absolutely necessary to a comprehension of the elementary principles.

HENRY KNOLLYS,
Capt. Royal Artillery.

17 EATON SQUARE, LONDON,
January 1877.

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The Principles and Practice of Modern Artillery. By Lieutenant-Colonel Owen, R.A.

The Manual of Artillery Exercises.

The Manual of Field-Artillery Exercises.

The Soldier's Pocket-Book. Third Edition. By Major-General Sir Garnet Wolseley.

Short Notes on Field-Batteries. By Captain Orde Browne, R.A.

The Blue-Book Report of Artillery Experiments carried on at Okehampton, 1875.

Army Estimates, 1876 and 1875.

Instructions for Infantry Outposts, issued provisionally for the Autumn Manœuvres of 1872.

&c., &c., &c.

PART I.

GUNS—AMMUNITION—CARRIAGES

NOTE.

THE various subjects treated of in this volume have been classified into Three Parts, each of which may be studied independently of the others, though of course a more thorough knowledge will be gained by a perusal of the whole.

THE ELEMENTS OF FIELD-ARTILLERY.

CHAPTER I.

GUNS.

DIFFERENT PARTS OF A GUN—CONSTRUCTION OF MUZZLE-LOADING RIFLED 9-POUNDER GUNS—BREECH-LOADING FIELD-GUNS—METHOD OF WORKING BREECH-LOADING GUNS—MACHINE GUNS—THE MITRAILLEUR—THE GATLING GUN—DEFINITIONS OF TERMS USED IN GUNNERY—PRINCIPLES OF LAYING A GUN—THE TANGENT-SCALE—RANGE-FINDER—TABLES OF FIELD-GUNS.

DIFFERENT PARTS OF A GUN.

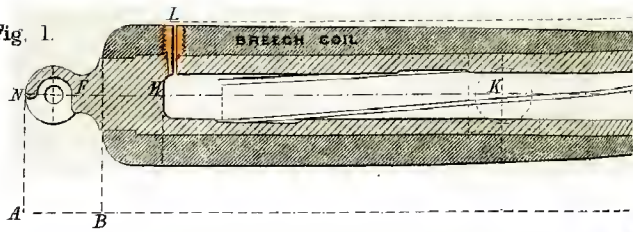
THE muzzle-loading field-gun now in use in the British service is divided into the following principal parts (fig. 1, Plate I.): “Cascable,” *A B*, “Breech-coil,”¹ *B C*, “Chase,” *C D*, “Muzzle,” *D E*.

¹ In the old smooth-bore gun the space between *L T* was marked off into two portions by a surface ring, and these portions were called the “First and Second Reinforces.” In modern guns the ring has been discontinued, and no recognised term has been adopted to designate this part of the gun.

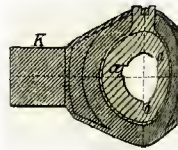
The projection in rear is called the "Button," F ; the "Breech," FH , strictly speaking, extends from the bottom of the bore to the junction of the button. The gun is supported in its carriage by projections called "Trunnions," KK , placed a little in front of the centre of gravity of the piece, in order that it may rest steadily on the carriage. This excess of weight in rear of the trunnions is the "Preponderance," and should be as small as possible, to facilitate raising the breech when additional depression of the muzzle is required. The "Vent," L , is the small channel by means of which the gun is fired. The increased thickness at the muzzle, adopted to check its tendency to droop after long-continued firing, is called the "Swell of the Muzzle," and the patch immediately above it the "Dispart Patch," M . It does not, however, exist in heavier guns than the 9-pounder. In the 16-pounder a trunnion-sight (see p. 12) is substituted. It forms one of the sights, a line, LM , called the "Line of Metal," drawn from the breech to the dispart patch, being parallel to the axis of the bore, HO , and thus facilitating aiming, or "laying" the piece. The "Dispart" is half the difference between the thickness of the gun at the breech and the muzzle—that is to say, it equals PM . The bore has three "Grooves," α ; the intervening portions are called the "Lands." The "Calibre," RS , is the diameter of the bore measured across the lands, and the slight

WROT IRON RIFLED MUZZLE

Fig. 1.

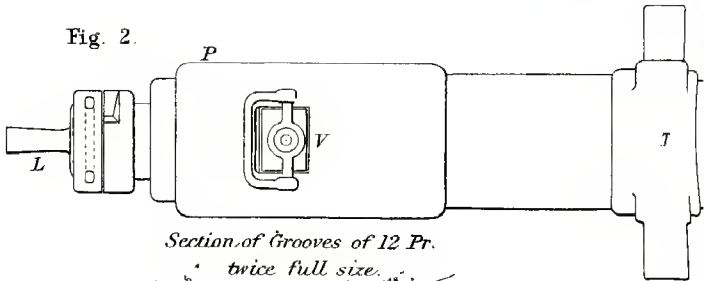


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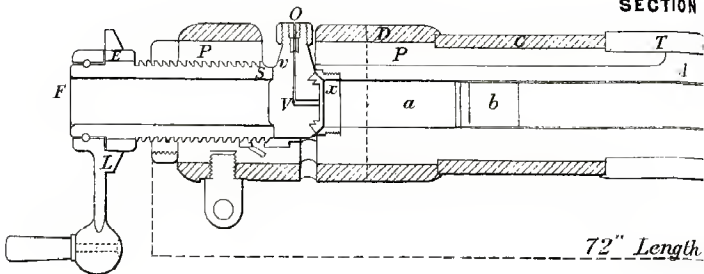


12 PR. B. L. RIFLED CO.

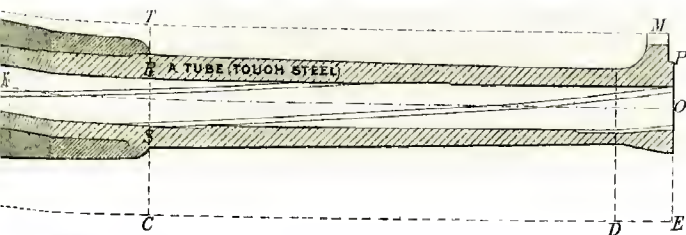
Fig. 2.



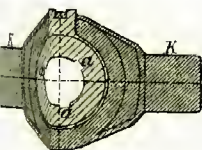
SECTION



72" Length

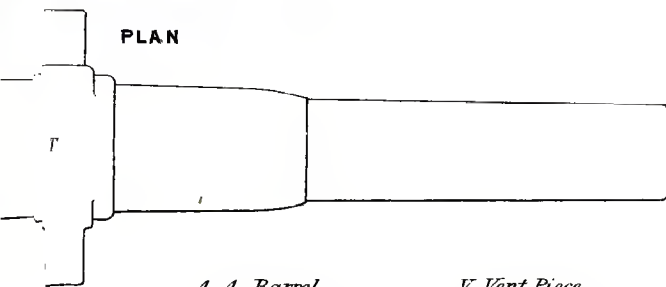


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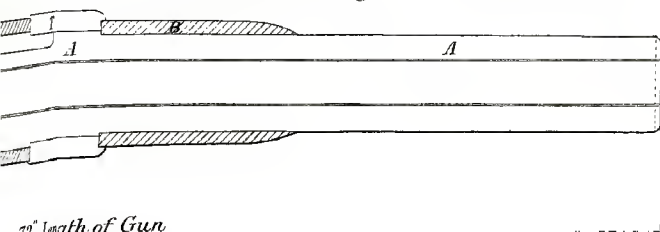


L. RIFLED GUN ARMSTRONG.

PLAN



SECTION



- | | |
|------------------------------|-------------------------|
| <i>A. A. Barrel.</i> | <i>V. Vent Piece.</i> |
| <i>B. C. & D. Coils.</i> | <i>E. Tappet Ring.</i> |
| <i>F. Breech Piece.</i> | <i>L. Lever Ring.</i> |
| <i>T. Trunnion Ring.</i> | <i>S. Breech Screw.</i> |

72" Length of Gun

difference between the diameter of the bore and that of the projectile is called the "Windage." In muzzle-loading guns windage is necessary, principally because it is impossible to construct projectiles which shall exactly fit the bore. They are therefore manufactured of an approximately regulated smaller size.

CONSTRUCTION OF MUZZLE-LOADING RIFLED 9-POUNDER GUNS.

This gun (fig. 1, Plate I.), which differs from the 16-pounder in detail only, is made of a cast-steel tube, over which, when cool, is shrunk a hot wrought-iron breech-coil. The outer coil contracts as it cools, and this arrangement equalises the strain arising from the explosion of the charge, which strain is manifestly greatest on the inner tube, while the outer coil is subjected to comparatively little violence. In technical words, the steel tube is in a constant state of "initial compression"—the outer coil in a constant state of "initial tension." It is also evident that the strain on the metal is greatest at the breech, and decreases towards the muzzle, for which reason the gun is made of a conical form. The ring on which are the trunnions, is shrunk on to the gun in a similar manner.

The steel tube is first cast solid, and then bored out. The coils are made by heating a long bar of

wrought iron, and twisting and hammering it round an iron roller or "mandrel," which can afterwards be withdrawn, leaving the original bar welded in the form of a tube. It is then reheated and shrunk on as already stated. The vent is of copper, which resists the corrosive action of the friction-tubes, whereby the charge is exploded, better than iron. A hole is drilled into the bore, and the copper vent is then screwed in. The bottom of the bore, or the chamber where the cartridge rests, is smooth—in front it is rifled on what is called the Woolwich system. The three grooves have rounded sides, and a uniform twist of one turn in 30 calibres, usually expressed as "1 in 30"—that is to say, supposing the calibre to be 3 inches, the groove will have made one complete turn in a length of bore of 3×30 inches, or 7 feet 6 inches. The actual length of the bore of the muzzle-loading rifled 9-pounder, measured from *H* to *O*, is, however, only 5 feet 6 inches, so that the rifling does not make one complete turn throughout the length of the gun.

The three grooves correspond to three double rows of studs attached to the projectile (fig. 7, p. 17); and these studs being deeper than the grooves, the shot glides entirely in these grooves, the body of it never coming into actual contact with the bore. In order to secure the grooves from injury, the studs are made of soft material—zinc or gun-metal.

BREECH-LOADING FIELD-GUNS.

These guns are almost obsolete in our service, but it is probable that the weight of opinion entertained by the majority of artillery officers in their favour will lead to their reintroduction for field service. The Armstrong system may be regarded as a type of British breech-loading ordnance. The gun (fig. 2, Plate I.) is made of wrought iron coiled in the same manner as described for muzzle-loaders, the barrel itself being formed of coils, or of a steel tube with coils shrunk over it. The bore is provided with a number of narrow grooves—38 in the 12-pounder: at the bottom the bore is slightly enlarged to form a shot-chamber, *b*; and behind it is the powder-chamber, *a*, of still greater diameter, and unrifled. The bore is continued completely through the breech-piece, *P*, above which is cut an opening or slot, *O*. Into the slot the vent-piece, *V*, is dropped, and is kept in its place by the breech-screw, *S*, which is screwed backwards and forwards by a lever ring, *L*, and a tappet ring, *E*. The vent-piece, which is of steel tempered in oil, is faced with a copper ring, *x*, exactly fitting into another copper ring at the end of the powder-chamber, and thus prevents the escape of gas. The vent-piece contains the copper vent, *v*.

METHOD OF WORKING BREECH-LOADING GUNS.

By means of the lever L (fig. 2), the breech-screw S is worked back, the vent-piece loosened, and taken out by the upper slot, O ; the projectile is rammed through the now open extremity, F , into the shot-chamber, b , and the cartridge into the powder-chamber, a ; the vent-piece is dropped into the upper slot, O , and being screwed tightly up against the powder-chamber by means of the breech-screw, S , the bottom of the bore is effectually closed. When the cartridge is fired, the soft coating of the projectile, which is of greater diameter than the bore in front of it, is forced into the grooves, and consequently takes the rifling. Thus windage is entirely obviated, and the accuracy of fire much improved.

There are many methods of closing the breech besides the Armstrong, which is open to the grave objections of being complicated and liable to jam. The Krupp system, for instance, is generally considered far superior.

Smooth-bore field-guns are now entirely obsolete. There are a vast number still in store, which are gradually being worked up into appliances for modern rifled ordnance.

MACHINE GUNS.

The most successful of the numerous recently invented machine guns are the French Mitrailleur and the Gatling gun.

THE MITRAILLEUR consists of 25 rifled barrels, fixed in five layers one above the other, the whole surrounded with a bronze casing, and presenting the appearance of a field-gun. It is mounted on a light gun-carriage. All the barrels are loaded simultaneously by introducing at the breech the case containing the cartridges, the whole of which are discharged so rapidly as practically to amount to a simultaneous discharge. The charge is exploded by working a handle called a breech-striker. The bullets are so concentrated that even a small object is riddled to a useless extent, while the arrangements for aiming are rough and unsatisfactory. Its service is laborious, and it easily gets out of order.

THE GATLING GUN (fig. 3) has been introduced into the English service, and is supposed to be less open to the above objections. As a matter of fact, however, no batteries are at present armed with it. It consists of a series of rifled barrels, 6 or 10, according to the size of the weapon, rigidly secured upon a main shaft. Each barrel is provided with a separate lock: at the breech is a self-feeding apparatus containing 240

rounds; and the whole operation of loading and discharging is conducted by turning a breech-handle,

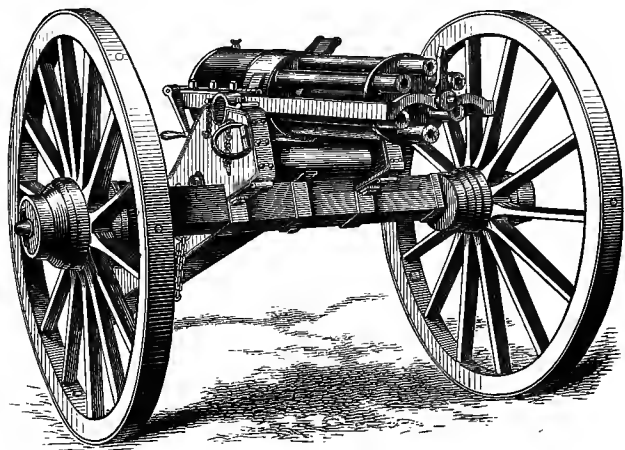


Fig. 3.—Gatling Battery-Gun.

while the barrels are kept in a continuously revolving movement. A lateral motion can be given to the machine when being discharged, so that a perfect sheet of bullets can be made to sweep the sector of a circle. Two men are required to serve it, and from 300 to 400 rounds can be fired in one minute.

Notwithstanding the idea popularly entertained of the deadly effect of machine guns, this view appears to be fallacious (as I have endeavoured to show in page 108), and their introduction into our service a measure of questionable expediency.

DEFINITIONS OF TERMS USED IN GUNNERY.

(Fig. 4, Plate II.)

The *Line of sight* is the line passing through two sights at any elevation, and the object.

Axis of the gun.—An imaginary horizontal line drawn through the centre of the bore.

Line of fire.—The axis of the piece produced.

Angle of elevation.—The angle B made by the line of sight with the line of fire.

A gun is laid *point-blank* when the prolongation of its axis passes through the object aimed at, whether such object be on the same level with the gun or otherwise.

Point-blank range differs entirely from “point-blank.” It is the distance from the gun to the first graze of the shot when the piece is on a horizontal plane and is laid with its axis perfectly horizontal. This definition, though not strictly accurate, is sufficiently so for all practical purposes.

Deflection.—The perpendicular horizontal distance of the first graze of the shot from the right or left of the object aimed at.

Derivation or drift.—The constant bearing off to the right or left of projectiles fired from rifled guns. If the rotation is right-handed, as in our service—that is to say, if the upper surface of the shot, viewed

from behind, is made to revolve from left to right—the projectile will gradually drift away to the right; but if the rotation is left-handed, the drift will be to the left. This holds good for pointed or conoidal heads only. The converse rule curiously applies to flat-headed projectiles, such as the Whitworth shot. In this case, right-handed rotation causes drift to the left; left-handed rotation, drift to the right.¹

PRINCIPLES OF LAYING A GUN.

In “laying” the gun, it is necessary first to bring the axis into the same vertical plane with the object aimed at, and then to give it a certain elevation above that object, according to the length of the range.

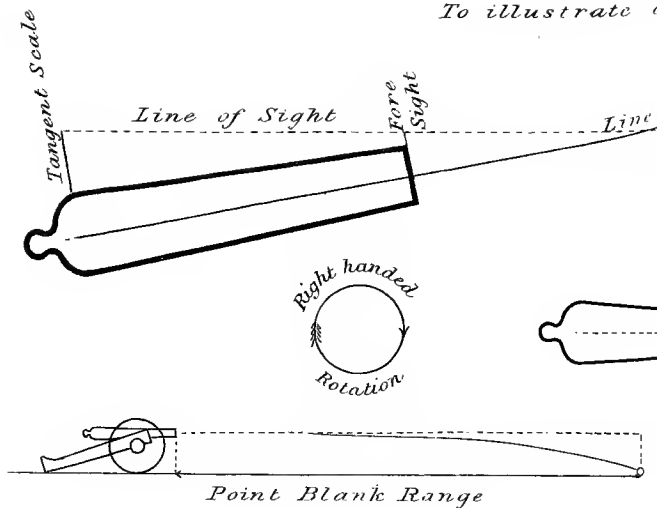
Points called “sights” are indicated on the upper surface of the piece, showing the direction of its axis. For the 9-pounder and 7-pounder the “fore-sight” is cut in a recess in the dispart patch, *M*, fig. 1; in the 16-pounder it is screwed into the trunnion. For a “back-sight” a tangent-scale (fig. 4) is used, whereby the exact required elevation can be given.

THE TANGENT-SCALE (fig. 5) is a graduated metal bar, working up and down at the breech. It is in-

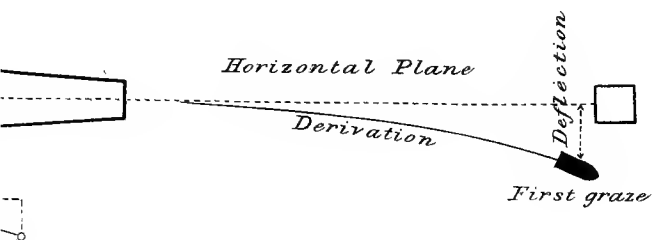
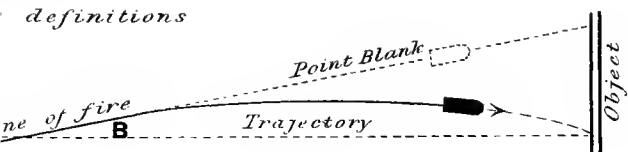
¹ With reference to flat-headed shot, I may mention that it has been stated as a curious fact that these projectiles punch a deeper hole than the ogival-shaped shot. The only reply to be given to this statement is, that it is altogether inaccurate. See Owen's *Modern Artillery*, 2d edition, note to page 267.

Fig.

To illustrate



4.
definitions



clined to the left of the vertical axis of the gun at a small angle— $2^{\circ} 16'$ —to correct for the constant drift of the shot to the right already spoken of—page 11. It has also a movable cross-head to allow for deflection from wind, &c. On one side of the bar are marked degrees; and on the other (not seen in figure), the number of hundreds of yards corresponding to those degrees. With the ordinary tangent-scale, an elevation of 5° , corresponding to 2100 yards, and a deflection of $30'$, can be given. With the long tangent-scale this elevation can be increased to about 11° , which gives a maximum range of 3500 yards to 9-pounders, and 4000 yards to 16-pounders. Under such circumstances, however, their fire is unreliable. In laying the gun, the scale is first raised to the height indicated for the range, and the cross-head adjusted, if necessary. By means of the handspike, the trail or end point on which the carriage rests is traversed until the line drawn from the eye through the tops of the tangent-scale and the fore-sight falls directly below (or above) the object aimed at—*i.e.*, until the gun is brought into the same

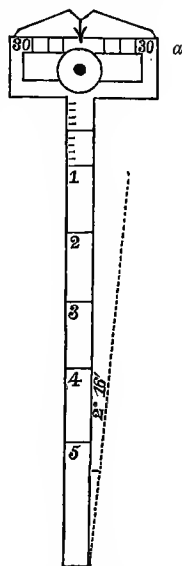


Fig. 5.—Tangent-scale.
a, cross-head for deflection.

vertical plane with it. With the elevating-screw the breech is then lowered (or raised) until the line of sight falls on the object.

RANGE-FINDER.—The chief difficulty in obtaining the formidable results from artillery-fire of which it is capable, arises from the incorrect estimates, made by the gunners, of distances from the gun to the object. No amount of training to judge by the eye will obviate the difficulty; and therefore the introduction into the service of "Nolan's range-finder" will certainly supply a great want. This simple instrument in appearance resembles a large wooden scale; it is fastened on to the breech of the gun or to a light portable tripod, and the calculations are made mechanically by merely turning a screw. The ranges can be ascertained, even by men ignorant of the multiplication table, in from two to three minutes; and at 2000 yards and upwards the average errors will not exceed ten yards.

Of course there are occasions when range-finders would probably not be used at all—for example, on coming suddenly and rapidly into action at comparatively short ranges to check the advance of troops moving quickly, or in actively pursuing a retiring enemy at constantly changing distances. But its employment would be highly advantageous in the great majority of instances.

TABLE OF THE PRINCIPAL SERVICE FIELD-GUNS.

	Weight.	Length.*	Calibre.	Preponderance.	Rifling.		Service charge.	REMARKS.
					Number of grooves.	Twist in calibres.		
Gatling,	cwt. 4	ft. in. 4 11½	in. .45	lb. 35	7	1 in 22	grains. 85	...
Muzzle-loaders— 7-pounders,	lb. 150	2 2½	3	3	3	1 in 20	lb. oz. 0 12	
9 "	cwt. 6	5 11	3	10	3	1 in 30	1 12	{ For light field-batteries and horse-artillery.
16 "	12	6 2¾	3.6	10	3	1 in 30	3 0	
40 "	34	8 0	4.75	28	3	1 in 35	7 0	For heavy field-batteries.
12-pounder Arm- strong breech- loader,								For guns of position.
	8	6 0	3	199	38	1 in 38	1 8	{ For light field-batteries and horse-artillery, at present almost obsolete.

* The length of a gun is generally measured from *F* to *O*, fig. 1.

CHAPTER II.

AMMUNITION.

PROJECTILES FOR MUZZLE-LOADING FIELD-GUNS—CASE—COMMON SHELL—WATER SHELL—DOUBLE SHELL—SHRAPNEL SHELL—ACTION OF SHRAPNEL SHELL—SOLID SHOT—HOT SHOT—PROJECTILES FOR BREECH-LOADING FIELD-GUNS—CASE—COMMON SHELL—SEGMENT SHELL—SHRAPNEL SHELL—ROCKETS—EXPLANATION OF THE ACTION OF A ROCKET—ADVANTAGES AND DEFECTS OF ROCKETS—FUZES—TIME-FUZES FOR MUZZLE-LOADING FIELD-GUNS—ACTION OF TIME-FUZES—TIME-FUZES FOR BREECH-LOADING FIELD-GUNS—PERCUSSION-FUZES—ACTION OF THE PERCUSSION-FUZE—COMPARATIVE ADVANTAGES OF TIME AND PERCUSSION-FUZES—MEANS OF FIRING GUNS—THE FRICTION-TUBE—PORT-FIRES, ETC.—GUNPOWDER—TESTS FOR GUNPOWDER—GUN CARTRIDGES.

PROJECTILES FOR MUZZLE-LOADING FIELD-GUNS.

CASE (fig. 6) is a tin cylinder filled with bullets of lead hardened with antimony, of about the same size as the old smooth-bore musket-balls, and varying in number according to the calibre of the gun for which they are designed. The 9-pounder case contains 110 bullets. The interstices between them are filled with clay and sand. When the gun is fired, the tin cylinder breaks up in the bore, and the liberated balls are

scattered at the muzzle. Case is effective up to about 350 yards, or, if fired with an extra charge of powder, a

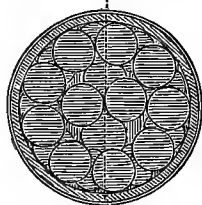
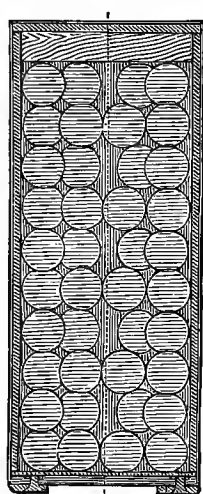


Fig. 6.—Shot, R.M.L.
Case, 9-pounder.

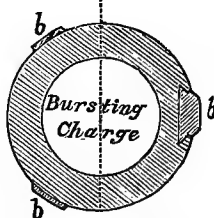
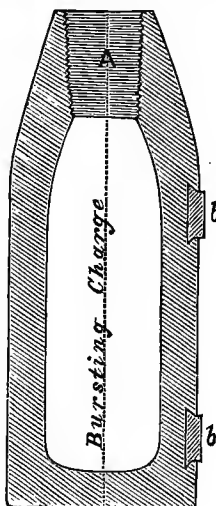


Fig. 7.—Shell, R.M.L.
Common 9-pounder.

little further ; the bullets quickly lose their velocity. It is used against infantry or cavalry at very close quarters.

COMMON SHELL (fig. 7) is a hollow cast-iron pro-

jectile filled with gunpowder called a "bursting-charge." In form it is cylindro-ogival (pronounced ōjīval; French, pointed arch), the ogive head being found to give superior range and penetration to the conoidal head. Its length is about three times its calibre—for instance, the diameter of the 9-pounder shell being 3 inches, its length is 9 inches. With the old spherical projectile, it is evident that to increase the weight of the shot, it was also necessary to increase the calibre of the gun; but with elongated projectiles, the weight can be increased simply by adding to the length. For instance, the 12-pounder and the 9-pounder Armstrong guns are of the same calibre, but the 9-pounder projectile is shorter than that for the 12-pounder. The bursting-charge of the common shell is ignited at the required moment in the flight of the projectile by means of a fuze, A, either "time" or "percussion," whereupon the shell is scattered into fragments with great violence. Its interior is made smooth by lacquer, as otherwise premature explosions are liable to occur, owing to the friction of the bursting-charge against the rough surface of the interior iron. As explained in page 6, it is made to take the rifling by three rows of metal studs, *b, b, b*. Common shell may be used with advantage against troops at long ranges, especially in column or under cover, and against buildings and obstacles. They are distinguished by being painted black.

WATER SHELL. — This projectile has been lately experimented on with excellent results. It consists of a common shell, fitted with a small cylinder, containing about a quarter of an ounce of compressed gun-cotton and a detonating fuze screwed into the head—the space unoccupied below this cylinder being filled with water. Thus the interior is more completely filled than can be insured by the ordinary bursting-charge, which is always liable to “set up,” and leave interstices; and in consequence, the shell breaks up into a larger number of fragments with greater destructive effects. The Special Committee on Rifled Field-Guns, 1875, reported that “the water shell, as used by them at Okehampton, is capable of producing a greater effect against troops as a percussion-shell than any projectile with which they are acquainted. It possesses the advantage of extreme simplicity and cheapness.” The following was the result of rapid firing with the 16-pounder gun at a range of 2000 yards:—

Rounds.	Hits per shell.
36 Shrapnel—time,	52
36 Shrapnel—percussion,	43
36 Water—percussion,	117

Its drawback is, that the gun-cotton being smokeless, no puff is produced on graze—a serious defect, because at long ranges the gunners would have great difficulty in correcting for those errors of laying which are almost inevitable on first opening fire.

DOUBLE SHELL is a shell of increased length, strengthened internally by three longitudinal bars, and containing a bursting-charge larger than that used with the ordinary shell. It weighs 12 lb., and is fired from a 7-pounder gun, generally with a very great elevation and a small charge. Under these circumstances, it fulfils to some extent the purposes of mortar or vertical fire, and can search out objects which would be otherwise completely under cover.

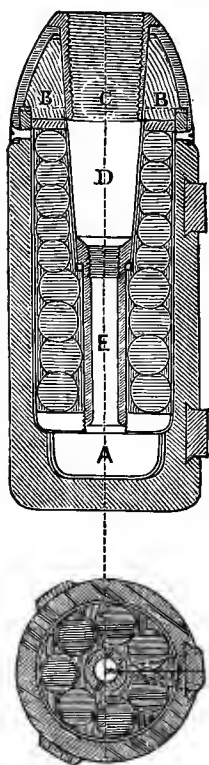


Fig. 8.—Shell, R.M.L. Boxer Shrapnel. 9-pounder.

SHRAPNEL SHELL (fig. 8) differs from common shell in having its interior filled with bullets embedded in rosin—63 bullets in the 9-pounder shrapnel. A small bursting-charge is placed in a tin chamber, A, at the base. The head, B, is of elm, covered with a plate of wrought iron,

and riveted to the body. A fuze, C, is fitted to the head, as with common shell; and in order to conduct the fuze flame to the bursting-charge, a

wrought-iron tube, D, in which is placed a metal primer, E, filled with mealed powder, passes down the centre of the projectile. The shell is cast with four longitudinal grooves inside, forming "lines of least resistance," and facilitating its being opened by the bursting-charge. It is distinguished from the common shell by having the head painted red. During transport, both natures have their tops closed with metal plugs, which are unscrewed on coming into action, and replaced by fuzes. Shrapnel as well as common shell, for field service, are always carried "loaded"—that is, with their bursting-charges inside them, ready for instant use.

ACTION OF SHRAPNEL SHELL.—At a certain point in the range, the fuze, bored according to calculation, ignites the bursting-charge, which opens out the shell, and sets free the bullets, which gradually spread, but proceed forward in nearly the same direction, and with nearly the same velocity possessed by the shell at the moment of explosion. The bursting-charge is very small—only just sufficient to open the projectile—as otherwise it would interfere with the direct flight of the bullets.

Shrapnel is used against scattered troops and skirmishers in open, fairly level ground, beyond the effective range of case. It is, in fact, merely case adapted to long ranges.

SOLID SHOT are obsolete for field-guns, shell being

employed in lieu. The latter, however, filled with sand instead of a bursting-charge, and plugged with conical pieces of wood instead of with fuzes, may be employed in the improbable event of solid shot being required.

HOT SHOT, which are useful in setting fire to buildings and exploding magazines, cannot, unfortunately, be fired from rifled ordnance.

PROJECTILES FOR BREECH-LOADING FIELD-GUNS.

CASE differs from that used with muzzle-loaders in having three solder studs at the base, which jam in the chamber of the gun, and prevent its being rammed too far up the bore.

COMMON SHELL differs from the muzzle-loading shell chiefly in being coated with lead and being slightly larger than the bore of the gun. The force of the explosion drives the soft coating into the rifling, as explained in page 8.

SEGMENT SHELL (fig. 9) consists of a thin cast-iron shell, inside which cast-iron segments are built up, leaving a hollow space in the centre, where the bursting-charge is placed. The outside is coated with lead, which flows between the segments and binds them together. This construction on the principle of the arch is very strong against external pressure, but readily yields to the inside, opening pressure of the

bursting-charge, especially since grooves are cast in the skeleton of the shell. Segment may be used as solid shot, as common shell, as case, or as shrapnel. In the first case, it has no fuze; in the second instance, the fuze is arranged so as to explode the bursting-charge on striking the object. As shrapnel, the fuze is adjusted so as to cause explosion when within 30 yards of the object; or if employed as case, so as to burst within 150 yards of the muzzle of the gun. The projectile is generally too complicated and unreliable to be satisfactory in its action; and as soon as the shell is burst, the released segments, from their peculiar shape, fly very wild, and quickly lose their velocity. It is not issued to muzzle-loading guns.

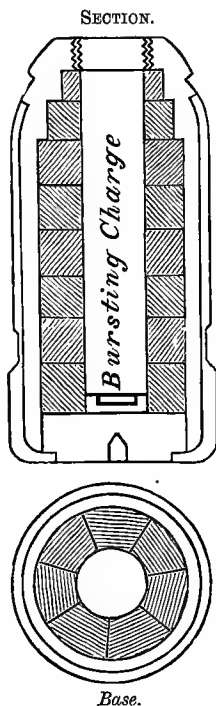


Fig. 9.—Segment Shell, B.L.

SHRAPNEL SHELL differs from muzzle-loading shrapnel principally in being coated with lead.

For the special purposes for which the various descriptions of projectiles above described are suitable, see also pages 103-109.

ROCKETS.

The service rockets are Hale's 24-pounders and 9-pounders.

HALE'S ROCKET (fig. 10) consists of a cylindrical case of Atlas metal, to which is riveted a cast-iron

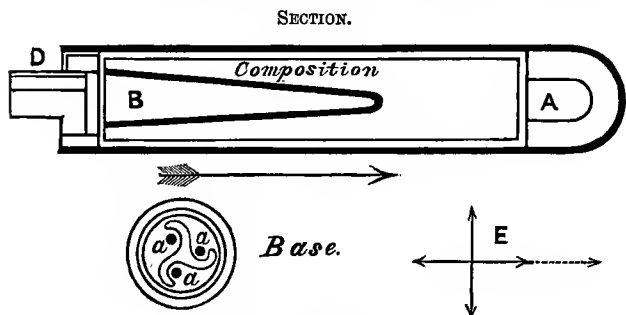


Fig. 10.—Hale's Rocket.

head, A, plugged with oak. Formerly the head was of the nature of a shell, and was fitted with a fuze; but the operation of preparing, in the field, the projectile for action, was so dangerous, and the results were so unreliable, that the shell head was discontinued: it will, however, be resumed on an improved construction. A comparatively slowly-burning composition is pressed into the case over a conical spindle, which, on being withdrawn, leaves a cavity, B, in the composition. The base of the case is closed by a cast-iron ring with three conical vents, *a, a, a*; and round

one side of each vent is a circular "half-shield," D, projecting about $1\frac{1}{2}$ inch. The gas of the burning composition, rushing through the vents, presses obliquely against these half-shields, and causes the rocket to rotate, whereby a greater accuracy of flight is attained, and the necessity for a steadying stick is done away with. The inside of the case is corrugated—in the form of folds—so as to give the composition a hold, and to prevent the latter twisting away from it—a contingency which would render their use very dangerous. Rockets are painted red. They are discharged from very light tubes, or from light V-shaped troughs, or they may be fired from the ground, the heads being slightly tilted up. The composition is lighted by a port-fire or a friction-tube: the projectile instantly starts forward, and, with an accelerating force, flies over a varying range of about 1800 yards, until the whole of the composition is consumed. During its flight it acquires a rotatory motion through the action of the vents.

EXPLANATION OF THE ACTION OF A ROCKET.—The generally-received explanation of the motion of a rocket is, that by reason of the cavity B, and the consequent large surface of the composition inflamed at once, the amount of gas thereby generated cannot escape through the vent-holes as quickly as formed. A pressure is therefore exerted in every direction inside the case, E (fig. 10). The pressures against the sides balance

each other ; but that against the head is greater than that on the base, owing to the escape through the vents. The surplus pressure imparts a forward motion. The armies of almost all civilised nations have in turn introduced rockets into their service, and have gradually abandoned them owing to their being so unmanageable and unreliable. In the English army we still cling to them, and attempt, occasionally with success, to employ them in active warfare.

ADVANTAGES AND DEFECTS OF ROCKETS.—Rockets are one of the unsolved problems in the science of gunnery. The subject is still in its infancy, and is beset with difficulties; and whoever succeeds in solving them, will probably be the greatest Artillery inventor of the day. On the one hand, the projectile, when successfully managed, produces very striking results, either as a solid shot, a shell, or an incendiary missile. Its moral effects are enormous, especially against cavalry; it requires no gun, and a mere fraction of the men, appliances, and expense involved in the use of other descriptions of projectiles; each rocket-detachment consists of five men only. "It is," to use the expression of Sir William Congreve, the practical adapter of them, "the soul of artillery without the body." On the other hand, the practical difficulties militating against their use have thus far been found insuperable. The burning composition deteriorates by being kept; the projectile is extremely dangerous to handle; and prem-

ature and unexpected explosions are of such frequent occurrence that the detachments never become used to their duties, get hopelessly nervous, and hate the sight of a rocket, which at last they regard as a dangerous kind of wild beast, to be got rid of as safely as possible. Again, all attempts to insure for them accuracy of flight have failed, simply because the expedients to steady them by giving them a rapid rotation, have answered only after they have accomplished a great part of their trajectory, while on first starting they fly very wild. This objection applies to a certain extent even to Hale's rockets. A very slight wind blowing across the range affects their accuracy most injuriously. In actual practice, rockets have sometimes been deflected to such an extent by wind, or by having struck some chance interposing obstacle, that their original direction has become completely reversed, and without exaggeration they have flown back to the party firing them, of course scattering them in dismay.¹

FUZES.

Fuzes are employed for igniting the bursting-charges of shells at the required moment. They may be classified into Time-fuzes and Percussion-fuzes.

TIME-FUZES FOR MUZZLE-LOADING FIELD-GUNS.—

¹ See also *post*, page 106.

The "9-seconds time-fuze" (fig. 11) consists of a truncated cone of beech-wood, about 3 inches long. An

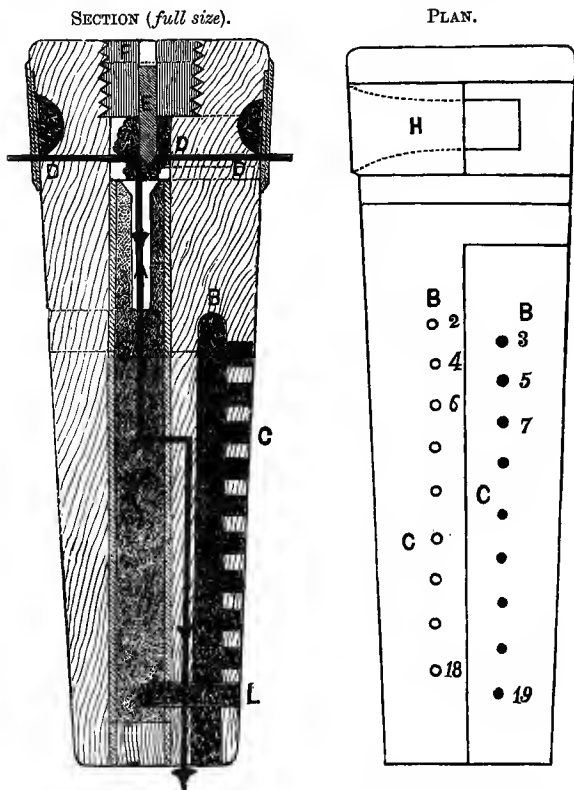


Fig. 11.—Fuzes, Time, Wood, Boxer M.L. Ordnance, 9 seconds.

inflammable substance, called fuze composition,¹ A,

¹ Its ingredients are : saltpetre, ground, 3 lb. 4 oz. ; sulphur, sublimed, 1 lb. ; powder, pit-mealed, 2 lb. 12 oz.—total, 7 lb.

burning at the rate of one inch in five seconds, runs down the interior; and parallel to it are two powder-channels, of which one only, B, is seen in the section. Side holes, C, likewise filled with powder, are bored into the channels, and are marked in odd and even numbers, representing the half-seconds occupied by the burning of the successive lengths of the fuze composition. They are covered over externally with varnished paper. The top of the composition channel is enlarged to hold the quick-match priming, D, which is wound round a copper pin, E, and passing through two fire-holes (not seen in section) to the outside, are protected by a strip of varnished paper, H. The head is closed by a gun-metal plug, F, to diminish the rapidity with which the composition would otherwise burn, owing to the air pressing against it in flight, and also to prevent its being extinguished should the projectile strike point first. "9-seconds" fuzes are painted drab and black.

"Five-seconds" fuzes are specially designed for use with shrapnel shell, which are almost thrown away unless they can be exploded at the precisely required point in the range. It is considered that these fuzes can be adapted to a greater nicety. They differ from the 9-seconds fuzes chiefly in having the large channel filled with mealed powder—*i.e.*, powder reduced to dust—instead of with fuze composition, and in having the side holes marked off into half and quarter seconds. They are painted drab and red.

The Okehampton Committee have recently recommended that these two different descriptions of time-fuzes be merged into one.

To prepare time-fuzes for use (figs. 11 and 12) a gimlet is forced through a side hole, C, corresponding to the number of seconds for the estimated range, scales for which are attached to each gun-carriage, into the composition, A. The metal plugs are then unscrewed from the shell openings, and the fuze driven into the fuze-hole with two or three sharp taps of a mallet. The paper band, H, is torn off from the head, the ends of the quick-match, D, being thus exposed, and the projectile is rammed into the gun.

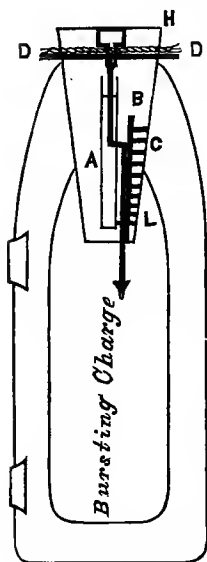


Fig. 12.—Time-Fuze fixed in Shell.

ACTION OF TIME-FUZE.—(The course of the flame is indicated in the figures by red lines with arrow-heads.) The flash of the discharge of the cartridge rushing over the sides of the shell ignites the ends of the quick-match, D, which quickly communicates with the composition.

When the latter has blazed down to the hole, C, through which the gimlet was inserted, the flame bursts into the powder-channel, B, fires the powder

in it, flashes downwards, ignites the bursting-charge, and explodes the shell.

Should the boring of the side-hole have been imperfectly executed, the ultimate explosion of the shell is, nevertheless, insured by a piece of quick-match, L, which connects the fuze composition with the bottom hole of each row.

The use of the small side powder-channels may not at first be apparent; for it might be supposed that the flame could rush directly through the side hole and ignite the burster. A reference to figure 12 will, however, show that some of the side holes, such as C, press directly against the metal of the shell; and thus the egress of the fire through this passage is prevented.

Should a projectile impinge upon a hard substance before exploding, the time-fuze will usually be driven into it, and instantaneously explode the bursting-charge, acting as what is termed a "percussion-fuze."

TIME-FUZE FOR BREECH-LOADING FIELD-GUNS.—Its general construction is similar to that of the time-fuze for muzzle-loaders; but as in breech-loading guns there is no windage, the flame of the cartridge cannot rush over the sides of the projectile, and therefore the fuze must be ignited in the first instance by a special detonating arrangement fixed in the head. The shock of the explosion of the charge breaks a suspended hammer, which, falling on some detonating powder,

ignites the quick-match strand and sets the fuze burning. Its subsequent action resembles that of fuzes for muzzle-loaders. Owing, however, to its increased complication, its results are very uncertain; and for breech-loading guns percussion-fuzes can alone be relied on.

PERCUSSION-FUZES¹ (fig. 13).—The body is of gun-metal. Inside the top plate a small needle, A, is fixed, pointing downwards. A metal collar, called the “guard,” B, fits inside next the top; a “safety-pin,” C, runs through it. A lead “pellet,” D, to the

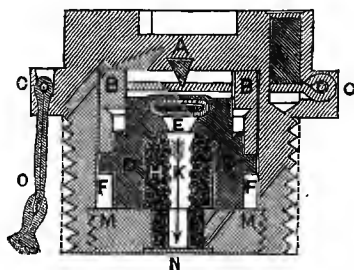


Fig. 13.—Percussion-Fuze.

top of which a detonating cap, E, is fixed, fits inside the edge of the guard, and is kept in its place when at rest by four “feathers,” F. Below the detonating cap, E, is the powder, H, pressed into a hard cake, with a hollow space, K, down the centre.

¹ This fuze is so complicated, that to thoroughly understand its construction without having previously examined a model of it is a matter of extreme difficulty. See also p. 49.

The object of the safety-pin, C, is to guard against accidental explosions in travelling, &c., by keeping the detonating cap, E, from jerking against the needle, A ; but as the flash of the gun would be liable to ignite the fuze through the withdrawn pin-hole, a second pellet, L, is placed so as to drop over the aperture as soon as the safety-pin has been removed.

When the fuze is required for use, it is merely screwed into the head of the shell, and the safety-pin pulled out by the tape, O.

ACTION OF THE PERCUSSION-FUZE.—On the shock of the discharge, the guard-collar, B, crushes down the feathers, F, slips to the base of the fuze, M, and during flight remains at rest. When the shell, on striking an object or the ground, causes a second shock, pellet and collar fly forward, the detonating cap, E, comes into contact with the needle, A, and explodes the fuze. The thin plate, N, is driven out, and the bursting-charge ignited.

This fuze, though open to improvement in point of simplicity, is less complicated than might be supposed from any written description, and has been used with excellent results. They were reported on by the Special Committee of 1875 as "the safest and most efficient percussion-fuze for field service with which the committee are acquainted."

The percussion-fuze for breech-loaders varies but slightly from those used with muzzle-loaders.

COMPARATIVE ADVANTAGES OF TIME AND PERCUSSION FUZES.—The present regulated number of fuzes supplied to each 9-pounder gun is 96 percussion and 120 time ; but it is probable that the majority of practical artillery officers are of opinion that this proportion is excessive, at any rate for field service, and that time-fuzes should either be altogether abolished, or that a very small proportion of them should be retained for exceptional emergencies. For many years past unceasing efforts have been made, especially in England, to improve them by rendering them more simple, and more certain in their results — and our efforts have unquestionably met with a large measure of success ; but the conditions under which time-fuzes are generally used, and which render them uncertain, are altogether beyond human control. They can, in fact, be relied on only when favoured by a combination of circumstances which can seldom or never be looked for in war. For instance, their action, if at all premature or retarded, will render the projectile comparatively harmless as an explosive missile, will discourage the gunners firing, and by frequent failure will weaken the moral effect of artillery against the enemy. And let not this moral effect be lightly considered. Napoleon used to declare that in war the moral is to the physical as three to one ; and Marshal Marmont argued that a battle is won, not by the number of men killed, but by the number of men frightened. Now,

this uncertainty as to the moment of explosion, this failure of results, may be caused by a small error in the elevation of the gun; by a miscalculation of even 80 yards in the range—for with time-fuzes it is absolutely necessary to know the exact distance in order that they may be accurately bored; by an imperceptible twitch of the hand boring the fuze; by its age, and the jolting to which it may have been subjected in transport; and by the dryness of the weather,—all of which affect the burning of the composition. On one occasion the practice of the battery to which I belonged was exceptionally bad, the fuzes all being “long;” and on investigation it appeared that this was due to the cylinder in which they had been kept having been opened for purposes of instruction, and when closed again having been insufficiently “lutened”—*i.e.*, rendered air-tight with a kind of solder. In consequence, the contents had become slightly damp.

Again, for effective firing with time-fuzes, there must be facilities for observing the value of each shell, as regards height and distance of the point of burst from the object.

Percussion-fuzes are liable to none of these sources of error. They are perfectly reliable under all circumstances, except over very soft marshy ground. They are more generally applicable than time-fuzes, and, as stated in p. 104, may frequently be used with advantage even with shrapnel shell.

The Special Committee on Rifled Field-Guns, 1875, while advocating the retention of both time and percussion fuzes for our artillery, nevertheless remarks: "The extreme simplicity of the service of percussion-shells, and the valuable aid they offered in readily picking up and varying the range, are advantages that cannot be overestimated, and render a projectile of this nature especially valuable for use in the excitement and heat of action."

The opinion I have urged seems to be justified by the lessons taught us by the wars of the last six years. In 1870, time-fuzes were not used by the Prussians at Sedan, Gravelotte, Forbach, &c.—were completely ignored by them. "They are worthless, and worse than worthless," said General von Bothmer, in command of the German forces investing Verdun, "because from their uncertainty they give rise to distrust. In the recent battles, the French at first used them largely, and at least four out of five shells fired with them burst ineffectually; until after a short time our men began to despise them, and the moral effect of their artillery-fire was in consequence greatly weakened. They are gradually falling into disuse among our opponents. For our own part, we will have nothing whatever to say to them. We restrict ourselves entirely to percussion-fuzes."¹

In September 1870 took place the opening bom-

¹ From Sedan to Saarbrück, p. 130.

bardment of Verdun. The Prussians poured into the place a hot fire of percussion-fuzed shells, which burst with unfailing certainty; and in about two hours the principal buildings were riddled, the town was on fire in several places, and the destruction wholesale. The French guns replied from their fortifications vigorously, but generally with time-fuzed shells, the majority of which, though excellently aimed, either burst high in the air, or harmlessly buried themselves in the ground. The result was, that the losses in the Prussian batteries were quite insignificant. -

On the afternoon of May 27, 1871, the Government troops in Paris posted on Montmartre were cannonading, almost without intermission, the despairing Communists crowded together with their artillery in the Buttes de Chaumont; and by degrees the latter, which had at first replied furiously, was completely silenced. Now, it is true that on this occasion the Government gunners had recourse largely to time-fuzes, but they were bored so long that they rarely exploded in the air, and percussion-fuzes would have answered the purpose more effectually.

Again, during the Carlist war, in October 1875, both sides restricted themselves entirely to percussion-fuzes, both in the vicinity of Estella and likewise about San Sebastian. The Alphonsist artillery, the *matériel* of which was apparently good, was blazing from morning to night, but not a sign of time-fuzes,

although the country occupied by their opponents, especially about Oyarzun, was, with its numerous dips and woods, singularly well adapted to the supposed requirements for their use. The Carlists, amongst whom was a great dearth of ammunition, were chary of every shot. Every gun was laid with the greatest care, the

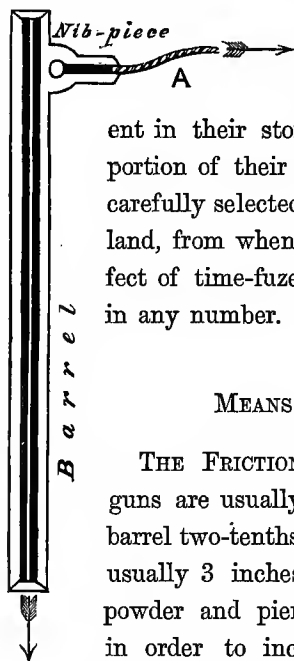


Fig. 14.—
Friction-
Tube.

ranges were all accurately known, and yet time-fuzes were only nominally exist-

ent in their stores, although the great proportion of their artillery *matériel* had been carefully selected in and imported from England, from whence, of course, the most perfect of time-fuzes could have been obtained in any number.

MEANS OF FIRING GUNS.

THE FRICTION-TUBE (fig. 14), whereby guns are usually fired, consists of a copper barrel two-tenths of an inch in diameter, and usually 3 inches long, driven with mealed powder and pierced with a central hollow in order to increase its explosive action. A hole is bored near the top of the barrel, and a short length of tubing called the "nib-piece" fastened on. Inside the nib-piece is placed a roughened copper "friction-bar," to which

are gummed two patches of detonating composition. The edges of the nib-piece are pinched together against the friction-bar.

The friction-tube is dropped into the vent, and the friction-bar being pulled out by a lanyard, A, the detonating patches explode and ignite the composition, from whence the flame strikes the cartridge.

PORT-FIRES, &c.—Should there be a deficiency of friction-tubes, paper-tubes filled with powder first damped and then dried can be easily manufactured, or a little loose powder may be poured by hand into and around the vent. The charge must then be ignited by a port-fire, a stick of inflammable composition which burns somewhat after the fashion of a squib. A certain number are supplied to each battery. If no service port-fire is available, "slow port-fire"—a roll of paper soaked in a solution of gunpowder—forms a fair substitute. Under these circumstances, a piece of "slow-match," or lightly-twisted rope boiled in water and wood-ashes, should be constantly kept smouldering with the battery when in action, whereby the port-fires may be lighted. On a push, slow-match itself can be applied to explode the charge.

GUNPOWDER.

The service gunpowder for field-artillery is that known as "Rifled Large Grain" (marked R. L. G.) It

is angular, and irregular in shape and in bulk—about equal to grains of barley. It must be remembered that gunpowder does not explode instantaneously, like detonating composition, but that its burning is rapidly progressive. The deflagration of the rifle large grain is comparatively slow; and though it subjects the gun to a less strain than the finer-grained powders, it imparts to the projectile a higher velocity—*i.e.*, it exerts a slighter blow, but a greater mean pressure.

The much-talked-of pebble powder is used for very heavy rifled ordnance only. Each grain, pebble-like, approaches a cubical form, with sides about half an inch long. The pebble powder used for the 81-ton gun is considerably larger.

TESTS FOR GUNPOWDER.—The following may be applied even by the most inexperienced:—

1. The grain should be firm, crisp, black, but not too shining, leaving no marks when rubbed between the hands, and not friable when pinched between the nails.

2. When poured from one bowl into another from a height of two or three feet, it should show an entire freedom from dust.

3. It should not be caked.

4. When a small quantity is flashed on a piece of glass there should be little or no residue; above all, no small white lumps.

5. A small quantity moistened, worked into a paste, spread on a piece of white paper and dried, should present a perfectly black, and not a rusty, reddish-black appearance.

The importance of ammunition being made up of the best powder, and the expediency of testing it, is illustrated by the following circumstance: At the outbreak of the Franco-Prussian war in 1870, the French Government, being in urgent need of further supplies of powder, entered into contracts with private manufacturers in England for large quantities of the same, and, amongst others, with a certain Mr —— of ——.¹ This individual bought up stores of damaged and blasting powder, caused it to be reglazed in a mill with black-lead, whereby it presented a brilliant shining appearance, and then sold it to the French as powder of the best quality. Manifestly its shooting powers must have been most inferior, and this may partly account for the exceptionally bad practice of the French artillery in some of the earlier engagements. An English artillery officer picked up on the field of Gravelotte some French small-arms cartridges, the powder of which, on examination, proved to be of a very inferior description.

GUN-CARTRIDGES.—The bags of service cartridges are of white serge, which packs and resists the wear and tear of travelling better than paper, and is less

¹ The name is suppressed, for obvious reasons.

likely to leave sparks in the gun. As an additional protection, they are generally wrapped in waterproof paper-bags, out of which they are taken previous to being inserted in the bore. Exercising cartridges will in future be made up with silk cloth, which reduces to a minimum the possibility of leaving any smouldering residue.

When the cartridge is attached to the projectile, the two together are called "fixed ammunition." It is supposed that the process of loading is thereby accelerated; but it is troublesome to pack, and is not in use in our service. After long-continued firing, the numerous small grooves of a breech-loading gun are apt to "lead" and to become foul. This evil is met by choking into the cartridge a small tin cup filled with grease, called a lubricator. The cartridge is placed in the bore with the lubricator pressing against the base of the projectile. The shock of the discharge breaks the tin cup, and the grease being splashed throughout the bore, the clogged dirt is thereby removed. Lubricators are not required for muzzle-loading guns.

CHAPTER III.

COMPARATIVE ADVANTAGES AND DEFECTS OF BREECH-LOADING AND MUZZLE-LOADING FIELD-GUNS.

THE much-vexed question of Breech-loaders *versus* Muzzle-loaders is in reality so intimately bound up with that of time-fuzes and percussion-fuzes, that the various *pros* and *cons* may be most appropriately discussed immediately after the preceding chapter on ammunition. In our service, muzzle-loading guns for field-artillery are practically the almost universal rule; for in the few instances abroad where the Armstrong breech-loader is retained, the muzzle-loader will doubtless be substituted on the first opportunity.

The comparative advantages of the two systems have in this country given rise to much heated argument. The superiority claimed for the muzzle-loader is, that it possesses greater strength with the same weight of metal as the breech-loader; that it is more simple in its construction and free from the complications of the breech-closing apparatus; that a simpler time-fuze can be used with it; and that it is cheaper.

The force of any one of these arguments is, however, strongly contested by a large number of experienced and practical field-battery officers. It is argued that the strength of the breech-loader is as great as can possibly be required for every practical purpose, and that the difference in the cost of gun and ammunition is too trifling to be of weight in a matter of such overwhelming importance. The breech-closing apparatus doubtless involves a slight mechanical complication, but even in the complicated Armstrong system, the evil is not of great proportion; while in others—that of Krupp, for instance—it is reduced almost to a vanishing-point.

The greater simplicity of time-fuzes for muzzle-loaders at first sight may appear an overwhelming argument in favour of the weapon. Windage admits of their being ignited by the flash of the cartridge; whereas breech-loaders, having no windage, their time-fuzes must first be set in action by a detonating arrangement. To this, however, it may be replied, that percussion-fuzes are, owing to their almost unfailing certainty of effect, infinitely preferable to the best time-fuzes ever invented either for breech-loaders or muzzle-loaders, save under special circumstances—for example, in the defence of a position where the required ranges can be accurately estimated beforehand to within a few yards, and the time-fuzes carefully prepared, or against troops com-

pletely under cover or retired behind the crest of a hill. A small percentage of time-fuzes might therefore be issued, whether the gun were breech-loading or muzzle-loading; but, as a rule, their action is so uncertain, as explained in page 34, that percussion-fuzes are almost invariably preferable.

A serious objection to muzzle-loaders which has not, I think, been sufficiently taken into consideration, is the liability of their projectiles to jam when being rammed into the bore. This evil is of frequent occurrence to 16-pounders, and probably arises from the studs having been damaged or deformed in travelling. The gun is, of course, for the time absolutely useless; and before it can be rendered once more serviceable, great trouble and delay are involved. Casualties of this nature frequently happened in the battery to which I recently belonged—B. 14—armed with 9-pounders, when at practice in Dublin in May 1875. We had previously marched upwards of 100 miles; and although the shell were carefully examined, and the studs equally carefully filed down when bulged, cases of jamming in loading continually occurred. Other batteries made similar complaints, and it sometimes happened that the jammed projectile could only be extracted by the tedious expedient of drowning the cartridge by pouring water down the muzzle, and then, by the introduction of a little loose powder into the vent, and firing it, forcing the shell out.

Breech-loading guns, on the other hand, possess certain absolute, indisputable advantages, foremost amongst which is the increased cover afforded to the gunners. No reasonable individual can deny that the men serving them are greatly concealed by the smoke in their front; whereas the moment a muzzle-loader is discharged, the gunners, stepping up to the muzzle, stand out sharply defined, with the smoke as a background "picking them out," an easy mark to the enemy's riflemen. To a certain extent the detachment of a breech-loader are protected by their gun and carriage from the effects of projectiles which would be fatal were the men told off to their places for muzzle-loaders; and practical experience has demonstrated beyond doubt that, *cæteris paribus*, breech-loading batteries lose fewer men in action than muzzle-loading batteries. These advantages are still more apparent when guns are fired from gun-pits or from behind earth-works. Breech-loaders can then be served with the greatest ease, and are almost completely under cover; whereas muzzle-loaders must be run back from the parapet, and the gunners are terribly exposed. Again, there being no windage in breech-loaders, there is an entire absence of the "wabbling" motion in the projectile; the practice is, on the whole, more accurate, and the charge is smaller. Another disadvantage of the windage necessary with muzzle-loading rifled guns, is that

the rush of the gas generated by the discharge over the projectile injures the upper surface of the bore, producing scoring. A breech-loader, too, can be worked in a smaller space, its bore can be more readily cleaned and ignited substances removed, thus diminishing the chance of accidental explosions; and there is no danger of the shot not being home. As regards rapidity of loading and firing, there is little difference between the two, though the breech-loader possesses a slight advantage.

There is, in fine, little doubt that if the opinions of field-battery officers of our Royal Artillery were polled, the majority would express a preference for the breech-loader. This opinion is backed up by the armies of nearly all civilised nations. The Prussians, whose experience on the subject has been almost unequalled, consider that the superiority of the breech-loader is utterly beyond cavil. The French, Austrians, Russians, Spaniards, Swedes, and some minor European states, hold similar views; and it would surely be unwise in the highest degree to persist in ignoring opinions so unanimous emanating from such collective weight of authority and such practical experience.

In concluding this subject, I may quote the opinion of a French artillery officer with whom I was discussing it while the Communist insurrection was still raging, and who had been serving during the then recent war with Prussia. "The Krupp breech-

loader," he said, "is as admirable for its simplicity as ours is detestable for its complication; and throughout the campaign their artillery-fire was far superior to any we could bring to bear. Then their vent-pieces can be more easily removed than ours, which are alike useless to friends and foes if, through fear of the guns falling into the hands of the enemy, we too precipitately throw them out of gear by striking them sharply with hammers. The advantage, too, of the men being able to work their pieces under more effectual cover than is possible with muzzle-loaders has been so clearly illustrated, that on the whole I give my opinion in favour of the Krupp system. At the same time, I have a horror of working breech-loaders with time-fuzes, always uncertain in their action, and rendered far more so by the elaborate arrangements necessary in this case for ignition. I would therefore restrict myself generally to percussion-fuzes, and would retain a few smooth-bore guns for *ricochet*-fire and for the service of time-fuzes at very short ranges."

In the above argument the advantages of the breech-loading system are claimed for field-artillery only. For the heavier natures of ordnance they are not equally applicable.

CHAPTER IV.

CARRIAGES.

THE GUN-CARRIAGE—THE GUN-LIMBER—THE AMMUNITION-WAGGON
—SMALL STORES—CARRIAGES FOR GUNS OF POSITION—CARRIAGES FOR MOUNTAIN-GUNS—SPARE CARRIAGES—COMPARATIVE ADVANTAGES OF SHAFT AND POLE DRAUGHT—AMOUNT OF AMMUNITION CARRIED WITH A BATTERY—TABLES OF AMMUNITION—MODELS.

TRAVELLING-CARRIAGES for field-artillery consist of two principal parts—the body (fig. 15 or 16, Plates III. and IV.), which carries two-thirds of the load; and the limber (fig. 16, Plate IV.), which carries the remaining one-third, takes the draught, and helps to form a four-wheeled carriage. The newest pattern carriage is chiefly composed of iron.

THE GUN-CARRIAGE (fig. 15, Plate III.)—Its most important parts are: The trail, *a*, made up of two iron brackets, connected together by bolts, and meeting at the trail-eye, *b*—at the other end of the trail are cut the trunnion-holes, *c*, wherein the gun rests; the trail-handles, *d*, for lifting the trail; the trail-eye, *b*, whereby the carriage is hooked on to its limber, or “limbered up” (fig. 16).

The axle-tree bed, *e*, of wood, which supports the brackets, and the axle-tree arms, *f*, on to which the wheels are fitted.

The axle-tree boxes, *h*, each of which contains two case-shot, two cartridges, spikes for spiking a gun, and some small stores. Each box can be utilised as a seat for a gunner, a foot-step, *k*, being provided for that purpose.

The elevating-screw, *l*, which, worked by a wheel, *m*, elevates or depresses the breech for the purpose of laying the gun.

The skid or drag-shoe and chain, *n*, to be used when going down steep hills.

The wheels—the different parts of which are the iron nave, *o*, the spokes, *p*, and the felloes, *q* (pronounce “fellies”), with a ring-tire, *r*, around them. The spokes have a dish (fig. 16, *h*), or inclination outwards, the better to resist the strain on the wheel going over rough or uneven ground. The wheels of field-artillery carriages are all of the same size, and interchangeable, thus offering facilities for replacing any damaged ones belonging to the most important carriages—the gun-carriages, for instance.

THE GUN-LIMBER is identical and interchangeable with the waggon-limber (fig. 16). Its most important parts, in addition to the corresponding portions of the gun-carriage, are: The futchells. *m*. and platform boards, *e*, on which rest two ammunition-boxes, *l*, con-

WROUGHT IRON FIELD GUN

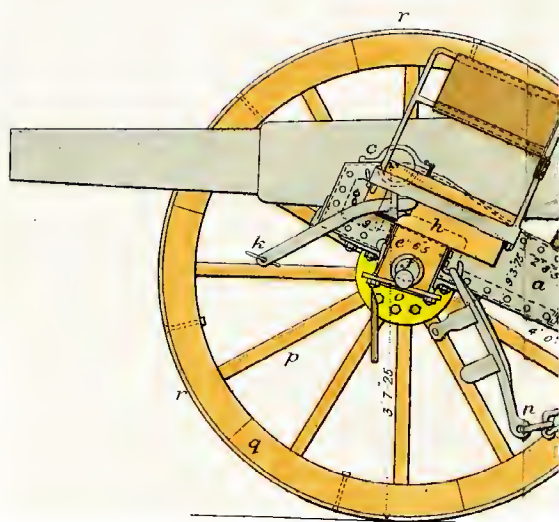
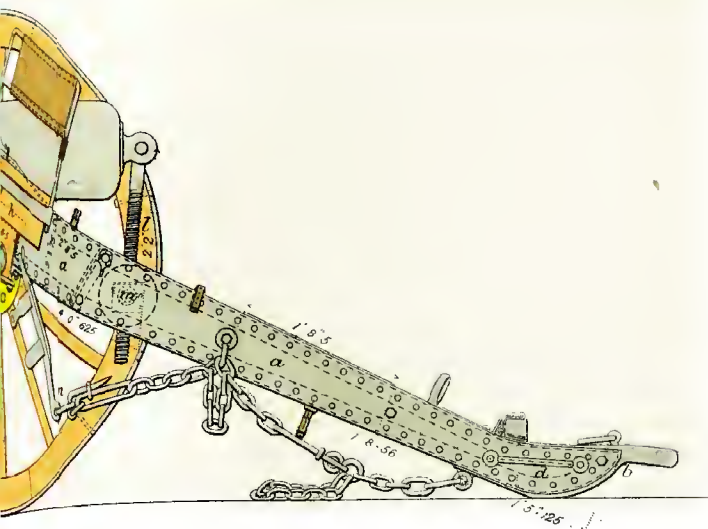


PLATE III.

Fig. 15.

FIELD GUN CARRIAGE FOR 16 POUNDER GUN.



taining shells, cartridges, and small stores. Between the ammunition-boxes is the fuze-box (not seen in plate), holding fuzes. The ammunition-boxes are provided with guard-irons, *c*, by which the gunners hold on when being jerked over rough ground.

The limber-hook, *q*, connecting the gun carriage or waggon with the limber.

The splinter-bar, *n*.

The shafts, *r*, which can be arranged for single, double, or treble draught.

Before the gun can be loaded, its carriage must be unhooked from its limber, or "unlimbered;" and before it is in a condition for travelling, it must be "limbered up" again.

THE AMMUNITION-WAGGON (fig. 16) is made up of a limber, as already described, and a body, connected with the limber by a perch, *a*, the end of which hooks on to the limber-hook. A wheel-block, *g*, is fixed to the framework, and conveys a spare wheel. The general construction of the body resembles that of the limber, being merely of greater length, that it may carry four ammunition-boxes instead of two.

The ammunition-boxes of the gun-carriage and limber and waggon furnish seats for a full detachment of eight gunners, the No. 1 being mounted. On an emergency, fourteen men can without difficulty be conveyed on them and on the axle-tree boxes.

SMALL STORES.—A vast number of small stores are

carried on the gun-carriage and ammunition-waggon in addition to what has been already mentioned. Amongst them are sponges and rammers, for cleaning out the gun and ramming home the charge; hand-spikes for traversing the trail when in action; water-buckets, camp-kettles, spare shafts, drag-ropes, spades, bill-hooks, felling-axes, pickaxes, saws, reaping-hooks, spare tangent-scales, spare sights, mauls, picket-posts, ropes, lifting-jacks, boxes of grease, scissors, screw-drivers, &c. &c. Chests containing materials for repair, and complete sets of carpenters', saddlers', and farriers' implements, are conveyed with the battery in a general service waggon; and altogether the whole equipment of an English field-battery is as admirably perfect and complete as is possible to imagine.

Carriages of the above description are supplied to field-artillery batteries only, not to garrison artillery.

CARRIAGES FOR GUNS OF POSITION. — 40-pounder guns are mounted on carriages which are generally similar to the above, but are of stronger construction. Each carriage has two pairs of shafts, so arranged that it can be drawn by four horses abreast. The total number of the team is twelve.

CARRIAGES FOR MOUNTAIN-GUNS are furnished with shafts which fit on to the trail, and so, on an emergency, can be transported by single draught. They have no limbers. The ammunition is invariably carried in boxes on the backs of mules, by which

Fig. 16.

AMMUNITION

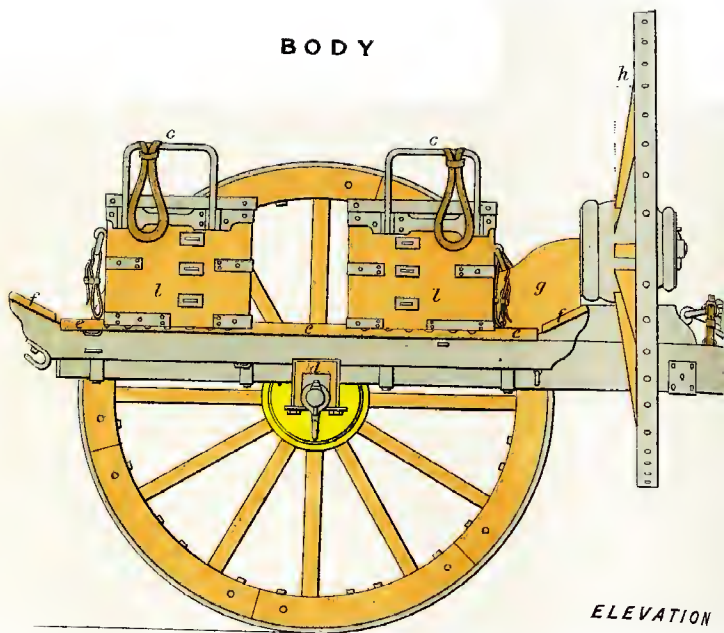
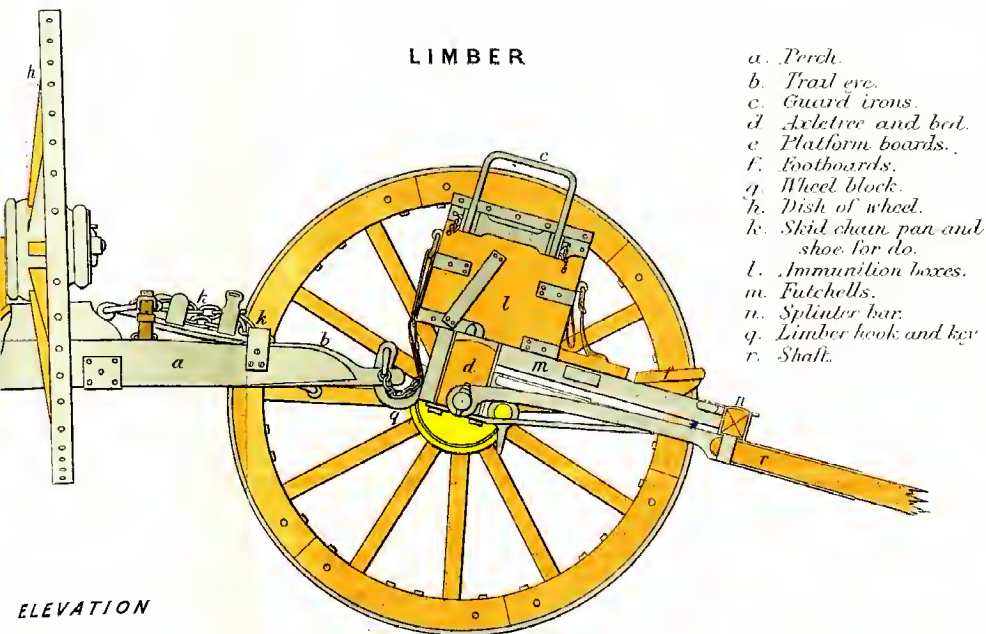


Fig. 16.

UNITION WAGGON.



means, also, both gun and carriage are usually conveyed. The piece can be taken off the pack-animal and mounted on its carriage in a very few minutes. These carriages were employed in the Abyssinian expedition.

SPARE CARRIAGES.—On the peace establishment one general service waggon accompanies each battery. It contains amongst other articles the forge, with bellows, hearth, anvil, coal, &c. On active service, three such waggons are allotted to every battery, one only of the three being provided with forge equipment. Under these circumstances, several spare carriages also are attached to the divisional reserve column, and are temporarily told off to batteries as occasion may require. These spare carriages are store-carts and store-waggons, some extra ammunition-waggons, small-arm ammunition-waggons, spare gun-carriages and rocket-waggons. The spare gun-carriage is an ordinary gun-carriage without a gun, but carrying instead four axle-trees, ironwork for a spare carriage, shafts, sponges, &c.

On service, the proximity of a spare gun-carriage is a matter of great importance to facilitate the repair of the other carriages in the battery which may have sustained injury.

The rocket-waggon differs from the ammunition-waggon in having its boxes so constructed that it carries its rockets, 150 in number, with their heads

downwards, so that in the event of any one of them being accidentally ignited, it will plunge harmlessly down into the ground.

COMPARATIVE ADVANTAGES OF SHAFT AND POLE DRAUGHT.—In our service the draught is taken by shafts, excepting in India, where the pole has been adopted. The advantages of shafts are, that the carriage is better under control, that it can “lock” or turn round in a smaller space, and that it can more easily cross ditches or “pitches” in the ground, where a pole would be liable to snap or to jar down on the horses, especially if moving at a rapid rate. On the other hand, with the pole, the weight of the carriage bears more evenly on the two wheelers, instead of pressing almost entirely on the shaft-horse—a great evil in going down a steep hill, when the shaft-horse must be of great strength. Pole-harness, also, is a little simpler. On the whole, with very powerful horses, such as we are able to obtain in England, shafts are most convenient; with a more weakly stamp of animal, the pole, which is in exclusive use with foreign nations, is preferable.

AMOUNT OF AMMUNITION CARRIED WITH A BATTERY.—The experience of warfare does not enable us to judge of the number of rounds which will probably be fired away by a battery in a hotly-contested action, because the expenditure varies greatly according to circumstances. Thus, at the Alma, our field-artil-

lery fired an average of 18 rounds per gun, and at Inkerman 53 rounds per gun. In 1870, the artillery of the 12th German corps expended on the average $14\frac{1}{2}$ rounds per gun during each of eleven engagements, while at Sedan one of the Prussian batteries fired away 126 rounds per gun. The supply, therefore, as laid down in the following tables, would meet any ordinary demand. On extraordinary emergencies, it would be necessary to bring up fresh supplies of ammunition from the reserve columns.

NUMBER OF SHELL, CARTRIDGES, AND FUZES CARRIED BY
9-POUNDER AND 16-POUNDER BATTERIES.

	PER GUN-LIMBER AND AMMUNITION-WAGGON.								Total number of rounds per battery.
	Shell.		Case.	Cartridges.	Total number of rounds per gun.	Fuzes.		Total.	
	Common.	Shrapnel.				Time.	Percussion.		
9-pounder } battery }	48	96	4	148	148	120	96	216	888 ¹
16-pounder } battery }	34	62	4	100	100	85	48	133	600

In addition to the above, a supply of artillery

¹ In a battery of horse-artillery, 564 only—there being but three ammunition-waggons, instead of six.

reserve ammunition is carried into the field, making the total number of rounds per gun as follows :—

	9-pounder battery.	16-pounder battery.
With battery—gun, limber, and waggon,	148	100
1st Reserve—Division Reserve, .	108	72
2d Reserve Corps—Column Re- serve,	44	108
Total,	300	280

MODELS.—The student is strongly recommended, after he has studied the foregoing chapters, to examine the various objects described therein either in a gun-park, or in one of the numerous model-rooms which have of late years been established. Without doing so, he will have but an imperfect idea of the *matériel* of artillery.

The United Service Institution in Whitehall Yard, London, contains an admirable collection of models.

PART II.

DIFFERENT DESCRIPTIONS OF FIELD-ARTILLERY—
DRILL—ADMINISTRATION

N O T E.

This Part can be studied independently of the others.
See Note, Part I.

CHAPTER I.

COMPOSITION OF BATTERIES OF FIELD-ARTILLERY.

FIELD-BATTERIES—DUTIES OF THE VARIOUS RANKS—PACE OF FIELD-BATTERIES—HORSE-ARTILLERY BATTERIES—BATTERIES OF POSITION—MOUNTAIN-BATTERIES—TABLES SHOWING THE ESTABLISHMENT OF BATTERIES OF FIELD-ARTILLERY.

FIELD-ARTILLERY may be classified into Field-Batteries, Horse-Artillery Batteries, Batteries of Position, and Mountain-Batteries.

FIELD-BATTERIES are subdivided into light field-batteries armed with the 9-pounder gun, and possessing great mobility; and into heavy field-batteries provided with 16-pounders, which have a greater range, but being more ponderous, are less frequently required to change their positions. The regulated gun detachment or number of gunners to each gun is 9—1 non-commissioned officer and 8 men. This estimate is calculated to meet casualties; for a field-gun can be fairly worked by 5 gunners, and on an emergency by even less. Each gun is, on peace service, drawn by 6 horses, and each ammunition - waggon by 4.

The foremost pair are called the "lead-horses," those behind them the "centre-horses," and those in the shafts the "wheel-horses." In each battery there are two or three spare pairs of horses, and also several extra gunners and drivers, who do not accompany their battery into the field, literally speaking, but remain in camp or quarters, available if their services are required. Gunners are armed with sword-bayonets—thoroughly useless weapons by themselves; 12 carbines are also supplied to every battery, but are reserved exclusively for picket and guard purposes. The gunners' knapsacks, when their owners are on the march, are strapped on to the carriages. The drivers carry their kits in valises attached to the off horses, and in their saddle-wallets. They are not provided with any description of weapon. On service, the number of horses is generally raised to 8 per gun, and 6 per ammunition-waggon. The power of draught does not increase in direct proportion to the number of horses, as it is impossible to make them all pull simultaneously; and though the above provision of horses may at first sight appear excessive, it is not so in reality. Casualties amongst them are inevitable and incessant, and under-horsed artillery loses half its power, both of offence and defence, of which a notable instance occurred in the French Metz army, when the possibility of its breaking through the investing army was mooted, and when one of the main reasons for

abandoning the project was the crippled condition of the artillery transport. Light field-pieces temporarily deprived of their horses may be dragged for a short distance by men with drag-ropes, several pairs of which are issued to each battery.

DUTIES OF THE VARIOUS RANKS.—The duties of gunners and drivers are entirely distinct in their nature. The former are required to work and keep in order the guns, and to look after the ammunition and stores; though, these duties performed, they are available for assisting to groom the horses, or for other purposes. They must be of a minimum height of 5 ft. 6½ in.;¹ and unless fairly strong, they cannot be efficient in all their duties, some of which, such as limbering up and unlimbering a 16-pounder, require the exercise of much muscular power. The duties of drivers are to drive, and to look after the horses. They must be under 5 ft. 6½ in., with a minimum chest-measurement varying according to height. Wheel-drivers should be sturdily built, that they may be strong enough to bring their horses round in limbering up, reversing, &c., the latter, when in this position, being apt to hang back in the breeching, or to jam against each other and their driver. The centre and lead drivers may with advantage be light. On the lead-driver depends, to a great extent, the

¹ Since the above has been in the press, a "short-gunner" standard of 5 ft. 5½ in. has been introduced as a tentative measure.

“pluck” with which a team is driven, and the accuracy in drill. A thoroughly efficient driver is an invaluable man, and can be rendered perfectly conversant with his duties only after the exercise of much time and trouble.

A *Field-Battery* in our service consists of six guns with their limbers, and six ammunition waggons, besides spare carriages.¹ One gun, with its waggon and proper complement of men, horses, and stores, is called a *subdivision*. There are therefore six subdivisions in a battery: they are designated “No. 1 subdivision,” “No. 2 subdivision,” and so on. Two subdivisions form a *division*. Consequently, in a battery there are three divisions, and these are designated the *right*, *centre*, and *left* divisions.

A battery may also be divided into *two half-batteries*, called the *right* and the *left half-battery*, each of which is composed of three guns, &c.

A “No. 1,” usually a sergeant, is in command of each subdivision. He lays the gun, and, under the officers, is responsible for its drill and general working.

A lieutenant commands a division. He is responsible to the major for its efficient working, in the same manner as Nos. 1 are responsible to the subaltern.

The captain dresses the line, takes up points, helps to select suitable positions, is specially charged to look after the ammunition-waggons; and if a half-battery

¹ See page 66.

is detached for any particular duty, he usually takes charge of it. In fact, he aids the commanding officer generally in working the battery, is second in command, and in the absence of the major assumes chief command.

The major is the commanding officer of the battery, and is responsible for its efficiency in every respect.

PACE OF FIELD-BATTERIES. — Field-batteries are usually required to act in conjunction with infantry, and their normal pace must therefore be considered a walk, when the detachments may either march alongside their guns, or they may be mounted—two gunners on each gun-limber, and six on each ammunition-waggon. The Nos. 1 are always mounted on their own chargers. Should the battery be moved at an increased pace, the gunners should not be required to double, but should invariably be mounted on the carriages, as otherwise they will be exhausted when the guns are brought into action. Sometimes the ammunition-waggons are detached from the battery, and the guns required to proceed at a trot. The emergency can be met by mounting two men on the axle-tree boxes, and three on the gun-limber, who, with the No. 1 on his horse, will be amply sufficient to work the piece for a short time. In the Indian artillery the gunners are sometimes carried on the off horses, which are provided with saddles instead of with the useless, clumsy old pads. This method of

equipment will in course of time be adopted in the home artillery.

HORSE-ARTILLERY BATTERIES are generally supposed to act with cavalry, towards which they hold the same relative position as field-batteries to infantry. Sometimes they form part of the reserve artillery. Under any circumstances they must be prepared to execute their movements more rapidly and over a greater extent of ground than is required of field-batteries, from which they consequently differ in the following respects :—

They are more lightly equipped, being armed with the 9-pounder gun—never with the 16-pounder.

They have only three ammunition-waggons, instead of six. On the war establishment, however, they have the full number of six.

Their gun detachments at full strength consist of fourteen men, the whole of whom are invariably mounted—two on the gun-limber, two on the waggon-limber or gun axle-tree boxes, and ten on horses. Of these latter, three are horse-holders ; while the remainder, on coming into action, dismount and serve the gun.

A superior class of horse is purchased for their use.

Their strength in men and horses actually in the field is in excess of that of field-batteries.

All their gunners are armed with swords.

In other respects they resemble field-batteries.

BATTERIES OF POSITION are equipped with 40-poun-

der guns, and are employed when heavy projectiles or extreme ranges are required—for instance, to batter substantial buildings, or to sweep distant and extended areas over which the enemy must pass. They possess less mobility, are seldom required to shift their positions, and are generally posted with the reserve until their services are called into play. They have only four guns per battery, with a proportion of wag-gons; and each gun is drawn by twelve horses, four abreast, which, as well as the men, should be of the most powerful stamp.

Batteries of position are specially fitted for the attachment of farmers' harness, so that they may be drawn by country cart-horses, if these are available.

MOUNTAIN-BATTERIES are designed to accompany light troops acting in a country too rugged or too precipitous for any other description of artillery. A mountain-battery is armed with four steel 7-pounder guns. They can be fired at an elevation of 34° ; and being supplied with shells of increased length, called double shells,¹ are capable of carrying on a species of vertical fire, and thus can be utilised as mortars.

Guns, ammunition, stores, and carriages are, in the case of mountain-batteries, usually conveyed on the backs of mules. When required for action, guns and carriages can be rapidly and easily taken off the pack-animals and put together.

¹ See *ante*, p. 20.

ESTABLISHMENT OF FIELD-ARTILLERY BATTERIES.

	PEACE ¹ ESTABLISHMENT.			WAR ² ESTABLISHMENT.		
	9-Pounder Horse- Artillery.	9-Pounder Field- Battery.	16-Pounder Field- Battery.	9-Pounder Horse- Artillery.	9-Pounder Field- Battery.	16-Pounder Field- Battery.
OFFICERS AND MEN—						
Officers,	5	5	5	7 ³	7 ³	7 ³
N.-C. Officers, . . .	18	18	18	20	20	20
Gunners,	70	66	66	70	72	87
Drivers,	56	61	62	70	62	73
Trumpeters,	2	2	2	2	2	2
Artificers,	7	7	7	10	9	9
Total,	158	159	160	179	172	198
HORSES—						
Riding,	58	18	18	77	30	30
Draught,	54	66	74	102	98	124
Total,	112	84	92	179	128	154
CARRIAGES—						
Gun,	6	6	6	6	6	6
Ammunition,	3	6	6	6	6	6
Forage or Store, . . .	1	1	1	3	3	3
Total,	10	13	13	15	15	15

¹ Estimates, 1876.² Army Circular, August 1875.³ Including one surgeon and one veterinary surgeon, both of whom in peace time are only temporarily attached to the battery.

CHAPTER II.

PRINCIPLES OF FIELD-ARTILLERY DRILL.

DEFINITIONS AND EXPLANATIONS OF TERMS—INTERVALS, FRONTAGE, DISTANCES, AND DEPTHS—POSITIONS OF OFFICERS AND NOS. 1 WHEN IN LINE—COMMANDS AND SIGNALS—GENERAL RULES FOR MANŒUVRES—DRILL MOVEMENTS—CAMPS.

DEFINITIONS AND EXPLANATIONS OF TERMS.

(Fig. 17, Plate V).

A *subdivision* consists of one gun with its waggon ; a *division*, of two guns with waggons ; a *half-battery*, of three guns with waggons ; a *battery* consists of six guns with its six waggons, spare carriages, &c.

A *brigade* consists of two or more batteries.

A *column of batteries*, *half-batteries*, or *divisions*.—The above bodies placed in rear of each other corresponds to column formations in infantry drill.

Column of route (the *ou* pronounced as in “lout”).—A column formed with a front of only one carriage—*i.e.*, with the carriages all formed in a string, one behind the other. It is invariably adopted on the line of march.

Right or left take ground.—Each carriage wheels independently to its right or left.

Right or left reverse.—Each carriage wheels about independently.

Right or left incline.—Each carriage inclines independently to its right or left.

Right or left wheel.—The gun wheels to the right or left, and its waggon follows in its wake.

When the guns are limbered up, the front of the battery is supposed always to be in the direction to which the horses' heads are pointed; when in action the front is in that direction to which the muzzles of the guns are pointed.

To come into action means that the gun-carriages are unhooked from their limbers, or "unlimbered," so that the guns are in a position to be loaded and fired.

Action front, rear, right, or left.—The guns are unlimbered and the muzzles pointed in the direction named. The limbers drive to the rear, so as to be ten yards clear from the guns.

Front, rear, right, or left limber up.—The limbers drive close up to the guns according to the word of command. The gun-carriages are then hooked on to the limbers.

INTERVALS, FRONTAGE, DISTANCES, DEPTHS (Fig. 17).

These measurements will slightly vary according as the waggons have four or six horses. In the 'Manual

of Field-Artillery Exercises,' it is assumed that they have six; but in the following calculations four only are allowed, for that number generally corresponds to actual conditions.

Intervals and distances are measured from Nos. 1 to Nos. 1 when the guns are limbered up, and from muzzle to muzzle when in action.

Intervals—

	Yds.
Between subdivisions in line at full interval,	19
" " half interval,	$9\frac{1}{2}$
" " close "	3
batteries, "	$28\frac{1}{2}$
a battery and a battalion (gun axle-trees in line with front rank except for parade purposes, when the horses' heads are usually dressed with the front rank),	$28\frac{1}{2}$

Frontage—

The front of a battery is generally reckoned in round numbers as 95 yards; more accurately, it extends over five intervals plus three yards, the front of a subdivision. It therefore equals—

	Yds.
At full interval $5 \times 19 + 3$, "	= 98
At half interval, "	= $50\frac{1}{2}$
At close interval, "	= 18

The frontage of three batteries at full intervals:

3×95 , "	= 285
$2 \times 28\frac{1}{2}$ (battery intervals), "	= 57
Front of one subdivision, "	= 3

Total, "	345
---------------------------------------------------------	-----

The frontage for three batteries at half or close interval may be calculated in the same way.

Distances (measured from No. 1 to the No. 1 in rear)——

	Yds.
Column of batteries,	= $123\frac{1}{2}$
Column of half-batteries,	= 57

The following closer formations are sometimes useful :

Half-column of batteries,	= $61\frac{3}{4}$
Half-column of half-batteries,	= $28\frac{1}{2}$
Quarter-column of batteries or half-batteries,	= 38

Distance between the rear of one carriage and the horses' heads of that behind it when in column of route, = 4

Depths——

Depth of a carriage with six horses,	= 15
Depth of a carriage with four horses,	= 11
Depth of a subdivision $15 + 4 + 11$,	= 30
Depth of a single battery in column of route without spare carriages or spare horses :	
Guns 6 ($15 + 4$),	= 114
Waggons 6 ($11 + 4$),	= 90
Plus 4,	= 4
	<hr/>
	208

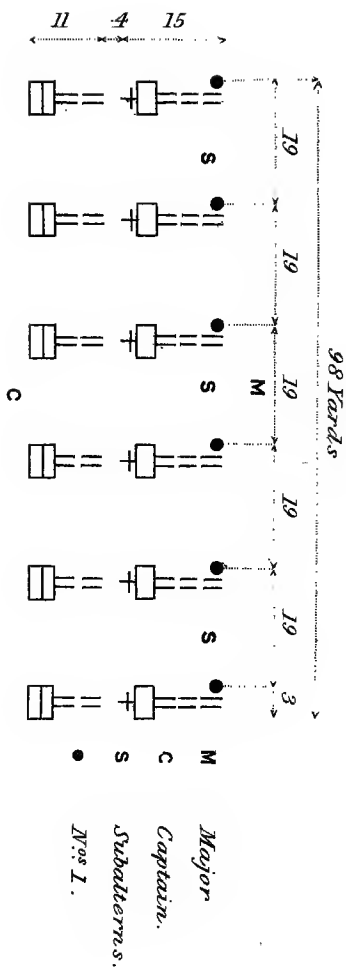
POSITION OF OFFICERS AND NOS. 1 WHEN IN LINE.

(Fig. 17.)

Major.—Three horses' lengths in front of the centre of his battery, but during the progress of manœuvring his post is wherever he can best superintend the movements.

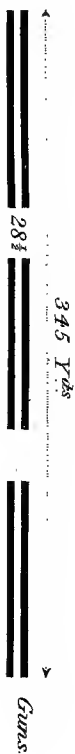
Captain.—Two horses' lengths in rear of the centre.

Battery in line, full interval.



ERY.

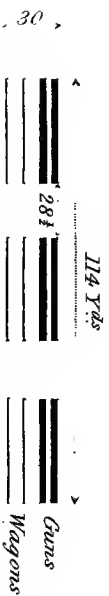
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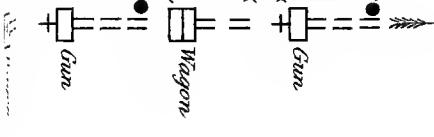
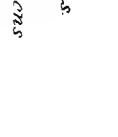
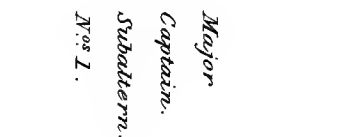


Wagon

*Remainder
of Battery.*



*Three Batteries in Line.
close interval.*



Wagon

11



Lieutenants.—Between their subdivisions in a line with the leading horse's head. If the guns are at close interval, one horse's length in front of the centre of their divisions.

Nos. 1.—On the left of the lead-drivers of their guns.

A horse's length is eight feet.

COMMANDS AND SIGNALS.

The commanding officer's words of command are repeated by all the other officers. So great is the noise made by a battery in motion, especially if the pace is a trot, that to render the voice audible is sometimes a matter of great difficulty. Except for instructional purposes, the bugle should seldom be used—never if other troops are present. Simple signals, by waving the hand or the sword, may occasionally be resorted to.

GENERAL RULES FOR MANŒUVRES.

For field-batteries the trot is the pace of manœuvre; although, as a matter of fact, commanding officers more frequently move at a walk, in order to save their horses. They should never gallop, except on very special emergencies. Horse-artillery *may* always move at a gallop—a rate of progression, however, which should not be unnecessarily resorted to.

Artillery cannot be wheeled about on its own ground. Additional space on either flank must be allowed for the purpose. Batteries usually remain in rear of any intended alignment until the other troops are finally formed, unless ordered to the front to cover the formation. The usual position of a battery on parade is on the flanks of the line. It is most desirable that the battery as a unit should be as little broken up as possible. All formations should be at full interval whenever practicable. Guns should be brought into action as rapidly as possible, with little regard to dressing, except on parade. Every advantage should be taken of cover.

When the word for "Action" is given, the gunners rapidly jump off the carriages and unlimber the gun. The Nos. 1 and the subalterns dismount, and giving their horses to one of the gunners or drivers, superintend the working of the guns. At the word "Cease firing," they mount again.

No gun must on any account be limbered up when loaded. Should "Cease firing" be ordered when the gun is half loaded, the process must be completed as quickly as possible, and the piece discharged.

Firing may be carried on independently, or the order may be given to fire a definite number of rounds from right to left. The range and the description of projectile and fuze must always be mentioned by the commanding officer.

In order to meet certain emergencies in the field, arising from damages occurring to carriages, &c., a definite drill to make them good is laid down—such, for instance, as to replace a damaged wheel (making use of a spare wheel or of a waggon-wheel), to dismount gun and carriage, to make good a disabled gun axle-tree arm, to move disabled ordnance by slinging and lashing the gun below the limber, or by hoisting gun and carriage on to the waggon, to shift shafts from double to single draught, &c.

DRILL MOVEMENTS.

For purposes of instruction, two or more batteries are frequently drilled together as a brigade of artillery under a lieutenant-colonel; but when working with other troops, each battery almost invariably moves independently, practically. The lieutenant-colonel should, however, endeavour to regulate the fire of his entire command, so as to effect a common object.

The following are the principal drill movements of a field-battery. They correspond closely to infantry manoeuvres, expressed in nearly the same terms. The details of their execution are here omitted, being purely technical, and consequently not required by other than artillery officers:—

From line,—“Action front,” &c.; “Advance,” “Retire,” “Right, take ground,” &c.; “Right wheel,” “Right incline,” &c.

Guns cannot come into action, retire, or take ground at close intervals. They must first be opened out to half or full intervals.

From line at full intervals, to diminish the front by "Half" or "Close interval," and *vice versa*.

From line to "Advance" or "Retire in column of route," or of "divisions," or of "half-batteries," from a flank.

From line to "Advance in echelon of subdivisions," or "divisions," or "half-batteries."

From line to "Advance" or "Retire by alternate half-batteries in action"—a most useful manœuvre to cover the retreat or support the advance of other troops.

From line to "Change front to the rear," to "Change front to the right" or "left," or to "Change position to the right" or "left."

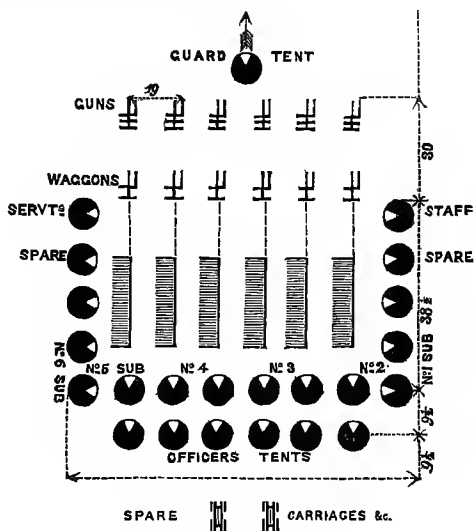
From column of route to "Form column of divisions" or of "half-batteries," or to "Form line."

From column of divisions or half-batteries to "Deploy outwards" or to "Form line."

CAMPS.

The annexed figure (fig. 18) shows the form of encampment, amongst the five examples given in the official regulations, usually preferred by artillery officers. It differs slightly from the regulation plate (compare Pl. XI.: Regulations and Instructions for Encampments) in having the establishment of only two

rows of carriages, and in forming the latter at full intervals. If space is an object, they can be compressed to half-intervals.



Total breadth, 133 yards.

When necessary to compress the camp, the tents at side to be formed in two rows, and the guns and waggons at half-intervals.

Fig. 18.—Artillery Encampment by Subdivisions.

The guns must not be unlimbered—picturesque though such an appearance may seem in the eyes of non-artillery men—so that they may be ready for instant march.

It should be remembered that one of the first requisites for an artillery camp is abundance of water.

CHAPTER III.

ADMINISTRATION AND INTERIOR ECONOMY.

COMPOSITION AND STRENGTH OF THE ROYAL ARTILLERY—FIRST APPOINTMENTS AND SUBSEQUENT TRANSFERS—THE BRIGADE ORGANISATION—LIEUTENANT-COLONELS—MAJORS—CAPTAINS—LIEUTENANTS—SERGEANTS—CORPORALS, BOMBARDIERS, AND ACTING-BOMBARDIERS—GUNNERS AND DRIVERS—STAFF-SERGEANTS—ARTIFIOERS—ROUGH-RIDERS—DUTIES OF THE ORDERLY OFFICER—GENERAL DUTIES OF OFFICERS—BARRACK-ROOM DUTIES—TABLES OF PAY.

“THE Royal Regiment of Artillery” is composed of 6 brigades of horse-artillery, of 5 batteries each; of 12 brigades of field-artillery, and 13 of garrison-artillery, of 7 batteries each; of a depot brigade, and riding establishment; and of the coast brigade,—1159 men and 25 officers, broken up into small detachments to look after the coast defences of the United Kingdom. Occasionally, to meet the requirements of foreign service, a garrison brigade is transformed into a field-brigade by the transfer of a certain number of drivers and horses; but this practice is much to be deprecated, so different is the nature of the duties of the two branches.

The strength of the Royal Artillery (1876) is as follows :¹—

	Officers (exclusive of surgeons).	All ranks.	Horses.	Approximate number of field-guns.
Home and } Colonies, }	834	22,791	5964	366
India, . .	596	12,233	7400	348
Total, . .	1430	35,024	13,364	714

Since 1860, the Bengal, Madras, and Bombay Artillery have been amalgamated with the Royal Artillery for the roster of duties. Promotion is still carried on in separate lists, until the various grades of the old Indian Artillery shall have been absorbed. No fresh appointments are made to the latter, the newly-commissioned lieutenants being all gazetted to the old Royal list.

FIRST APPOINTMENTS AND SUBSEQUENT TRANSFERS.
—Cadets who have passed through the Royal Military Academy at Woolwich are alone eligible for commissions in the artillery, except as regards riding-masters, quartermasters, and the officers of the coast brigade, all of whom are ex-non-commissioned officer artillerymen.

¹ Army Estimates, 1876.

A young officer, on first joining, is posted indifferently to a field or a garrison brigade as the exigencies of the service may require. He may continue in the same brigade during the whole of his service as lieutenant, or he may be transferred from field to garrison, and *vice versa*, as a matter of inclination or aptitude—exchanges in the artillery involving no loss of seniority. On each occasion of his being promoted to a higher grade, he takes his chance of “falling” to a field-artillery or garrison-artillery vacancy. This arrangement is doubtless a very wholesome one, and has worked admirably up to a certain point. If, however, a captain, promoted to be a major, chances to fall to a field-battery, and if the whole of his previous service has been with garrison artillery, his want of experience with horses, and with the working of artillery in the field, will cause him to be at sea in his novel and most important position; and unless he be a man of superior abilities, woe, indeed, to his battery!

Shortly after an officer is gazetted, he can, if he please, apply to be placed on the list of candidates for horse-artillery; and should his application be granted, he will in his turn—at the present time, after about six years’ service—be appointed to that branch, where he remains until he is promoted, when he must revert to a field or a garrison brigade. In course of time he may be reappointed to the horse-artillery; but on each occasion of obtaining a step of rank, he resumes duty,

either temporarily or permanently, with one of the other departments.

The expenses of a horse-artillery officer are a little higher than those of a field-battery officer. His first appointment thereto involves an expenditure of £300 for the purchase of horses, equipment, and uniform; and he can scarcely live with comfort on a smaller private income than £150 a-year. A field-battery officer is provided with a charger from his battery and with saddlery at the public expense.

THE BRIGADE ORGANISATION.—The grouping together of batteries into brigades is unconnected with tactical considerations, and is solely designed to meet administrative requirements. Changes of stations, promotions of non-commissioned officers, and channels of correspondence, are all carried on by brigades, each of which was formerly under the command of a colonel; but subsequent to 1875 the colonels have been detached from brigades, and have been appointed to command the whole of the different branches of artillery in various districts, such as Aldershot, Dover, Portsmouth, Manchester, Chatham, Ireland, &c.

LIEUTENANT-COLONELS.—In each brigade there are four lieutenant-colonels, the senior of whom commands the brigade. He is stationed at its headquarters, and is assisted by an adjutant, paymaster, quartermaster, riding-master, &c. Through his hands passes the

brigade business above alluded to as having been formerly transacted by the colonels.

The remaining lieutenant-colonels of the brigade are each made available to command divisions of two or more batteries, either at headquarters or at out-stations: strictly speaking, two batteries should be the minimum of his command, whether with reference to tactical or administrative organisation; but as the number of lieutenant-colonels is, for the purpose of insuring a fair flow of promotion, in excess of those actually required, they are occasionally quartered at out-stations with single batteries.

Their duties as regards interior economy—for duties in the field, see page 126—comprise the general supervision of discipline and “drill,” the disposal of prisoners confined for serious offences, and the transmission of correspondence between the battery commanders and the senior lieutenant-colonel commanding the brigade.

In illustration of the foregoing, a colonel commands the whole of the artillery in the Ireland district, which comprises a brigade of horse-artillery, a field-brigade, some garrison batteries, and some detachments of the coast brigade.

The senior lieutenant-colonel of the horse-artillery commands the horse-artillery brigade, the headquarters of which are at Dublin, with out-stations at New-bridge and Ballincolig.

The senior lieutenant-colonel of the field-brigade commands his brigade, the headquarters of which are at Newbridge, with out-stations at Clonmel, Kilkenny, &c.

Junior lieutenant-colonels are posted at Limerick, Ballincolig, &c. &c.

MAJORS.—The major of a battery holds a somewhat analogous position to that of the commanding officer of a battalion, especially if at an out-station, but with greatly-curtailed powers should there be a lieutenant-colonel of artillery present. Under all circumstances, however, he is the mainspring of the battery. From him emanate the whole of the battery correspondence, returns, and pay and clothing accounts. He is responsible for the tone of his officers, for the discipline of his men, and for the proper performance of the duties of both; for their knowledge of drill, and for the general efficiency both of *personnel* and *matériel*: all recommendations for the promotion of his non-commissioned officers emanate from him, and all applications for leave must be submitted through him. In fact, it is scarcely too much to say that no battery can be in first-rate order unless commanded by a first-rate major.

CAPTAINS.—The captain of a battery holds the same position to his major as the major of a battalion to his lieutenant-colonel. According to his own capabilities, and to the course of administration pur-

sued by the major, he may be either a superfluity and a nonentity, or he may be a very valuable adjunct. Second in command of the battery, he assumes the chief direction when the major is absent ; and at other times he may be a most useful channel for carrying out the orders of his commanding officer, whether as applied to the subalterns or the men, and for assisting him generally in the administration of the battery. He is expected to pay particular attention to the clothing, equipment, harness, and gun-stores—to the preliminary drills of the gunners and drivers—to riding-school and to stable duties.

LIEUTENANTS.—The lieutenants of a field-battery hold nearly the same position with regard to their major as the captains of an infantry regiment to their lieutenant-colonel. In every field and horse-artillery battery there are three lieutenants, each of whom has charge of a division of two guns, with the same relative authority in barracks as in the field. They are directly responsible to the major for the general well-being of their divisions as regards men, horses, stores, ammunition, harness, and equipment, and are bound to bring under his notice any important incidents connected therewith. They have, however, little concern with questions affecting pay. They inspect kits weekly, and use their discrimination in backing the leave-lists of the men of their divisions.

SERGEANTS. — The connecting - link between the

lieutenants and their men are the sergeants, or Nos. 1. A No. 1 is in charge of each subdivision, and is responsible to his lieutenant in the same way as the lieutenant is responsible to his major. On him depends the real efficiency of his subdivision. The Nos. 1 are aided by

CORPORALS, BOMBARDIERS, AND ACTING-BOMBARDIERS, one of each per subdivision. The two former rank, according to date, with corporals of other corps; acting-bombardiers with lance-corporals. Acting-bombardiers are selected both from the gunners and the drivers, and in the first instance are appointed at the discretion of the major; but their subsequent promotion is carried on, not according to a battery list, but according to a brigade list. A corporal, for instance, on being made a sergeant, usually falls to another battery.

GUNNERS AND DRIVERS.—The general duties of gunners in barracks are — guards, escort duties, fatigues, and the care of the guns and stores. Those who are not so employed are required to assist the drivers in the stables. They are instructed in gun, marching and carbine drill, but, except in the horse-artillery, are not taught riding.

The general duties of drivers comprise the care of their horses and harness, and furnishing stable guards — duties which are so laborious as to leave them very little spare time. In theory they are supposed to be not only instructed in marching, riding, driving, and

battery drill, but in gun and carbine drill. In practice this is seldom or never practicable. One driver is permanently told off to each pair of horses, both in the field and in stables, and he should be shifted from them as seldom as possible. The spare drivers are utilised in the general duties connected with the stables. Should a young driver grow to a height above the regulated standard—*i.e.*, above 5 feet 6½ inches—he may be converted into a gunner. A driver appointed acting-bombardier is at once put through a course of gun-drill; and, under similar circumstances, a gunner is instructed in riding.

The pay of gunners and drivers, and the terms of their engagements, are identical, except that a horse-artillery gunner receives a penny a-day more. The two classes are supplied with a different set of equipments; gunners with knapsacks, drivers with valises. They are enlisted for the following periods: 1st period, 12 years—or, at option, 8 years with their batteries and 4 years with the army reserve; 2d period, 9 years in addition to the above—the whole of this latter term to be passed with their batteries.

STAFF-SERGEANTS.—A sergeant-major and a quartermaster-sergeant are attached to each battery, and are among the main aids of the major; the first-named for discipline, drill, and general administration—the second for pay, clothing, and stores.

ARTIFICERS. — The artificers are the farrier and

shoeing-smiths, the wheeler, and two collar-makers or harness-makers. They are selected from among those men who have been accustomed to work at the above trades previous to enlistment. Wheelers and collar-makers are, after a preliminary trial, sent to Woolwich to go through a regular course of instruction; and if they show any aptitude for their work, are regularly appointed, with extra pay, and with the relative rank of non-commissioned officers. They are termed bombardier collar-makers, corporal collar-makers, &c., and hold relative rank according to their seniority. Shoeing-smiths receive their instruction at the battery forge. They do not rank as non-commissioned officers.

The ROUGH-RIDER is the instructor of riding appointed to each battery. He is a non-commissioned officer who must have passed through a course of equitation at the Riding Establishment, Woolwich, and must have received a certificate of proficiency. His duties include breaking in the remount horses.

DUTIES OF THE ORDERLY OFFICER.

It is the custom in every battery for the three subalterns to take their tour of duty week by week, not day by day. A field-battery subaltern's work is far more severe than in other branches of the service, as may be judged from the following detail of the routine under ordinary circumstances:—

8 o'clock A.M.—examines and signs morning states.

8.30 to 10.15—superintends the exercising of the horses.

10.45—inspects the forage, causes it to be in part weighed in his presence, and then issued.

11.45 to 12.45—mid-day stable-hour.

12.50—visits the men's dinner-rooms and cook-houses.

2 P.M.—mounts the guard.

2 to 3—attends afternoon drill.

5 to 6—evening stable-hour.

6—mounts the stable-picket.

10—receives tattoo report.

He is also required to inspect occasionally the rations, teas and breakfasts ; to visit daily the hospital, schools, workshops, canteen, and the prisoners in the guard-room ; and to turn out the guard once by day, and the guard and stable-picket once by night. On the latter occasion he should go round the stables, accompanied by a non-commissioned officer with a lantern, to make sure that the horses are properly tied up.

When under canvas there are various additional duties, such as superintending morning stable-hour, from 6 A.M. until 7 A.M., and the watering of the horses—duties which in barracks are carried on under the sergeant-major.

Under certain circumstances there may be a slight relaxation of the above requirements ; and when there

are two or more batteries quartered together, a small portion of the work is performed by the subaltern on brigade duty.

GENERAL DUTIES OF OFFICERS.

In addition to general parades, brigade and battery parades, office work, courts-martial and barrack routine, every officer in every battery is required to be present at mid-day stables from 11.45 to 12.45. This in the mounted services corresponds to the daily morning parades of infantry. There is scarcely any department of duty on the careful performance of which the efficiency of the battery more depends. The subalterns should pass the greater part of the hour actually in the stables—not in the yard outside—and, aided by their Nos. 1, superintend the grooming; occasionally “pass” a horse; investigate the causes of chafes, galls, and illnesses; see that the stables are kept tidy and well ventilated; and, in fact, insure the stable duties being carried out in an orderly, efficient manner. The major and the captain should make a complete tour throughout the stables, the subalterns bringing under their notice any unusual occurrence or casualties. By 12.40, when the trumpeters sound “feed,” all the horses should have been “passed”—*i. e.*, individually examined by the No. 1 and pronounced clean. Any gunner or driver who

has failed to pass his horse should be required to continue grooming it until the work has been properly performed.

The surgeon and the veterinary surgeon are temporarily attached to the battery, and do not, strictly speaking, belong to it. When two or more batteries are quartered together, one surgeon and one veterinary surgeon perform the duties for all the batteries. The officers in a battery, in addition to the foregoing, consist of 1 major, 1 captain, and 3 lieutenants.

BARRACK-ROOM DUTIES.—The system carried out by the Royal Artillery differs but little from that pursued by other branches of the service, except that greater neatness is required and attained.

*Pay per Diem of Non-Commissioned Officers and Men
of the Royal Artillery.*

	Horse- Artillery. <i>s. d.</i>	Field- batteries. <i>s. d.</i>
Battery sergeant-major, }	4 0	3 10
Battery quartermaster-sergeant, . . . }		
Sergeant,	3 1	2 11
Corporal,	2 4	2 2
Bombardier,	2 2	2 0
Acting-bombardier, ¹	2 1	1 11
Gunner,	1 4	1 2½
Driver,	1 3	1 2½
Farrier,	3 6	3 4
Shoeing-smith,	2 2	2 0
Collar-maker,	2 0	1 10
Wheeler,	2 0	1 10
Boys, until they attain the age of 15, . . .	0 9	0 9

¹ Only four per battery receive this extra rate of pay.

PART III.

PRACTICAL EMPLOYMENT OF FIELD-ARTILLERY

N O T E.

This Part can be studied independently of the others.
See Note, Part I.

CHAPTER I.

WORKING OF A SINGLE BATTERY IN THE FIELD.

DEFINITIONS OF DIFFERENT DESCRIPTIONS OF FIRE—RULES FOR THE SELECTION OF POSITIONS—NATURE OF PROJECTILE TO BE FIRED UNDER VARIOUS CIRCUMSTANCES AND RANGES—COMMON SHELL—SHRAPNEL SHELL—CASE—RATE OF FIRING—ROCKETS—MITRAILLEURS AND GATLINGS—SUPPLY OF AMMUNITION AND REPLACEMENT OF CASUALTIES IN THE FIELD—MARCHING—TRANSPORT OF ARTILLERY BY RAILWAY—FORDS.

DEFINITIONS OF DIFFERENT DESCRIPTIONS OF FIRE.

Enfilade-Fire.—A fire raking the enemy's line of troops or works. The battery so firing must occupy a position in prolongation or nearly so of such line.

Ricochet-Fire.—Its direction is enfilading, but the guns being fired with reduced charges, the projectiles bound along the ground, clearing interposing obstacles in their frequent hops, and, of course, causing devastation in their path. Ricochet-fire can only be carried on with smooth-bore guns, and is, therefore, obsolete. Elongated projectiles are apt to spin away in a vague direction as soon as they touch the ground. The term "ricochet" is, however, still in use.

Curved Fire or *Indirect Fire* is the modern substitute for ricochet-fire. In its direction it is not enfilading but perpendicular to the enemy. The gun is fired with a reduced charge and a high elevation, so that the projectile may just curve over an interposing obstacle and descend upon the object of attack sheltered behind.

RULES FOR THE SELECTION OF POSITIONS.

The following are the principal requirements, though it will rarely be practicable to combine all of them:—

1. The battery should command the greatest possible sweep of range.

2. The height of the position above the plane of site should not be excessive.

3. The position should, if possible, admit of the guns enfilading some portion of the enemy's lines.

4. The position should not itself be liable to be enfiladed by the enemy's artillery.

5. There should be no cover within easy range from whence the enemy's riflemen could pick off the gunners.

6. There should be every facility in point of open ground for retreat, and no probability of the battery being cut off.

7. If possible, the guns should be concealed until they open fire, and the ground should admit of lim-

bers and horses being sheltered while the guns are in action.

8. A battery in action should not be immediately in front or in rear of its own troops.

9. Stony positions should be avoided.

1. THE BATTERY SHOULD COMMAND THE GREATEST POSSIBLE EXTENT OF RANGE.—A great point will be gained if the guns command not only the ground in their immediate front, but also the roads in the vicinity along which the troops must march when moving to the attack. This advantage especially applies to guns of position. I cannot but think, however, that very erroneous ideas prevail in theory with respect to the effective zone of rifled artillery-fire; for it is not unfrequently asserted that infantry cannot move deliberately within a range of 4000 yards of guns, if the ground be at all open. Firstly, an uninterrupted tract of this extent is a very rare exception; and secondly, greatly as has the range of guns of late years been increased, the range of human vision has remained unaltered. To open fire beyond the limit at which the effects of projectiles can be ascertained by long-sighted men, aided with good telescopes, is to a great extent to throw away ammunition.¹ Under the most favourable circumstances, large objects over 3000 yards distant dwindle into almost imperceptible

¹ See also Sir Garnet Wolseley's 'The Soldier's Pocket-Book,' p. 281.

points, and the results of even common shell are with difficulty distinguished. Every artilleryman knows that with the best gunners in the world one or more trial shots are necessary to correct for inevitable errors. An appreciation of these errors is indispensable, and therefore, extent of range beyond a certain point becomes useless.

During the recent civil war in Spain, the Carlists used to boast that their tiny $4\frac{1}{2}$ -pounder Whitworths, weighing only 150 lb., and carried on mules, were effective at 7400 yards; and doubtless these guns, perched on a Pyrenean peak, could send their projectiles to the above distance. But their artillerymen, on being further pressed, were forced to admit that their fire was then of little value, the necessary elevation being 30° , and the gunners being unable to judge of effects and rectify errors. As a matter of fact, they almost invariably allowed their opponents to approach to within 2000 yards before opening fire, ammunition in Don Carlos' army being scarce and of great value.

In November 1875, the Alphonsists frequently pitched their shells haphazard into the straggling open town of Estella from their batteries on Monte Esquinza, about $4\frac{1}{2}$ miles distant; but the projectiles flew so wild that they were only dangerous to the innocent townspeople.

On the other hand, the effective range of guns may be put at a much higher figure when firing into

a camp, fortress, or large area of earthworks, or into a considerable body of troops in column. The Carlist batteries, apparently 16-pounders, between San Marcos and Andouain, played havoc with the San Sebastian works, distant, on an average, 5 miles.

It therefore seems reasonable to fix 3000 yards as the utmost useful range of artillery in the field—the different calibres ranging as follows:—

Guns of position from 1500 to 3000 yards.					
16-pounder guns	„	1000	„	2500	„
9	„	„	800	„	2000

Eight hundred yards may be considered the minimum range, as within that distance the enemy's riflemen could pick off the gunners. Theory—but theory merely illustrated by the illusory experiments on the practice-ground, with nerves undisturbed by the sense of danger—would assign a much higher minimum. Of course, on emergencies a battery might be required to engage at much closer distances.

In opposition to the foregoing, I am bound to state that the Special Committee on Rifled Field-Artillery, 1875, have reported that they “are of opinion that bodies of troops cannot with impunity remain stationary, or even move deliberately in front of guns at any distance under 4000 yards, if the ground is at all open, the artillery posted so that they can see that distance, and the atmosphere clear. Villages or depots of stores would be unsafe at longer ranges.”

It is indeed difficult to demur to an opinion emanating from so authoritative and eminent a source; yet I would venture to suggest that the maximum possible range has become a question of eyesight rather than a question of artillery science; and that, moreover, the Committee themselves indicate grounds for hesitation in the following argument, which is strikingly applicable to all practice-ground experiments:—

“In estimating the value of artillery-fire against troops in different formations, from the experiments carried out at Okehampton, the Committee thoroughly recognise the fact that these trials do not really represent what takes place in action. It is impossible to represent by dummy troops in motion, crouching, or taking advantage of cover or inequalities of ground during an advance; and it may be urged with reason, that no body of troops would remain patiently standing in one spot for several minutes under the deliberate fire of artillery. Moreover, it must be borne in mind that the accuracy of the artillery-fire was not discomposed or impeded by the effect of an enemy's fire, or by the excitement or smoke of an action. Indeed it is not too much to say, that if the result of these experiments really represented at their full value the effects of artillery-fire in action, it would be difficult for troops to show themselves in the open.”

2. THE HEIGHT OF THE POSITION ABOVE THE PLANE OF SITE SHOULD NOT BE EXCESSIVE.—A steep, high hill, by no means always constitutes a good position for a battery—very frequently the fire from it would be too plunging, especially at short ranges, and its destructive effects consequently small; and the enemy advancing to the attack will be completely sheltered on reaching the foot of the acclivity if it be very steep, as the muzzles of the guns cannot be depressed more than 10° . A more gentle slope of about 1 in 15 is to be preferred. This maxim was illustrated at the Alma, where the Russian guns, posted on over-high ridges, were able to inflict comparatively little loss on our troops as they crossed the valley. It is worth remembering, as a practical measure under fire, that if troops posted on ground sloping towards their enemy are suffering severely from his artillery, their losses will often be more effectually diminished by advancing lower down towards their adversary than by retiring up the slope; because, in the former case, the enemy will for some time fire his shot harmlessly over his opponents' heads before he has learned the requisite altered elevation. This was strikingly illustrated in the case of Captain Anderson's field-battery at the battle of the Alma. The battery was posted in action a short distance down the slope on the brow of which the English were formed up, and was

suffering severely, both in men and horses, from the enemy's artillery on the opposite range. In consequence, the commanding officer limbered up, advanced lower down the hill closer to the Russians, and once more opened fire. The beneficial results of this movement were at once apparent; for the enemy, not at once distinguishing our change of position, his projectiles for some time afterwards passed high over our gunners' heads.¹

3. THE POSITION SHOULD, IF POSSIBLE, ADMIT OF THE GUNS ENFILADING SOME PORTION OF THE ENEMY'S LINES.—This advantage will almost, *per se*, constitute a favourable position; for it is evident that a single successful enfilading shot will cause greater damage and confusion than a dozen merely piercing the line at right angles. At the Alma, Lord Raglan ordered two guns from Turner's battery to be brought up to a knoll considerably in advance of the general line of the English position at that moment, from whence they were able to enfilade 18 Russian guns which on the opposite range were playing heavily on our troops. A very few shot raking the enemy caused them such loss, and so disconcerted them by threatening their flanks, that the Russian "Causeway" batteries, unduly apprehensive, moreover, of losing a single gun, quickly limbered up,

¹ My authority for this incident is Sergeant-Major Beezley, who served as a gunner with the battery on the occasion.

and, together with four battalions, withdrew to the rear, leaving the centre or "Pass" open. This circumstance conduced materially to the victory of the Allies.¹

4. THE POSITION SHOULD NOT ITSELF BE LIABLE TO BE ENFILADED BY THE ENEMY'S ARTILLERY.—This maxim naturally springs from the preceding one. Such a defect, quickly taken advantage of by an adversary, would be fatal, and the commander of a battery would be compelled to withdraw his guns immediately. The Floing Spur near Sedan was literally strewn with the *débris* of French batteries, smashed woodwork, dead horses, and the mounds where the gunners had been buried.² The position of two Prussian batteries on the opposite side of the Meuse, on a knoll called the Mamelon d'Atoi, scarcely 1200 yards distant, teaches an instructive and most interesting lesson to all artillerists. Here we see 12 field-guns posted with a judgment amounting to genius; so that while they themselves, on the reverse brow of the hill, were in a great measure protected from fire, their enemy was forced to choose between the alternative of being made a target of by the direct fire in their front, or of being sheltered from the latter by retiring to the west crest, where they would have been enfiladed from their right.

Another portion of the Floing Spur, to the north, and nearly facing Saint Menges, furnished a personifi-

¹ Kinglake's *Invasion of the Crimea*, ii. 233 and 398.

² Three weeks after the battle.

cation of a hopelessly fatal position for artillery. It consisted of a narrow ledge, about 40 yards wide, with the ground in rear perpendicular to a height of about 12 feet; and a French battery had been here posted in a perfect shell-trap, the scarp in rear catching all the "high" Prussian projectiles. The battery dared not withdraw higher up the hill, for fear of being subjected to enfilade-fire from another quarter. Not a shell from its opponents could have missed its mark; and the riddled condition of the site, together with the ruined limbers, led to the conclusion that the battery had been very nearly annihilated.¹

5. THERE SHOULD BE NO COVER WITHIN EASY RANGE FROM WHENCE THE ENEMY'S RIFLEMEN COULD PICK OFF THE GUNNERS.—This maxim almost speaks for itself. It is very difficult to shell an enemy out of a wood; though, as an instance to the contrary, during the early part of Waterloo the English howitzers, with the clumsy old pattern time-fuze, on our right, played havoc with Jerome's infantry in the coppices above Hougomont. Still, good rifle-shots, numbering, for instance, 200 men, posted under cover within 800 yards of a battery, their nerves unshaken, knowing that they are fairly sheltered from danger, should always be able to silence the gunners before the guns can silence them.

6. THERE SHOULD BE EVERY FACILITY IN POINT OF

¹ From Sedan to Saarbrück, pp. 39 and 60.

OPEN GROUND FOR RETREAT, AND NO PROBABILITY OF THE BATTERY BEING CUT OFF.—Should the ground in rear of the position be much intersected with banks, ditches, or streams, or checkered with wooded, marshy, or rough, impracticable ground, the battery might be much hampered and delayed in its retreat, and exposed to the danger of being cut off. For this reason, too, the site should not be unduly detached from the main position.

7. IF POSSIBLE, THE GUNS SHOULD BE CONCEALED UNTIL THEY OPEN FIRE, AND THE GROUND SHOULD ADMIT OF LIMBERS AND HORSES BEING SHELTERED WHILE THE GUNS ARE IN ACTION.—This can often be attained by taking advantage of the inequalities of ground, by posting the guns a few yards back from the edge of the plateau or down the reverse slope ; with the muzzles just peering over the crest. The recoil on discharge might expose the gun to the danger of running back with violence down the slope ; but this risk can be entirely removed by fixing on the drag-shoe, when the recoil will be slight, and the carriage not damaged. The guns may also be concealed or “ masked ” with a troop of cavalry, an operation especially easy with horse-artillery, since their mounted detachments can be employed for the purpose. The presence of a gun should be hardly suspected by an enemy, until just before it opens fire. The above principle was apparently carefully acted up to by the French in their demonstration—futile as it

was—against Saarbrück on 6th August 1870. Their batteries were placed so that the muzzles just looked over the range fronting the town—they followed the curvature of the crest; and narrow trenches, parallel to the guns, about 2 feet 6 inches deep, were cut close to the wheel and trails, wherein the gunners stood when not actually serving their pieces.

Under some circumstances it may be desirable to throw up gun-pits or a slight epaulment to protect the battery, especially if it be a battery of position. This can be done by means of the spades carried with the limbers.

8. A BATTERY IN ACTION SHOULD NOT BE IMMEDIATELY IN FRONT OR IN REAR OF ITS OWN TROOPS, as not only might it impede their advance or retreat, but would offer a double mark to the enemy. Moreover, it would tend to demoralise friendly troops in front, see p. 105.

9. STONY POSITIONS SHOULD BE AVOIDED; for on such a locality the enemy's shells would burst with their maximum effect, and the fragments of flint might cause a great deal of annoyance. Marshy ground, on the contrary, in front of a battery, will save the men from the effects of the *ricochet* of the enemy's shot, as the projectiles will bury themselves in the soft earth. Even a ploughed field will much deaden their effects, although they burst with a considerable fuss and throwing up of dirt.

Battery commanders, when expecting to be shortly engaged, should ride a little in advance of their guns, for the purpose of selecting positions in accordance with the above maxims. Similarly, when a retreat is anticipated, a battery officer should be sent to the rear for the same purpose.

NATURE OF PROJECTILE TO BE FIRED UNDER VARIOUS CIRCUMSTANCES.

COMMON SHELL is effective at short ranges, but is specially useful at maximum ranges where shrapnel would be useless. It may be advantageously employed against troops posted in hollows and woods, against troops in column, or even in line, if they can be enfiladed or taken obliquely; also to batter down buildings and obstacles, and to set on fire combustible materials. It is usually fired with percussion-fuzes, but occasionally with time-fuzes (see p. 18), particularly against troops in woods or under cover; or against magazines, earthworks, or buildings, when the fuzes should be bored long, so that the projectile may penetrate before exploding.

When firing against troops, the moral effect of the shell will be much increased if some of the fuzes be bored very long. The few moments of dread, waiting for the bursting of the projectile after it has pitched, are very trying.

SHRAPNEL SHELL is fired against skirmishers and

troops much scattered, if in open, fairly level ground. It is totally useless against men under cover, as the released bullets have not sufficient velocity to pass through interposing obstacles. It is scarcely available beyond 1800 yards, and even at that range it is not easy to judge of results.

Shrapnel may be employed with good effect with percussion-fuzes, especially at short ranges and over hard ground; but in our service time-fuzes are considered peculiarly appropriate to this description of missile, and should be bored so as to burst about 50 yards short of the object. It is, however, extremely

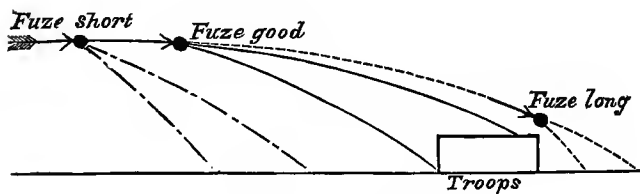


Fig. 19.—Effects of Shrapnel.

difficult to hit off the precise range and consequent length of fuze;¹ and if the explosion be premature or retarded, the results of the projectile as a shell will be almost nugatory, as illustrated in the accompanying sketch, fig. 19.

CASE may be resorted to to repel a sudden charge of cavalry—as a parting discharge previous to a hand-

¹ See also page 34

to-hand fight with infantry—or to check a rush across a bridge, through a gap, or a defile. It is a rude kind of projectile, only to be used at a crisis, and almost harmless beyond 350 yards. Within that distance, however, it is extremely effective, especially if fired over hard, stony ground, for the *ricochet* is then considerable. The spluttering of the dust and pebbles looks very formidable, and the confusion caused amongst cavalry is great. The noise of the balls glancing on the earth and cleaving the air is such as to convey the impression that the atmosphere is filled with them. At a very close range—say 100 yards—double charges of case may be fired as a final blow. There is no fear whatever of thereby bursting the gun. Remember that case is kept handy for instant use in the gun axle-tree boxes.

It is worth remembering that on an emergency shrapnel can be used as a fair substitute for case, by being introduced into the bore point first, when the head will be blown off and the bullets released at the muzzle.

Case must never be fired over the heads of friendly troops, as the scattered bullets would be liable to cause casualties. Shrapnel and common shell may be so employed, but with extreme care, as a single mishap to the men in front will tend to render them unsteady. Time-fuzes under such circumstances would never be desirable.

RATE OF FIRING.—Under favourable circumstances field-guns, whether breech-loaders or muzzle-loaders, served by well-drilled gunners, can be loaded with shell and accurately laid and fired twice in one minute, though generally the fire would be much more deliberate. Four rounds of case can be fired in the same time.

ROCKETS may be used with astonishing results over a perfectly level hard plain.¹ Their moral effects are then even greater than their physical effects, horses especially being terrified by them beyond measure. Over hilly ground or a site much intersected with obstacles they are of little use. Rockets have been tried by almost every nation in turn, with occasional brilliant success; but ultimately they have been invariably abandoned as too unreliable for practical purposes. In 1864, while the American civil war was raging, the Inspector-General of Artillery at Washington, General Barry, informed me that shortly after the outbreak of hostilities the Federals formed a rocket-battery, the effects of which were on one occasion so destructive, that a brigade of six rocket-batteries was at once organised. On the next occasion, however, when their services were called into requisition, one of the missiles twisted back actually amongst the detachment who fired it; and the nervousness to which this incident gave rise was so great and uncon-

¹ See *ante*, page 26.

querable, that the whole brigade was shortly after broken up.

In 1813, at the battle of Leipsic, the British Rocket-Troop (horse-artillery), the sole representative of our troops in that action, rendered itself very conspicuous by the good service it performed. The French used rockets with great success against the Russians in the battle of the Tchernaya, 1855.

The late Sir John Aitchison told me that when he was serving with the Guards in 1814 in the vicinity of Bayonne, two companies of his regiment were pushed across the Adour by boats to act as an advanced-guard to the remainder of the British force. Before, however, they could be reinforced, a French brigade, consisting of either three or four battalions, pounced on them from the direction of Boucau; and their capture or wholesale destruction seemed inevitable, when a rocket-battery on the English side of the river suddenly opened fire, and sent their missiles with such singular success amongst the French, that the whole brigade broke and fled, leaving a vast number of killed and wounded behind them.¹ This locality, it must be remarked, is extremely favourable for the use of this projectile, the Adour here being

¹ General Sir William Knollys, who a few days after marched with a detachment of his regiment over the site of the above engagement, bears witness to the remarkable havoc caused by these projectiles, as evidenced by the number of corpses of French soldiers which cumbered the shore.

about 500 yards broad, and the open sandy banks sloping very gradually for a considerable distance from the river. Twenty miles south, among the Pyrenees, rockets would be almost useless. They had no existence among the Carlists, although, from their portability, they would have been invaluable if available. Rockets were used with excellent effect in the Gold Coast war of 1873-74. It would appear advisable that a colonial power like England should always retain a certain number of these missiles in the service, on account of their moral effect on barbarous nations.

MITRAILLEURS AND GATLINGS.—Of late years popular fancy has inclined strongly towards weapons of this description, but it is doubtful whether on actual service they will fulfil the expectations formed of them. In 1870-71, the French were apparently seldom able to turn them to much account; and the only striking traces of their effects during the early part of the war which I succeeded in hearing of and in authenticating, were on a mamelon about 900 yards north of the Floing Spur. Here, innumerable numbers of graves of Prussian soldiers attested the truth of the assertions that they had suffered severe loss from the mitrailleurs posted opposite to them and near Floing, where old mitrailleurs' cartridge-cases were lying about the ground literally in heaps. Probably the Prussians had been unduly crowded on to the mamelon for some temporary tactical reason.

After Sedan, the Prussians huddled 80 of these captured weapons into a large public square in the town, without attempting to turn them to account, although they had plenty of ammunition and equipment.

Since their first introduction, they have doubtless been much improved, and the Gatling is probably one of the best; but the objections are inherent to the very nature of the weapon.

Boguslawski, in his admirable work, 'Tactical Deductions,' says, p. 104,—“This mongrel weapon possesses neither the advantage of infantry in being able to get under cover and to move rapidly, nor the power or range of artillery.” He also remarks that mitrailleuse-fire is in fact “case” at long range—of itself a contradiction.” It is then impossible to judge of the effects of the bullets, and shell could be used with much greater success. With mitrailleurs, either the balls are uselessly concentrated, since one will kill a man as well as twenty; or if, by a special arrangement of the breech-handle, a horizontal movement can be imparted at will to the barrels during the process of firing, some of the bullets will be caught in the folds of the ground, unless it be as flat as a billiard-table.

For short ranges, case fulfils every ordinary requirement. A mitrailleuse requires appliances, and occupies space in a similar manner as does a piece of artillery,

while for general purposes it is far inferior to the latter, and for breeching or smashing is quite useless.

Perhaps mitrailleurs can be used to best advantage in street-fighting. During the final struggle of the Commune in Paris in May 1871, they were much used by the Versailles troops, and evidently held in high value by them.

SUPPLY OF AMMUNITION AND REPLACEMENT OF CASUALTIES IN THE FIELD.—When a battery takes up a position for action, the waggons, spare men, and horses, should be drawn up under charge of the captain or second in command in the most sheltered spot in rear at any distance varying from 100 to 500 yards, according as cover is available, and, if possible, entirely protected from the enemy's fire. As the ammunition in the gun-limbers becomes exhausted, the commanding officer should communicate with his captain, and cause one or more waggons to be brought up to replace the expended ammunition. Under special circumstances, when a speedy completion of the process is necessary, some of the gun-limbers may be exchanged bodily for the waggon-limbers. Casualties in men and horses with the guns must be made good from the reserves with the waggons. A disabled horse with its fellow can be quickly disengaged from the rest of the team; and as a temporary measure, four or even two horses are sufficient to drag a gun a considerable distance, provided the ground is fairly level and unobstructed.

I was told by a Prussian artillery officer, the Baron de Grumphenberg, that towards the close of Sedan, the battery to which he belonged was suddenly thrust forward to the front, on that part of the ground which lies between Balan and the south side of Sedan to resist De Wimpfenn's attempt to break out towards Douzy. Owing to casualties, his battery had but two horses per gun; yet it galloped forward, and remained in action for about fifteen minutes, when the efforts of the French were frustrated. Had they been successful, the Prussian guns must have fallen into the hands of the enemy; as owing to the losses the former had sustained at such close quarters, they had not even two horses per gun at the end of the quarter of an hour, and were totally unable to move.

It is recognised as a sacred principle in field-artillery, that if a gun be disabled, whatever the cause, its waggon must remain with it to assist in its repair and supply it with ammunition. If, on the other hand, a waggon be disabled, its gun abandons it, and pursues its work independently.

MARCHING.—The invariable formation of a battery marching along a road is that of "column of route," which extends over a distance of 208 yards (see p. 70). At a walk, its maximum rate is a little under 4 miles an hour—or, including a halt of ten minutes every two hours, an average of $3\frac{1}{2}$ miles an hour. 24 miles is a good day's march for a battery in training; and on an emergency, the battery with which I served

accomplished 34 miles in the day without any extraordinary effort. When the word "March at ease" is given, the gunners are allowed to mount the carriages, or to walk alongside at their option, except in going up or down hill, when they should always be on foot. The distances between the carriages are then lengthened out, so that each team may work more independently and with less fatigue. Going down a steep hill the dragshoe should be applied, and going up hill the bearing-reins cast free. During the halts, the collars and straps are carefully examined; and if there is any appearance of galls, the chafed places are eased by spare paddings.

When marching in an enemy's country, a battery should have an escort either of infantry or cavalry; or if no escort be available, the gunners with their carbines, of which there are 12 per battery, must make good the deficiency. A battery marching by itself should always have an advanced and rear guard. In a hilly or enclosed country it should explore the ground in front, so as to guard against ambuscades and surprises. A defile should be passed as quickly as possible, as guns can seldom be used in it. In a retrograde movement the ammunition-waggons should be sent to the rear, one or two only being retained at hand to supplement the supply of the gun-limber ammunition.

In case of an attack *en route*, the carriages should close up, and the battery should continue its march,

while the escort shows front to the enemy. If closely pressed, a square should be formed of the carriages, with the guns at the angles, the escort sheltering itself behind the carriages, and from thence keeping up a fire on the attacking party.

In night marches through an enemy's country, strict silence should be maintained, and the men must not be allowed to crack their whips or light any matches.

TRANSPORT OF ARTILLERY BY RAILWAY.—Field-artillery is, owing to the heavy and extensive nature of their equipment, generally required to proceed from one destination to another by march-route. If, however, they are to be transported by railway, an officer should precede the battery, and in concert with the station-master should mark off on the carriages with a piece of chalk the subdivision of the battery allotted to them, and the number of men, horses, or carriages each will hold. As a rule, each compartment will hold eight soldiers with their arms and accoutrements; a horse-box will convey 3 horses; a cattle-truck, 8 horses; and a goods-truck, a gun-carriage and limber, or waggon and limber. One train should consist of from 24 to 30 carriages, and therefore two trains will be required for the transport of a complete battery. By using cattle-trucks instead of horse-boxes, one train with a powerful engine would suffice.

The flooring of the horse-trucks should be carefully

inspected, to guard against any loose or unsound planks.

A battery can generally be most conveniently embarked from a freight-shed. If there be not sufficient length of platform for the horses and guns, rough "ramps" or slopes must be constructed, by means of skidding or rails and some planks.

The battery should arrive at the station about $1\frac{1}{2}$ hour previous to the time fixed for departure. It should first be drawn up in some handy, adjacent spot. The drivers will dismount, take off their accoutrements, and, assisted by the gunners, will unhook and file their horses off to the trucks indicated for each subdivision. The gunners will then embark the guns, carriages, wag-gons, and stores. Finally, all the men will be marched to their respective carriages.

A really good battery, however, accustomed to the work, and with suitable appliances and sufficient length of platform, will be able to complete the embarkation in about half an hour after the drivers have dismounted and begun to unhook.

The rate at which the engine may be expected to travel will not exceed 25 miles an hour. On the arrival of the train at its destination, the men quit their carriages at the trumpet-sound and fall in. The horses will be then disembarked, straw being placed over each lowered truck-side, on which they may step, though this is not absolutely essential. They

are then formed up at the discretion of the commanding officer, the drivers remaining in charge of them. The gunners next proceed to take off the guns, carriages, and stores, and the battery is finally hooked in.

If there is ample length of platform, and abundance of hand labour, horses and guns may be disembarked simultaneously, and the whole operation should be completed in about twenty minutes.

FORDS.—The maximum depth for artillery is 3 feet. 3.6 is usually laid down ; but practical experience shows that this depth is excessive, and would, moreover, spoil the ammunition. Even with a ford 3 feet deep, the current must be gentle, and the bottom sound, level, and free from boulders. The leader of the column should keep his eyes steadily fixed on a point on the opposite bank, which may serve to mark the direction of the ford ; otherwise he is likely to be deceived by the appearance of the current, which, seeming to carry him down, might induce him to keep too high up. No carriage should be allowed to swerve in the least from the line marked out by the leader ; nor should any horses be allowed to halt, trot, or drink while crossing.

CHAPTER II.

WORKING ARTILLERY IN THE FIELD IN CONJUNCTION
WITH OTHER ARMS.

DISTRIBUTION OF THE ARTILLERY OF AN ARMY CORPS—FREQUENT SOURCES OF ERROR IN THE EMPLOYMENT OF ARTILLERY—EXAMPLES OF THE EMPLOYMENT OF ARTILLERY—RESERVE ARTILLERY—DUTIES OF THE BRIGADIER-GENERAL COMMANDING THE ARTILLERY OF AN ARMY CORPS—A DIVISION OF ARTILLERY WORKING WITH OTHER TROOPS—DUTIES OF LIEUTENANT-COLONELS OF ARTILLERY IN THE FIELD—TRANSMISSION OF ORDERS FOR ARTILLERY—THE INDIVIDUAL BATTERY IN THE FIELD IN CONJUNCTION WITH OTHER TROOPS—DUTIES OF HORSE-ARTILLERY WORKING WITH CAVALRY—ESCORTS FOR ARTILLERY—POSITION OF ARTILLERY ON THE LINE OF MARCH WITH OTHER BRANCHES OF THE SERVICE—OUTPOSTS—MEANS OF RENDERING GUNS UNSERVICEABLE—MEANS OF RENDERING DISABLED GUNS FIT FOR USE.

DISTRIBUTION OF THE ARTILLERY OF AN ARMY CORPS.
—In order that the utmost possible benefit may be derived by an army in the field from its artillery, as well as for convenience of organisation, a certain number of batteries are allotted to each division of infantry and brigade of cavalry. These are called the *Divisional Artillery*. The remaining batteries are called the

Reserve Artillery, and are kept as far as possible together in one body, at the disposal of the chief of artillery, to be used by him subject to the approval of the general in chief command, as circumstances may require.

In our service, the necessary proportion of artillery is apparently estimated at about 3 guns for every 1000 fighting-men.—See Army Circular, Aug. 1875. The regulated strength of one of our army corps is 36,800 men; but in calculating for the necessary number of guns, we must deduct from the above grand total the artillerymen themselves, the engineers, medical, control, and police departments, &c.,—or, in round numbers, we have to allow for—

	Men.
3 infantry divisions of 7670 infantry men each, .	23,010
Cavalry—3 regiments : one regiment attached to each infantry division, 1850,	} 3,700
1 brigade of cavalry, 1850,	
Total, in round numbers, . . .	27,000

The artillery provided for the above consists of 15 batteries with 90 guns, which are thus distributed—

	Guns.
1st infantry division, 3 field-batteries, . . .	18
2d " " 3 " " . . .	18
3d " " 3 " " . . .	18
Cavalry brigade—1 battery horse-artillery, . . .	6
Reserve artillery, { 3 batteries horse-artillery, } { 2 field-batteries, }	30
Total artillery per corps, 15 batteries, . . .	90

It is, however, a moot question whether the whole of the horse-artillery shall not be attached to the reserve artillery, one or more horse-artillery batteries being temporarily told off to the cavalry brigade, as the circumstances of the moment may require.

The proportion of the different natures of field-artillery will, however, depend in a great measure on the character of the country. Flat, open countries are advantageous for the employment of heavy guns and horse-artillery; hilly, enclosed districts for light field-batteries and mountain-artillery.

FREQUENT SOURCES OF ERROR IN THE EMPLOYMENT OF ARTILLERY.¹—Non-artillery officers have a constant tendency to utilise guns placed at their disposal, by merely supplementing with them the fire of an infantry brigade, battalion, or even line of skirmishers; they forget that, owing to the increased range and accuracy of small-arms, artillery cannot now, as formerly, accompany the attacking columns during their advance for the purpose of opening fire within a short range of the enemy's lines; and they seem to ignore the fact that by requiring guns to march on the flanks of infantry they inflict on them the enormous evil of constant changes of range and

¹ In the following remarks I have quoted largely from a memorandum issued by Colonel Radcliffe, commanding the Royal Artillery in Ireland in 1874; and from instructions issued in Divisional Orders, Aldershot, July 1874, by General Sir Hope Grant, for the guidance of artillery employed in autumn manœuvres.

position—a greater or lesser range of 400 or 500 yards, however important to infantry, being of little moment to modern artillery. Hence it constantly happens that batteries are split up into sections of two guns each, whereby their fire is frittered away. Even when the battery is maintained intact, the leading idea of the officer in command of the combined force seems to be “artillery to conform.” It cannot be disputed that the chief superiority of artillery over other arms consists not only in the more destructive effects of its projectiles, but in its greater powers of range; yet if it is to “conform to the movements of the infantry,” this latter advantage is entirely nullified. For instance, it is not uncommon to see guns ranged side by side with a line of infantry, and maintaining with it a simultaneous fire. In Prussia, notwithstanding the alleged perfection of their peace manœuvres, the practice is flagrantly prevalent. It is evident that in nineteen cases out of twenty this must be an absurdity. Either it must be assumed that the infantry is firing at an enemy not more than 800 or 900 yards distant, in which case the greater part of the artillerymen and horses would be picked off and the guns silenced, or else the infantry must be wasting their ammunition at impossible ranges. *A fortiori*, should the latter be firing, artillery should never be in action in advance of them.

Now it is not for one moment disputed that artillery is purely an auxiliary branch, and that the other

arms are the backbone of the fighting strength. Without their aid, artillery alone can never carry on the most insignificant operations; while, of course, important achievements are continually being effected where artillery is entirely unrepresented. On the other hand, no decisive blow on a large scale can be struck without the aid of guns; and, bearing in mind the increased power of modern ordnance, the following general principle appears to be sound:—

“Artillery should be employed in conjunction with other arms to accomplish an object common to all; but the means to be adopted by each arm for attaining this object should differ materially in detail, and should, in a great measure, be carried out independently.” This maxim may be illustrated by the following

EXAMPLES OF THE EMPLOYMENT OF ARTILLERY.

1. In the attack, the objects of artillery at the outset are to prepare the way for the other arms by creating disorder in the enemy's ranks, by dismounting his guns, by destroying obstacles, and by rendering cover untenable. At a later period it should support the advance of other troops directly, and should form a rallying-point in case of repulse.

2. On the defensive, artillery should direct its fire against the advancing cavalry or infantry of the enemy,

so as to check, harass, and threaten his attacking columns, cover the retreat of the defenders, or defend the key of the position. Jomini's maxim is, that "artillery in battles ought never to forget that its principal mission is to batter the troops of the enemy, and not reply to his batteries." A departure from it to some extent would be judicious in example 1; but in the present example the defenders' artillery must be particularly careful not to turn their fire against the hostile guns, because by so doing the enemy will have succeeded in diverting fire from his attacking columns, and will have effected his purpose as effectually as though he had for the time silenced his antagonists' pieces.

It is difficult to insist too strongly on the great importance of a superiority of artillery-fire at the beginning of an action, so as to crush the enemy's batteries in detail as they advance into action, and so as to prevent the deployment of a hostile force.

3. Artillery may be of the utmost aid in deciding an action by the concentration of the fire of a number of batteries against a vital point.

In the three above examples the objects of artillery will be best attained by causing the batteries to be partially detached from their infantry division, and by relieving them from following closely in its wake, instead of requiring them literally to "conform." For by conforming they would be compelled to change

their positions incessantly, so as to post themselves a little in advance or in rear of the troops they are supporting.

RESERVE ARTILLERY.—The Reserve artillery—or, as it might be more fitly called, the Corps artillery—exists as a distinct body apart from the divisional artillery, and consists of a certain number of batteries placed at the disposal of the chief of artillery, who in an army corps would hold the rank of brigadier-general. The reserve batteries are at his entire disposal for detached duties, for strengthening the divisional guns when required, and, above all, for combining the fire of a large number of pieces as an artillery mass for a decisive effort, and must never be employed except with his direct sanction—subject, of course, to the authority of the general in command. They should consist of horse-artillery and heavy field-batteries. The former is employed when rapidity of movement is required for sudden emergencies of support or concentration; the latter are brought to the front when weight of metal is desirable in addition to a mere number of pieces. The reserve artillery should generally be posted in rear of the centre, or in some position from whence the batteries could be quickly despatched to spots where their services would probably be required.

DUTIES OF THE BRIGADIER-GENERAL COMMANDING THE ARTILLERY OF AN ARMY CORPS.—The brigadier-

general royal artillery is responsible to the general officer commanding the army corps for the general efficiency of his arm. It is his special duty to take care that all casualties amongst officers, men, horses, and *matériel* are promptly made good, and he is responsible for all reserves of ammunition and *matériel*. Therefore, although the batteries of divisional artillery are, under their lieutenant-colonels, subject to the general officer of the division in the same manner as the other arms under his orders, yet it is the duty of the lieutenant-colonels to keep the general officer of artillery constantly informed as to the state of discipline and general condition of the various batteries. He will exercise jurisdiction both for discipline, and to some extent for manœuvres, over the whole of the artillery in the field—whether horse or field, divisional or reserve—and will hold the same relative position to the commander of the army as does a lieutenant-colonel to his division-general. He is a member of the staff of the commander of the army corps, and should be thoroughly in the confidence of his general with regard to the plan of operations.

A DIVISION OF ARTILLERY WORKING WITH OTHER TROOPS.—A *division of artillery*—to be distinguished from a battery division of two guns and waggons—consists of two or more batteries under the command of a lieutenant-colonel; and therefore the three batteries attached to each infantry division, and called

the divisional artillery, will, when working together, compose a *division of artillery*. On the march with other troops, one of the batteries should be near the head of the column, and the others distributed between brigades. In the field, batteries may be posted approximately on either flank of the infantry division to which they are attached, provided the occupation of the ground be such that they are not unduly separated from each other. It is not here intended to advocate the Prussian theory, that the *Abtheilung* of three batteries must never be allowed to slip away from the immediate grasp of the officer commanding it, nor the clumsy practice of his moving them and giving the word of command as though he were handling a single battalion, whereby long lines of artillery sometimes formed into columns are advanced and retired in a mass. This involves the loss of much time—in a close country the delay becomes serious—and many brilliant opportunities. But it must be borne in mind that in proportion as the several batteries can be made to respond to the general guidance of one hand, the more effectually will they be able to support the operations of the other troops. Lieutenant-colonels, therefore, should be constantly on the watch for opportunities of concentrating the fire of their guns upon vulnerable points. In opposition to this principle, it is the fashion to argue that the battery is the tactical unit of artillery, and that it should

be worked under the sole and independent command—so far as regards the jurisdiction of artillery officers—of its own major. This is true only to a very limited extent, chiefly in point of interior economy. It is a valuable unit for making up a valuable total, but in the majority of cases it is a unit insufficiently powerful to obtain singly decisive results. Officers commanding batteries are generally tenacious of their authority; they are apt to tacitly assert their right to work with their infantry or cavalry division, subject only to the orders of their general, and are frequently inclined to regard those emanating from their lieutenant-colonel when in the field as undue interference. If detached for the purpose of performing any special duty, they often delay rejoining the main body of artillery at its conclusion, and reporting their arrival to their lieutenant-colonels, preferring their semi-independent commands. This practice is objectionable. It should be clearly recognised that the lieutenant-colonel is responsible for the general correctness of the movements of his batteries, especially when the efficacy of their fire is involved, and that it is his bounden duty to rectify promptly all errors which may come under his notice. On the other hand, the less he interferes with their interior economy, except when discipline is manifestly going astray, the better.

It may be assumed that rarely more than two batteries should be massed together for action, as a greater

number would be beyond the thorough supervision of the lieutenant-colonel, and would offer too conspicuous a mark for the enemy's notice ; but this limit of concentration of guns does not preclude the convergence of fire at critical moments from as many points as may be practicable and desirable. The most important distinction between convergence of fire and massing does not appear to be sufficiently recognised.

DUTIES OF THE LIEUTENANT-COLONEL OF ARTILLERY IN THE FIELD.—The lieutenant-colonel should accompany his infantry division-general as a member of his staff, should be taken into counsel by him, and be informed of the objects sought to be obtained, and the probable share which his artillery will be required to take in carrying them into effect. He should communicate this latter point only to battery commanders ; and while maintaining his communication with his general, should take care that the instructions are being acted up to. When it is necessary to break up the divisional artillery into batteries separated by comparatively wide intervals, he should see that their fire is so directed as best to support the general design. It is the lieutenant-colonel's special duty to take the initiative, if necessary, in pointing out to the divisional general any opportunities which may occur for availing himself of the superior powers possessed by the artillery for striking a decisive blow by concentrating its fire ; and in this case especially he should

personally superintend the measures for carrying the same into effect rapidly and simultaneously, without which half the effect will be lost. With this view, application may be made to the officer commanding the combined artillery of the army corps for permission to employ, in addition, one or more batteries from the reserve.

TRANSMISSION OF ORDERS FOR ARTILLERY.—Orders should always be transmitted through the lieutenant-colonel; otherwise conflicting instructions may be issued, and his authority becomes weakened. Sometimes commanders of batteries are completely bewildered by receiving simultaneously contradictory orders from three or four different sources; for instance, from the general-in-chief, from the infantry division-general, from the officer commanding the combined artillery, and from the lieutenant-colonel.

THE INDIVIDUAL BATTERY WORKING IN THE FIELD IN CONJUNCTION WITH OTHER TROOPS.—The commanding officer of a battery is responsible, under his lieutenant-colonel (see p. 124), for aiding with his guns in carrying out the intentions of his division-general. He should select his own positions, subject to general instructions; and in the absence of special orders, should not hesitate to act instantly, to the best of his judgment, in supporting any change in the disposition of the troops, or in meeting the sudden emergencies of the moment. Whenever practicable,

he should keep his battery at full interval, thereby diminishing the chance of casualties from the enemy's fire. The fact should never be lost sight of that guns limbered up are impotent for offence or defence, and are then even a source of weakness and anxiety to the force to which they are attached. They should therefore be kept out of fire, and concealed to the very last moment. All superfluous movements and display should be avoided, and even the presence of a gun should hardly be guessed at until it opens fire. When, however, a battery is ordered into action, it should move with the utmost celerity. Whenever it is about to advance or retire through a line of infantry, notice should be sent to the officer in command of the latter, in order that passages may be opened for the guns without confusion or delay. Field-batteries being generally required to work with infantry, the walk has been laid down as their normal pace; but the necessity for proceeding at a trot is of constant occurrence—and a blind, stupid ignoring of this necessity would materially cripple the value of the arm. For example, in supporting an advance, in covering a retreat, or in preparing a way for other troops, it may be of paramount importance to open fire as quickly as possible, and to continue it up to the last moment. Can it be seriously maintained that it is unlawful for the field-batteries to move at a brisk trot, and so gain a few

precious moments, and that they must in lieu plod along at a snail-like walk on the flank of the infantry? The pace should be left to the discretion of commanding officers, leaving them unfettered by short-sighted orders. Any one can abide by a hard-and-fast rule; it is for the wise man—and such we must assume a man holding an important command—to decide when it is expedient to depart from the rule. Commanding officers may be relied on not to abuse this discretion—indeed their usual tendency is to err in moving too slowly, so anxious are they to spare their horses.

To ascertain the required elevation and to hit off the exact range is of so great importance, and involves so much delay, that the officer commanding the battery should be careful to avoid changing his position oftener than is absolutely necessary. For this reason one battery should never be ordered to relieve another actually in action, unless the one to be relieved is nearly *hors de combat*, or unless the heavier metal of the relieving guns renders the change desirable. Supposing guns in action against an enemy 1500 yards distant, he might advance 500 yards or retire 700 yards; and yet it might not be expedient for the battery to limber up—assuming, of course, the field of view to remain unobstructed—for field-guns are perfectly effective at either range of 1000 yards or 2200 yards.

Ammunition should not be expended on the off-chance of hitting one or two of the enemy. Irrespective of the consideration of waste, it gradually causes the artillery-fire to be held cheap.

The principle that the loss of a gun is disgraceful, and must be avoided at every cost, should be abandoned as a vicious tradition tending to cause guns to be withdrawn at the most critical moments. A battery may be bound to cling to the very last to a position, if from thence it be pouring in a deadly fire on the enemy; and it may thereby be rendering a service of such inestimable value, that even if its guns be eventually captured, it may have more faithfully complied with the requirements of duty and honour than by having ceased fire, limbered up, and saved its pieces. An instance of the vice of the principle occurred at the Alma. The Emperor Nicholas, an enthusiastic admirer of the Duke of Wellington, had for years dinned into the heads of his officers the glory of our great captain in never having lost a gun throughout his military career, and had impressed on them the disgrace he considered attached to such a loss. As stated in page 98, the opposition of the Russians to the Allies' advance at the Alma was much hampered and curtailed by the apprehension lest by any possible contingency one of their guns should fall into our hands. Consequently, when Turner's two pieces began to partially enfilade them from the ad-

vanced knoll, they prematurely limbered up and withdrew their guns when the persistence of their fire was essential to the defence of the position.

In the event of a sudden and unexpected attack against any portion of the position, the brigadier or other officer in command of the troops on the spot is entitled on his own responsibility to give such orders as he may deem necessary to repel it to any battery at hand, and the commander of the battery is bound to obey them without delay or reference to his lieutenant-colonel. A report of the measure should at once be made by the officer who has taken it to the lieutenant-general commanding the division.

A battery should, as far as possible, be maintained intact, and not broken up into detached portions. This rule is not absolutely invariable. Occasionally retirements and advances under fire may be made advantageously by alternate half-batteries, each half-battery rapidly advancing or retiring in turn to previously-selected positions about 500 yards' perpendicular distance apart. This movement is very suitable in covering a retreat. A battery may also be broken up when a portion of it only is required for some special or detached duty — such as to strengthen an outpost, or to cover a bridge-head, road, or defile. Two guns should be the smallest fraction. To post a single gun by itself can scarcely ever be advisable; its fire would be too intermittent to be very

effectual even in defending a bridge, as the assailants could rush forward with impunity between the intervals of the discharge.

THE DUTIES OF HORSE-ARTILLERY WORKING WITH CAVALRY are to protect the manœuvres of the latter, to shake the enemy's troops previous to their being charged, and to support pursuit or cover retreat. The folly of horse-artillery "conforming to the cavalry movements" by galloping hither and thither with a great amount of display, sometimes actually charging full tilt on the flanks of the troops they should support, needs only to be alluded to to be condemned. The principles laid down for field-batteries, p. 92, are in the main applicable to horse-artillery likewise, thorough advantage being taken of their superior powers of mobility. Great care must be exercised that they are never posted directly in front or in rear of their own cavalry, as not only do they present a double mark to the enemy, but the gunners might be ridden down by the troopers advancing or retiring in confusion through the gun intervals—a casualty which has actually taken place both in war and in home service. Such a mishap occurred at Chillianwallah, where the teams and gunners of a battery of horse-artillery were ridden down by some British cavalry retiring in disorder from an unsuccessful charge. Horse-artillery, by means of their detachments, can generally "mask" their own guns—*i.e.*, by making the mounted gunners

ride in line in front of their pieces, they can so effectually conceal them that an enemy at a moderate distance can discern nothing more apparently formidable than a squadron of cavalry.

ESCORTS FOR ARTILLERY.—Since artillery cannot provide for its own security against attack, it seems desirable that an escort of cavalry or infantry should be told off to each battery, to resist any possible attempt to capture it by a *coup-de-main*. The escort should not be less than a company of infantry or a troop of cavalry, which should be attached to the battery during the entire progress of active operations, remaining with it under all circumstances, and being entirely under the direction of the senior artillery officer. The Prussians consider such a provision a mere waste of troops, arguing that the nearest infantry or cavalry is sufficient to obviate the risk of capture, provided due vigilance be exercised on the part of the major, and that in exceptional instances it is preferable to detach a temporary escort. Judging by their peace manœuvres—which, after all, should be a close approximation to the practice of war—this method is faulty. Through fear of losing the guns, there is a constant fidget to limber-up and retire into the background; and their batteries may not unfrequently be seen to cease firing and withdraw, when, by the occupation, prolonged even for a few minutes, of an advanced position, they might have inflicted serious losses on an enemy.

In practice, a field-battery escort is with us generally composed of infantry—that for horse-artillery of cavalry. The sounder rule would be to detail infantry in an enclosed, wooded country, or where a moderate pace only would be required ; and cavalry in an open country, or where the movements must be rapid. In the former case, a proportion of the escort can on emergency be carried by the battery. With a detachment of six gunners per gun, and by utilising the axle-tree boxes, each subdivision could convey nine infantry, or the whole battery fifty-four infantry, supposing the waggons to accompany the guns.

The movements of the escort must depend entirely on those of the guns—the battery commander, of course, being bound to be careful for the safety of his defenders. A cavalry escort should remain echeloned about 200 yards in rear of the exposed flank of the battery if in action—one of infantry about 100 yards in rear. Sentries or vedettes should be posted so as to keep a sharp look-out, and give warning of any impending irruption on the part of the enemy. The infantry may be sometimes required to keep down the fire of his riflemen. In forward movements the escort should march in front of the battery, throwing out patrols and flankers. In retiring, it should allow the guns to pass it, and then move steadily in their wake, as close as cover and other circumstances will allow.

If the commanding officer of a battery finds him-

self unprovided with an escort, he should apply for one if necessary, and under pressing circumstances may even claim to be so supported from the nearest detachment of troops.

POSITION OF ARTILLERY ON THE LINE OF MARCH WITH OTHER BRANCHES OF THE SERVICE.—Sir Garnet Wolseley, in his 'The Soldier's Pocket-Book,' third edition, p. 230, lays down the following as the normal order of march of a division of infantry moving independently :—

Advanced-guard.

General and staff.

Troop of divisional cavalry.¹

Leading battalion of leading brigade.

Divisional artillery—three batteries.²

The two remaining battalions of leading brigade.

Small-arm ammunition-carts of leading brigade.

Tool-carts of leading brigade.

The second brigade.

Small-arm ammunition-carts, and tool-carts of second brigade.

Infantry and artillery reserve ammunition column.

Ambulance, led horses, baggage, commissariat, and military police.

¹ The remainder of the cavalry is with the advanced-guard.

² Minus two or more guns, as the case may be, in front with the advanced-guard.

The horse-artillery batteries attached to the cavalry will, of course, march with their respective brigades.

The reserve artillery should, when practicable, march under escort on a different road from the other batteries, so that they may be easily and quickly moved to the front to cover the formation of troops for action.

OUTPOSTS.—Guns required for detached or outpost service should, when practicable, be detailed from the reserve artillery, and will generally consist of horse-artillery; and on the conclusion of the duty, the officer in command of them should at once rejoin the main body from which he was detached, and report his arrival to his superior. In peace manœuvres, this principle is by no means sufficiently regarded. The officer in command of a battery or portion of a battery ordered on outpost duty, must be careful to ascertain before marching that he has a proper supply of ammunition. Circumstances will determine whether or not he should take with him any of his waggons. Usually there will be a sufficient supply of ammunition in the gun-limber boxes.

The guns are generally stationed with that portion of the troops called “the reserve of the outposts;” but it may sometimes be advisable to post two or more of them in an advanced position—for instance, to guard a defile or bridge, or to sweep a causeway. Great care must then be taken that they are adequately protected, that they are not liable to be cut off, and that

they can effect a rapid retreat. When the senior officer arrives on the ground he is to occupy, he should at once select, in conjunction with the officer commanding the outposts, a favourable position for his guns, and improve any natural existing cover by digging gun-pits or throwing up an epaulment or slight parapet. He should also endeavour to ascertain the range of all objects within fire ; and after a careful study of the nature of the ground, should make up his mind what description of projectile he will use under possible circumstances. The guns will, as usual, be protected by infantry or cavalry.

MEANS OF RENDERING GUNS UNSERVICEABLE. — In actual warfare an officer may sometimes be called on to render guns unserviceable either because the enemy is on the point of gaining possession of them, or because a temporary capture has been made of the hostile artillery, although there is every prospect that the prize must be shortly abandoned. To the uninitiated, to disable guns is not quite so easy as might perhaps at first appear. If it is probable that they will be shortly recaptured, they may be rendered useless for the time by plugging up the vents with spring spikes, which are manufactured expressly for the purpose, and which can afterwards be withdrawn with but little delay ; or a shell may be rammed home without a cartridge. Should the guns be breech-loaders, they can easily be rendered perfectly useless by taking

away the vent-pieces. If the guns are to be permanently abandoned, common spikes, a supply of which is with us always kept in the gun axle-tree boxes, or large nails, to be obtained from the farrier or shoeing-smith, should be hammered into the vents; the tangent-scales, elevating screws, and handspikes should be removed and concealed, and the wheels destroyed by snapping the felloes. If time admits, the bores should be half filled with powder, jammed with two or three shell and some nails, tamped—*i. e.*, bunged up—with earth, and fired by means of a long piece of quick-match or train of damped powder plastered on to the breech. To burst English guns, however, of modern manufacture, is by no means easy, so great is their strength. Finally, a cannon-shot may be fired against the muzzle at a short distance from it.

Guns should not be abandoned until the very last extremity. It by no means follows that they are permanently lost, even though the enemy may be wandering at will for a time among them. Should a battery be charged by cavalry, the gunners, by creeping underneath the carriage or between the pairs of horses, will be fairly out of reach of cut and thrust; but if attacked by infantry, they may be compelled to take refuge elsewhere—in rear of their own troops or within their own squares, holding themselves in readiness to sally forth at the first opportunity and once more serve their pieces.

Towards the close of Waterloo, the English guns frequently fell into the hands of the French for short periods, who were, nevertheless, unable to carry off their capture. The gunners took refuge in the nearest squares, and as soon as the enemy had retired, they quickly resumed serving their guns. At Balaclava, five regiments of English cavalry rode through two Russian batteries of six guns each, and theoretically were in complete possession of them, the Russian supports having retired, although they kept up a galling flanking fire. Nevertheless, the English were unable to carry off or to spike a single piece, and were finally obliged to relinquish their prize, the captors themselves having been almost annihilated.

MEANS OF RENDERING DISABLED GUNS FIT FOR USE.
—The spikes may be drawn out by the shoeing-smiths, the process being facilitated by pouring vitriol, or even common oil, into or around the vent, so that the liquid may penetrate into the interstices. They may also be blown out or loosened by loading the piece with a large charge, and firing it by means of quick-match running down the bore. It is possible to drill a fresh vent; but this is a tedious process. If the gun be a breech-loader, and the vent-pieces have been removed, there are no means whatever for making good the deficiency. Should shot be jammed into the bore, drown the charge, if there be a cartridge in rear of the projectile, by pouring water into the vent or the muzzle;

drop a little powder into the vent, and explode it. The drowned cartridge will burn like a squib, and will combine with the fresh powder to force the shell slowly out of the piece.

The handspike and a rough kind of tangent-scale can be made good by planking. To replace the elevating-screw, fix a block of wood crosswise on the trail and beneath the breech. Above the block place a slowly-tapering wedge, or "quoin." By being thrust in or out it will give the required elevation.

If a wheel be only partially damaged, the gun can be dragged along for a short distance by putting on the drag-shoe, and thus preventing the wheel revolving. Should the damage be more serious, it must be made good by a spare wheel or a waggon-wheel, or a wheel from any military carriage at hand. The process of shifting is a very easy one, and the height of the replaced wheels is of no great moment, provided, of course, that the substitute forms a pair of the same height. The pipe-boxes must, however, be of a size to fix on to the axle-tree arms.

If the ammunition-waggons are at hand, a damaged gun-limber should be bodily exchanged for a waggon-limber, for the two are as nearly as possible identical.

CHAPTER III.

EXAMPLES FROM MODERN WARFARE ILLUSTRATING THE EMPLOYMENT OF ARTILLERY.

FRIEDLAND—WAGRAM—FUENTES D'ONOR—SOBRAON—INKERMAN—
MALAKOFF—SEDAN—THE CARLIST WAR, 1875.

THE following are some of the most celebrated examples in modern warfare illustrating the great results which can be obtained by powerful artillery efficiently handled :—

FRIEDLAND,¹ June 14, 1807. — Gained by the French under Napoleon, over the Russians and Prussians under Benningsen. In the night of the 13th June, Benningsen received information that the corps of Lannes, consisting of 12,000 infantry and 3000 cavalry, had arrived at the village of Posthenen, three miles from Friedland, where the Russian general was encamped with an army of 4500 infantry and 10,000 cavalry. The exposed situation of Lannes' corps, which formed the advanced-guard of the French

¹ For a more detailed account, see Jomini, Thiers, Alison, &c.

army, inspired Benningsen with the hope that, by a sudden attack, it might be destroyed before the main body of Napoleon's forces, about thirteen miles distant, could be brought up in support. Between Benningsen and Lannes the river Alle interposed; and by four o'clock in the morning of the 14th June the Russian troops were defiling over the bridge of Friedland to the enemy's side, and without delay attacked the French advanced posts, who slowly fell back. The corps of Mortier arrived to the support of Lannes a short time after the firing had commenced; and the resistance thus opposed was so considerable, that Benningsen, who had at first crossed the Alle with only a single division, found himself under the necessity of passing over another and another to its support, until by degrees his whole army had been brought over. Thus was the Russian general, who at first contemplated only a partial operation, insensibly drawn into a general action in the most disadvantageous of situations, with a superior force of the enemy in front, and a deep river, traversed only by a few bridges, in his rear.

Meanwhile Napoleon, at the first sound of the distant cannonade, had despatched orders for the rapid concentration of his various army corps on the scene of the partial conflict before Friedland, and by 4 P.M. 70,000 French infantry and 10,000 cavalry were there collected; while Benningsen, now aware of

the straits in which he had placed himself, had long since abandoned his original intention of surprising Lannes, and was desirous only of maintaining his ground until the darkness of night should enable him to recross the Alle.

At five o'clock P.M. the general action was begun by Ney's corps on the right advancing against the Russian centre and left. After a brilliant but ephemeral success, the attack was repulsed—Ney's right was enfiladed by some Russian guns on the opposite side of the river, and the Russian Imperial Guard pushed him back at the point of the bayonet. As, however, they hurried on in pursuit, they were checked by the corps under Victor, which had been brought forward from the reserve into the gap in the first line originally occupied by Ney. Here occurred that brilliant manœuvre in artillery tactics carried out by the French general Senarmont—a manœuvre which, in point of success, and as illustrating the irresistible power of artillery masses skilfully directed, has no parallel in the annals of military history. Senarmont, who commanded the whole of the French artillery, collected all the guns of Victor's corps, in number 36, that general having first acquiesced in the operation. He then told them off into two masses of 15 pieces each, with a reserve of 6 pieces. One mass was posted on the right of Victor's corps, one on the left, and the reserve in rear of the centre.

The guns opened at 470 yards, and after a few rounds advanced to 235, and finally to 130 yards, at which range only case-shot were fired. The fire of the French guns, playing without intermission on the crowded ranks of the slowly-retiring Russians, was terrific. Senarmont passed from one battery to another, directing their movements and gradually pushing them forward. The Russian cavalry attempted to check his advance, but Senarmont quickly changed front, and, unaided by cavalry or infantry, with ease repulsed the attack, solely by the overwhelming fire of his guns. The ground over which the batteries moved being in the form of a triangle, they at last formed a junction. The site was particularly favourable for the manœuvre, the Russians being driven into a confined space formed by the river in their rear, which rendered retreat difficult. The French artillery losses in this portion of the field were only 3 officers and 52 men killed and wounded, and 53 horses. Each piece fired 72 round-shot or shell, and 12 case. The total number, therefore, fired by the artillery mass, was 3124 rounds.¹

In consequence of the decisive success of Senarmont's artillery manœuvres, Benningsen's left wing was completely defeated, and compelled to fall back in disorder to the banks of the Alle. Meanwhile the Russian right and centre had kept their ground with

¹ Owen's *Modern Artillery*, p. 427.

undaunted firmness. But when the retreat of the left had uncovered their flank, and when the French, pushing their advantage, gained possession of Friedland in their rear, and the bridges over the river, it was evident that the battle was irretrievably lost, and that the whole Russian army was in a condition of well-nigh desperate peril. Nevertheless, slowly and in solid order, they retired towards the Alle, keeping up a fire on the enemy, and turning on him with the bayonet whenever hard pressed. Benningsen, without losing his presence of mind in the midst of this terrible disaster, did all that prudence could suggest to repair the consequences of the error into which he had been drawn in the early part of the day. Having discovered a ford lower down the river, his army was drawn to the spot, and, by means of it, crossed over to the other side, suffering, however, fearful losses from the French artillery, which played heavily on the retiring masses. His losses were 17,000 men and 17 guns. Those of the French were 8000 men and 2 eagles. The next day, the 15th June, the Russian army retreated to Wehlau, and on the 18th reached Tilsit. On that day, however, the Emperor Alexander made overtures to Napoleon for an armistice, which ultimately resulted in the celebrated peace of Tilsit.

WAGRAM,¹ July 6, 1809.—Gained by the French

¹ See Jomini, Thiers, Alison, Owen's *Modern Artillery*, &c.

under Napoleon, over the Austrians under the Archduke Charles.

The Austrian army, 140,000 strong, occupied a position about ten miles north-east of Vienna, with its left on the elevated plateau of Wagram, its centre about the village of Aderklaa, and its right stretching towards Stammersdorf. It thus formed an immense concave semicircle, with its strength thrown into the two wings. The French were drawn up on the interior convex quadrant, nearly parallel to their enemy, with their columns issuing, like the folds of a fan, from the centre. Their total numbers were 180,000 men, and their main strength was concentrated on their centre and right.

At daybreak the right wing of the Austrians descended the slopes on which it was posted, and advanced against the left flank of the French army. The attack was completely successful. By 10 A.M. the assailants, preceded by 60 guns, had swept the whole of the ground in their front, and had captured several pieces of artillery. They then proceeded to drive back the French to the very edge of the Danube, and even pushed their advanced troops so close to Napoleon's bridges as seriously to endanger his line of retreat. In fact, his defeat appeared already effected. But while this splendid success attended the efforts of the Austrian right, their left, against which Napoleon had accumulated his forces under

Davoust, had undergone a serious reverse. The latter, having received the Emperor's directions to attack their enemy on the Wagram plateau, carried out these instructions with such skill and energy, that the Austrian left flank was compelled to fall back and to take up a position nearly at right angles to their original front. Thus the Archduke's line on the plateau was enfiladed, and the fire of the French artillery was so effectual that a large proportion of the Austrian guns on that flank were dismounted or silenced.

During the progress of these alternate successes and disasters, Napoleon had been making preparations for a crushing blow against his opponent's centre at Aderklaa, where an intermittent but fierce strife had been carried on since the beginning of the battle. For this purpose he had collected, in a convenient central spot, Raschdorf, a vast body of troops, consisting of Eugene's corps, strongly supported by cavalry, and preceded by 100 guns. These were launched straight against the centre of the Archduke, who, perceiving the danger with which he was menaced, promptly reinforced the threatened point. Nevertheless, the 100 pieces of French artillery, under the artillery officers Lauriston and Drouot, regardless of the cross-fire from the hostile batteries with which they were encountered, advanced at a trot to within about 1100 yards of their enemy, and then opened a crush-

ing fire, which was sustained with such rapidity for half an hour that it forced back the Austrian line immediately in front and dismounted several of their guns. Napoleon, taking advantage of the confusion, instantly pushed forward his infantry; and although the Archduke's centre was not actually broken, it was bulged in to a perilous extent. Once more the French attacking column resumed its forward movement, preceded, as before, by its terrible batteries; and then the Austrian general, despairing of maintaining his position—his left having been turned by Davoust, as already explained—gave directions for a general retreat. His right wing, whose success in the early part of the day had been so signal, was withdrawn from the posts they had so gallantly gained almost in rear of the French left, and the whole army fell back, slowly and in perfect order, towards Brunn. The French and Austrian losses were nearly equal, about 25,000 men killed, wounded, or missing on either side.

Although the grand artillery attack alluded to failed to break the Austrian centre, its success was sufficiently decisive to induce the Archduke Charles to withdraw from the contest.

It may be mentioned, that but for the failure of the Archduke John, thirteen miles distant, with 30,000 men, to comply with his brother's orders, and to march to his assistance as speedily as possible, the battle would doubtless have terminated in a glorious victory for the

Austrians. In consequence of their defeat, they demanded an armistice a week after, which ultimately resulted in a peace, signed at Vienna, October 1809.

FUENTES D'ONOR, May 3, 1811.—An indecisive victory gained by the English under the Duke of Wellington, over the French under Marshal Massena.

The French attacked the British right with extreme vehemence ; and a body of 3000 guerillas there posted having given way, our own regiments were thrown into disorder, and our flank pierced and turned. Under these perilous circumstances the Duke adopted that most delicate operation under fire of “changing front, right back,” with the whole of his right wing, the centre and left holding their original positions. This operation saved the day, and ended in the repulse of Massena ; but in carrying it out, Captain Norman Ramsay’s troop of horse-artillery was cut off and entirely surrounded by large bodies of cuirassiers under Montbrun. The occurrence, which has become a household word in the annals of the British Royal Artillery, is thus described in Napier’s ‘*Peninsular War* :’—

“Montbrun charged the British cavalry. The combat was unequal. By an abuse too common, so many men had been drawn from the ranks as orderlies to general officers and other purposes that no more than 1000 English troopers were in the field. The French,

therefore, with one shock drove in all the outguards, cut off Norman Ramsay's battery of horse-artillery, and came sweeping in upon the reserves of the seventh division. Their leading squadrons approaching in a loose manner were partially checked by the British, and then a great commotion was observed in their main body. There troopers were seen closing with disorder and tumult towards one point where a thick dust arose, and where loud cries, and the sparkling of blades, and the flashing of pistols, indicated some extraordinary occurrence. Suddenly the crowd became violently agitated; an English shout pealed high and clear; the mass was rent asunder, and Norman Ramsay burst forth, sword in hand, at the head of his battery. His horses, breathing fire, stretched like greyhounds along the plain; the guns bounded behind them like things of no weight; and the mounted gunners followed close, with heads bent low and pointed weapons, in desperate career."

SOBRAON, February 10, 1846. — Gained by the English, under Sir Henry Hardinge, over the Sikhs. The Sikh intrenched camp was bombarded by 36 heavy English guns for two hours before the infantry advanced to the assault. With regard to the effect produced by their fire, Sir Henry Hardinge thus expressed himself: "In confidence, I will say that if the 36 heavy guns had not been brought to bear, we should have been repulsed."

INKERMAN,¹ November 5, 1854.—Gained by the allied English and French forces over the Russians.

The Russians surprised the British army early in the morning under cover of a fog, planting 22 pieces of position, so that they completely enfiladed a portion of our camp before the troops could be assembled for its defence. They ultimately brought into line 94 guns. The British field-pieces, greatly inferior in number, and of a smaller calibre, only arrived gradually, and were compelled to come into action under a storm of shot, shell, and bullets, concentrated on a very narrow space. By degrees 36 of our guns were engaged, and this number was ultimately increased to 54 guns, of which 2 were 18-pounders and 12 were French pieces. The English guns were well posted, most of them just behind the crest of the ridge, so that little but their muzzles could be seen; and some of them were sheltered behind a low, half-finished breastwork, which accounted for these few escaping with only slight injuries to several carriages. The losses of most of the batteries were, however, severe; and the horses with the limbers and waggons in rear suffered heavily, the slope of the ground behind the ridge being nearly parallel with the path of any projectile passing over the crest. The front engaged was so narrow, and so constantly exposed to infantry attacks, as well as to pressure on the flanks, that it was

¹ See Owen's *Modern Artillery*, p. 440.

necessary to keep the horses and ammunition close at hand. Six British guns were captured by the Russian infantry, and three of them were spiked, but they were all retaken. Todleben says: "The English artillery in general sustained its infantry perfectly. It followed them everywhere, and opened fire at sufficiently close distances against the assailing columns of the Russians."

In this engagement the large artillery mass of the Russians failed to accomplish its object fully from not having been skilfully handled. They succeeded in bringing a large number of guns unobserved into position by dawn and had their light guns been pushed forward early in the battle, the English position would probably have been carried.

CAPTURE OF THE MALAKOFF at Sebastopol by the French, September 1855.—Two French field-batteries received the order to advance towards the curtain to support the attack. They galloped up and came into action in the most gallant and self-devoted manner, firing several rounds, and only retiring when they had lost the greater number of their men and horses, and were almost annihilated under the terrible fire of the more powerful Russian guns.

SEDAN, September 1, 1870. — Gained by the Prussians under the King of Prussia, over the French under Marshal MacMahon.

This battle has often been quoted as a striking ex-

ample of the power of large masses of modern artillery; and doubtless the conquerors chiefly owed their victory to the decisive and terrible effects produced by their guns. At the same time, it is to be remarked that, owing to the numerous tactical advantages possessed by the Prussians, together with their enormous superiority in point of numbers and of artillery, the defeat of the French was a foregone conclusion before a shot had been fired. The Prussians had only to pour a sustained fire from their vast assemblage of guns—posted in positions naturally the most favourable—into the masses of their opponents, cooped up into a small space, to inflict on them crushing losses, although, had their operations been less skilfully combined, a portion of the French army might perhaps have cut its way out either in the direction of Metz or Mézières. Therefore Sedan, unlike Friedland and Wagram, offers no example of a decisive success due solely or chiefly to the *skilful* employment of an equally-matched artillery force; for at Sedan this arm possessed in the first instance overwhelming advantages of numbers and position.

The French army, a little more than 100,000 strong, with about 440 guns, including 70 of those feeble weapons, mitrailleurs, occupied a position of an elongated horse-shoe shape, with its left resting on Givonne, its centre on Bazeilles, Balan, and Sedan, and its right sweeping round to Illy. In the time of

old smooth-bore guns, Sedan would have been a strong fortress; but to modern artillery occupying the heights around, it is to all intents and purposes an open town.

The Prussian forces, consisting of 220,000 men, with from 600 to 700 guns, were thus disposed: The Saxon army, under the Crown-Prince of Saxony, occupied the ground parallel to the French from before Givonne to Bazeilles. The army of the Crown-Prince of Prussia, taking up the line, extended from a point opposite Bazeilles, on the south side of the Meuse, to Donchery. At the same time, two Prussian corps were marched in the direction of Floing and Fleigneux, immediately opposite Illy, in order to attack MacMahon's right flank. The river Meuse flowed between the centres of the two contending armies.

The action was commenced at about 6.30 A.M. by a simultaneous attack by the Saxons against the French left, especially at Givonne, and by part of the Crown-Prince of Prussia's army against the centre at Bazeilles. After a brief but decisive combat, the French left wing was turned and driven in, crowds of fugitives hurrying into the woods, while others fell back on the now pressed centre; and by ten o'clock the victorious Saxons were pushing forward in the direction of Fleigneux to effect the concerted junction with the left wing of the Prussian army.

Meanwhile Bazeilles had been attacked by a brigade of Bavarians, who, being unsupported by artillery,

were repulsed. Then the town was vigorously shelled by the German batteries on the opposite side of the Meuse; and after it had been judged that its defenders were sufficiently shaken, the Bavarians once more advanced to the assault, supported by guns so posted as to be able to pour in a destructive cross-fire. The French, conscious of the vital importance of this point, clung to it with desperate tenacity, and repulsed their assailants with severe loss again and again, and for seven hours the fight surged backwards and forwards. At last, when the town had been reduced to a wreck, and had been set on fire in numerous places by the shells of the Prussians, and when the positions on the right and left rear were falling into the hands of the fast-accumulating Germans, the gallant defenders, fearfully thinned, relinquished their hold on Bazeilles, and gradually fell back on Sedan.

The turning movement of the two Prussian corps against the French right was also completely successful. The main defensive point of the French on this part was the Floing Spur. Here they had intrenched themselves, and had placed six mitrailleurs, which completely commanded the valley in front, so that, as the enemy advanced to the attack, whole masses of them were swept away. "The numerous Prussian graves on the slope . . . attest the severe loss they suffered; and in this solitary instance the effects of the mitrailleurs were confessedly superior to any which

could have been inflicted by common shell.”¹ Nothing could withstand a fire so murderous, and the Prussians at first fell back in confusion. Almost exactly opposite the French, however, and at a distance of about three-fourths of a mile, was a conical hill named the Mamelon d’Atoi, and “the position of the two Prussian batteries stationed here teaches an instructive and most interesting lesson to artilleryists. Here we see that twelve field-guns were posted with a judgment amounting to genius; so that while they themselves were in a great measure protected from fire on the reverse brow of the hill, their enemy was forced to choose between the alternative of being made a target of by the direct fire in their front, or of being sheltered from the latter by retiring to the crest, when they would have been enfiladed from their right. It is not too much to say that the successful attack on the Floing Spur, and consequently the decisive results of the battle, was in a great measure due to the effective fire from these two batteries.”¹ The Germans plied their artillery with vigour, and silenced the French guns; in consequence of which the Prussians once more advanced to the attack, and succeeded in gaining the position.

About the same time the Prussians turned the extreme right of the French near Illy, and pushing forward, joined hands with the Saxons advancing from

¹ From Sedan to Saarbrück, p. 40.

Givonne, thus completing the circle and deciding the battle. The subsequent events are too well known to need description.

Boguslawski says that the artillery of the Prussian left wing pushed on in front of the advanced-guards, notwithstanding the difficulty of ground, and surrounded the enemy before the infantry came up. The French masses advancing against the guns were brought to a standstill over and over again at 2000 yards. The ranges at which artillery-fire was employed in this battle varied from 700 to 3000 yards.

In support of the statement that the result of the battle could never really have been doubtful for an instant, may be quoted the following extracts from the Prussian official account: "Seventy-one German batteries (426 guns) in all combined their fire from three different sides upon the French army, which was now crowded together in a confined space. Not only their batteries and foremost lines of infantry, but also their reserves, moving backwards and forwards, and the masses of cavalry vainly seeking cover, were overwhelmed with such an iron hail that they fell more and more into disorder, and found their power of resistance wellnigh broken before they were even able to engage in the struggle. The fate of the battle was already to a certain extent decided by this deployment *en masse* of the German artillery, even without the further advance of the infantry. . . . So

annihilating was the fire of the artillery, that the French were scarcely capable of any organised resistance when the German infantry, towards 4 P.M., moved forward from all sides against the wood [of La Garenne].”

The great lesson of this battle is plain. It displays in a practical manner the extraordinary innate power of modern field-guns under favourable circumstances.

THE ARTILLERY FORCE OF THE CARLIST ARMY.—The following extracts from notes written during a residence with the Carlist army in the month of November 1875, may perhaps not be altogether uninteresting, as bearing on points connected with the most recent employment of artillery in the field—actually carrying on the operations of war:—

At Estella, near Pampeluna, the scene of a good deal of desultory fighting, Don Carlos’ artillery officers gave every facility for examining their batteries. Close to one of their outposts “is a detachment of gunners with some mountain-artillery—miserable little 3-pounder pieces weighing 150 lb., but which their owners regarded with a pride and confidence, I venture to think, far beyond their deserts. Still, their extreme lightness renders their transport along the rockiest paths and over the steepest mountains a mere bagatelle, the gun being carried on the back of one mule, the carriage on that of a second. On the breech are stamped the words

‘Joseph Whitworth.’ . . . Other three 9-pounders are of iron, rifled muzzle-loaders. I am not surprised to learn that they are importations from England, for both guns and ammunition are such an exact counterpart of the present Woolwich gun, that were a certain English battery with which I am acquainted to mount the Carlist weapon I am now alluding to upon our own carriages, the exchange would not be discovered, except from a little absence of finish about the breech. . . . I am informed that many of their artillery officers come over from time to time to England, and are in constant communication with private firms at Birmingham, with Sir William Armstrong and Sir Joseph Whitworth. They declare that the foundry of the latter is, as a private establishment, the finest of all that they have seen in Europe. As a matter of course, the vexed question of muzzle-loaders *versus* breech-loaders crops up; the latter for field-guns bears away the palm. The Carlist artillerymen urge, amongst other objections, that the muzzle-loading shell sometimes jams in the bore, and that the gunners are more easily picked off while loading.” On another occasion “I obtained permission to examine a Carlist field-battery more in detail than was possible during my visit to the outposts. The guns, six in number, had on the breech the usual engraving—‘Joseph Whitworth, Manchester, 1874, Patent, C. VII.’ [Charles VII.] They were

breech-loaders, calibre $1\frac{4}{10}$ ths inch, iron projectile, hexagonal, elongated, nearly flat-headed, fitting the bore mechanically, and weighing about 6 lb. The elevating-screw, sights, side-arms, and fittings are of the most primitive description; but the carriage, though rough, combines lightness with a considerable amount of strength. The gun-limber contains 102 rounds of ammunition; there are no ammunition-waggon, but in lieu each battery is accompanied by one 'general service waggon' conveying another 102 rounds per gun. The draught is pole, and is performed almost exclusively by mules, for which animals my appreciation increases with every day's experience. The complement of the gun detachment is six, the sergeant being mounted, two gunners seated on the axle-tree boxes, and three on the limber-boxes; and they declare this number to be amply sufficient. The maximum range is stated to be 6800 metres—7400 yards nearly; but as this involves an elevation of 30° , the range may be considered a fancy one. Moreover, owing to the very elevated positions above the plane of site from which these mountain-guns are fired, their projectiles sometimes attain exceptional distances. Theoretically, the time-fuze is in use with the Carlists; but practically, they restrict themselves entirely to the percussion-fuze, of which their pattern is simple and effective, though without the elaborate ingenuity of our own. Don Carlos' artillery officers swear by

their Whitworths, and of the two systems much prefer the breech-loading. There is a special keenness to model their batteries after those of the English artillery. The respect in which this branch of our service is held is remarkable; and even the private gunners, when they see a chance Englishman, inquire eagerly, 'Is he an artilleryman?' and if so, 'Is he going to take service with us?' How can we account for the want of further decisive success on the part of Don Carlos' army? Firstly, I imagine, because no general of conspicuous ability has been forthcoming to take the lead; while among the existing chiefs, incompetence, petty jealousy, and double-dealing reign supreme. Secondly, because the regimental officers are relatively inferior to their men. Thirdly, because Don Carlos is hampered to a maximum degree through want of funds — as a consequence, his artillery is crippled, and his power of assuming the offensive at critical moments fatally restricted."

As regards the wasteful expenditure of artillery ammunition, it was noticed that "the Carlists, unlike the Alphonsists, are reasonable enough to recognise the folly of throwing away cannon-shot on individual wayfarers. The practice embitters the peasants; and even if they do succeed in blowing a head off now and then, how can this in the slightest possible degree affect the results of the war?

The enemy [occupying the Alphonsist forts during the siege of San Sebastian] suddenly opened so prolonged and continuous a fire that at last the Carlists gave heed to it, and then I perceive how fully justified were Colonel de Cordova's assertions respecting their promptitude in emergencies. The shrill bugles re-echo amongst the mountains, signalmen stand up clear against the sky-line, the warning is waved from each peak, 'The enemy are advancing;' and in a few minutes, from every mountain-side, path, and road, knots of ten or twelve men are seen hurrying to the point indicated. The shells fly thickly; . . . but in course of time the Carlist bugles are again heard, but in a different note. The Carlists have discovered that all this tumult is an empty display, and their men are being summoned to dinner. I take advantage of a projecting ledge of rock to examine Oyarzun with my glass at my leisure. The rattle continues, and puffs of smoke throw a mist about the houses. But against what respectable Carlist force is all this directed? Against a few stragglers or outposts at the utmost. This day, indeed, has been thoroughly characteristic of the Alphonsist method of carrying on warfare. In order to avoid capture, we have been compelled to make a detour of nearly forty miles, although our line, from point to point, did not extend over half that distance. From 6.15 A.M. until 1.30 P.M., when I lost sight of

the combatants, the Alphonsist batteries have maintained as furious a cannonade as though they were putting forth their strength for some end which must be attained at all hazards. High and low, right and left, far and near, their shells were flying about in every direction. In vain did I endeavour to ascertain at what they were firing. True, at one time eight or ten of these missiles would come thumping against some massive Carlist earthwork, and, ill directed, would cause chance wayfarers like ourselves to hurry their steps—true, a chance shot might drop amongst a small picket and disable two or three men; but the Alphonsists, though strong in comparative numbers and concentration, never backed up this flashy display by quitting the shelter of their parapets, and by a rough onset against the scattered defences of their foes. Surely this prodigal expenditure of the most costly munitions of war is against the very first principles of artillery practice, and can but result in a justly daily increasing contempt on the part of the Carlists for the powers of destruction of their enemy.”

[It is to be noted that the Carlist troops were ultimately defeated and dispersed, not owing to any deficiency of bravery or skill in their gallant army, but because they were absolutely crushed by the overwhelming superiority of force brought against them by the Alphonsist Government.]

CHAPTER IV.

GRADUAL DEVELOPMENT AND PRESENT CONDITION
OF ARTILLERY.

EARLY HISTORY AND SUBSEQUENT PROGRESS—RECENT REMARKABLE IMPROVEMENTS IN ARTILLERY—PRACTICAL APPLICATION OF THE SCIENCE OF ARTILLERY—REQUISITES FOR THE EFFECTIVE EMPLOYMENT OF ARTILLERY—COMPARISON BETWEEN ENGLISH AND FOREIGN FIELD-ARTILLERY.

“I shall therefore close this paper with predicting that whatever State shall thoroughly comprehend the nature and advantages of rifled barrel-pieces, . . . will by this means acquire a superiority which will almost equal anything that has been done at any time by the particular excellence of any one kind of arms, and will perhaps fall but little short of the wonderful effects which histories relate to have been formerly produced by the first inventors of firearms.”—Extract from Robins' ‘New Principles of Gunnery,’ 1742.

THE history of artillery may be divided into three ages—the dark, the middle, and the golden age. For many years after the invention of gunpowder, the value of its application for warlike purposes was little appreciated. Tradition states that cannon were first used at Crecy, 1346; but even admitting the fact, it is probable that they were so rude in their construc-

tion as to have been scarcely more effective than a dozen smooth-bore muskets of the nineteenth century. Indeed, for many generations afterwards, there seems to have been a contempt and hatred for "villanous saltpetre dug out of the harmless earth" akin to the feelings with which we now regard the use of explosive bullets or Greek fire. Gradually, however, the new science made its way. Bows, bills, and, last of all, the dearly-loved weapon the pike, were discarded, and firearms were adopted in their place. It is singular that among the earlier types were many breech-loaders, and that "organ guns" were in use resembling in principle the modern mitrailleuse. Thus have the first glimmerings of invention and the perfect development of mechanical science joined hands.

The great obstacles to the vigorous development and application of artillery arose less from the imperfections of the weapon itself—which in essential features differed little in 1650 from that of 1850—than from its imperfections in *matériel* and method of transport. So destitute were the guns of our ancestors of mobility, that to drag them forward in the field of battle at a foot's-pace in front of the infantry, to limber them up after they had once come into action, or to shift them to new positions, were Herculean tasks; so that troops once beaten back in any engagement generally lost a large proportion of their artillery. In point of mobility the English were even

behind their neighbours. Macaulay, in his 'History of England,' says, that when, in 1688, William III. marched from Devonshire to London, the apparatus for transporting artillery which he brought with him, though such as had long been in constant use on the Continent, and such as would now be regarded at Woolwich as rude and cumbrous, excited in our ancestors an admiration resembling that which the Indians of America felt for the Castilian harquebuses. Again, at Blenheim in 1704, Marlborough having taken up a position with his left wing to attack the French right, was forced to remain inactive from 8 A.M. until 12.30, because his right wing under Eugene, which had marched at the same hour, and had to accomplish four or five miles extra, was unable to bring up sooner his cumbersome artillery into the line of battle. At this date the appliances for serving guns were rude to a curious degree. Cartridges for cannon were not in use, the powder being shoved in with an iron ladle; there were no handspikes and no elevating-screws; and when elevation was required, the point of the trail was lowered into a hole dug for the purpose.

About the middle of the eighteenth century, Frederick the Great applied himself with such energy to the improvement of his artillery, and other nations, England excepted, so actively followed his example, that the middle age of the science may be said to

have begun at this period. By degrees guns were formed into batteries, though there was still a certain number of battalion guns—two per regiment; light field-batteries, with greatly-increased mobility, and horse-artillery (Prussia, 1759), were established; a distinct corps of artillerymen was told off to serve them, and their general equipment was much improved. The English artillery, however, continued much neglected; and it was not until the beginning of the present century that it was organised on an efficient footing. Then it made a sudden start; and after having been trained by the long and valuable experience of the Peninsula war, attained a high degree of efficiency. During the long peace subsequent to the battle of Waterloo it was reduced to a condition of atrophy and inefficiency—to a mere shadow of its former vigorous strength—but which has rendered more striking the era of unexampled improvement by which it was to be succeeded.

RECENT REMARKABLE IMPROVEMENTS IN ARTILLERY.
—The golden age began to dawn upon us about the year 1854. The requirements of the war with Russia then caused all the departments of field-artillery to be brought up to a strength and standard of perfection never before attempted, and which, with some improvements and modifications, are maintained at the present day. At the same time, rifled small-arms were universally introduced; and hence the absolute

necessity of adopting some system of rifled ordnance which should restore the superiority in range of guns over small-arms became apparent to the minds of most artillery officers. Here theory—and a theory which subsequently proved sound—had been for many years in advance of practice. It had been proved that the power of guns would be immeasurably increased by imparting to their projectiles a rotatory motion; and it was confidently asserted that this desideratum depended simply on improvements in our manufacturing science which were well within our grasp. On the other hand, it was argued that an essential property of iron being a capricious uncertainty of strength, guns could never be made sufficiently strong to resist invariably the strain on them caused by giving rotation to an iron projectile; while the expense of leaden projectiles altogether excluded them from consideration. This problem—the problem of an advance in manufacturing knowledge—was practically solved by Mr (now Sir William) Armstrong. By his invention of constructing barrels for ordnance by coiling bars of heated wrought-iron round a mandrel, as explained in page 6, and by shrinking on hot tubes over the cold inner barrel, he built up a weapon sufficiently strong to resist any strain to which it could be subjected; and by coating an iron projectile with lead, he disposed of the question of ruinous expense. In 1860 the first Armstrong guns were introduced into

our service, and gave results, on the practice-ground, as well as against an enemy in New Zealand and China,¹ which exceeded the most sanguine anticipations, and which, in spite of a few defects, still constitute it an admirable weapon. During the sixteen years which have since elapsed, many modifications and improvements have been introduced into the original Armstrong gun; and at the present date even the system has been altered, studded iron projectiles and muzzle-loaders having been substituted for lead-coated projectiles and breech-loaders. But it should not be forgotten that to Sir William Armstrong is due the great honour of having taken the initiatory successful steps in the introduction of rifled ordnance into the British service, of having thrown light on many points of practical gunnery previously enveloped in darkness, and of having solved perplexing mechanical difficulties, after much patient and laborious investigation. Sir William Armstrong may, in fact, be justly called the father of English rifled ordnance.

PRACTICAL APPLICATION OF THE SCIENCE OF ARTILLERY.—There is reason to believe that since the year 1860 the science of the practical application of artillery in the field has by no means kept pace—in England,² at all events—with the improvements in its

¹ See Incidents in the China War of 1860.

² In Prussia, the shortcomings of any branch of their service is barely admitted. *Vide* their current military publications for the last five years.

construction and organisation. True, we look to our artillery to accomplish much; but we employ it in a cramped, limited method, and are far from making full use of it. We have, as it were, called up a stupendous power; but we are apt to dally with it, and seem to ignore its efficiency for performing the mighty deeds of which it is capable. I do not presume to attempt to propound the details of the manner in which this deviation of principle should be rectified. I would merely urge that the examples of warfare, and especially those of the present century, all teach us that the most effectual means of striking a decisive tactical blow, of obtaining a brilliant tactical success, are to be discovered in the skilful employment of artillery masses, or, to speak more precisely, in the sudden convergence of an overpowering artillery-fire upon a vital point. In support of this assertion may be quoted Napoleon's successes at Friedland and Wagram—see pp. 141, 145; and from what he then accomplished with his comparatively feeble smooth-bore guns, which stood in the same relation to the old musket as the modern rifled pieces bear to modern small-arms, may it not be fairly deduced that similar results would attend similar tactics? Napoleon's leading idea in all his great battles was to bring to bear an overwhelming force against a decisive point—a principle the soundness of which is still fully recognised. Now, is it possible to turn to a more effectual agent for this

purpose than to the artillery? Yet, instead of thus utilising this source of giant strength, our wont is to fritter it away in fragments amongst infantry brigades—unquestionably effecting somewhat here and somewhat there, but at no one point concentrating its full powers. Of all armies in the world, it behoves us to make the utmost possible use of our artillery. Our infantry and cavalry, however excellent in quality, will in quantity never be more than a mere fraction of the vast hosts of the Continental armies with whom we shall be called on to contend if we are engaged in a European war. But we may to a great extent compensate for this enormous disproportion by our powerful artillery, which, by no means contemptible in numerical strength, is admirable in point of mobility, efficiency of equipment, service in the field, and destructive effects of fire. Thus it is especially capable of bringing all its powers to bear so as to paralyse the enemy in one vital point, relegating chiefly to the infantry the duty of keeping the enemy at bay in the less vulnerable parts of the field. Here I cannot forbear from suggesting that for an infantry or cavalry officer to handle a mixed force efficiently, it is surely essential that he should have previously turned his attention in some degree to the science of artillery—not, indeed, to the theories of initial velocities and resistance *in vacuo*, nor to the details of fuzes and friction-tubes, but to its practical service. Surely

a man can no more intuitively comprehend the working of this arm than he can intuitively comprehend the working of a telegraph machine or the management of a steam-engine ; yet, practically, this necessity has hitherto been almost ignored.

REQUISITES FOR THE EFFECTIVE EMPLOYMENT OF ARTILLERY.—For the due development of artillery there are three essentials, which in the British service have hitherto practically been little recognised.

1st, The provision of a reserve of batteries as a separate body, to be at the disposal of the chief of the artillery, under the commander of the army. To rely in any great measure on the power of collecting the divisional artillery for the purpose would be unsafe, because the delay which might ensue must deaden the force and mar the suddenness of the blow, even if by giving the enemy time for preparation the attempt be not rendered altogether nugatory.

2d, A readiness on the part of all artillery officers, especially those in the higher ranks, but extending even to the juniors, to take the initiative of action, and to assume unhesitatingly a weight of responsibility at the critical moment. At present, their frequent practice seems to be, to acquiesce in being “lumped together” with a number of infantry battalions—in “conforming to their movements”—in being bound by their rules—and in ignoring the superior powers of their own weapon. If an artilleryman, chaf-

ing at these vicious principles, seeks to break through them, he is not unfrequently made to subside from the cold water thrown on him, at the implied opinion that he is officious and obstructive, that he wants to swamp the other troops, and that "the artillery are always in the way." It is scarcely too much to assert that it is for the interest of the service and the success of our arms that gunners should steadily insist on their superior knowledge in all that concerns the working of their special arm.

3d, The maintenance of our field-artillery, on a footing efficient in numbers, equipment, and organisation. An infantry soldier can, under pressure, be drilled fairly into shape in a comparatively short time by an extra amount of instruction compressed into the twenty-four hours; with artillery recruits this is not equally applicable. It is evident that to teach a man merely to load and fire a gun is the work of a few days; but this automaton faculty will not constitute him an artilleryman. He will be worse than useless unless he has been taught, in addition to the elementary duties of a soldier and the first principles of foot-drill, the whole of the diverse duties of an entire gun detachment, and the uses of the numerous and complicated natures of ammunition; and unless he has been so thoroughly habituated to work his gun, that under all the circumstances of smoke, turmoil, and excitement inseparable from artillery in action,

he can perform his functions with steadiness and presence of mind, without which guns become simply elements of disorder. No amount of drill crammed into a short time by instructors, however intelligent and zealous, will impart the above qualifications ; they are to be acquired only by a long familiarity with the use of guns and the practice of gunnery, until at last it becomes part of the man's nature to perform his duties almost unconsciously. This training cannot be effected under ordinary circumstances in a shorter period than one year. *Mutatis mutandis*, the same argument applies to the teaching of drivers.

COMPARISON BETWEEN ENGLISH AND FOREIGN FIELD-ARTILLERY.—We may justly regard with feelings of pride the present condition of our artillery, which, in point of general efficiency, is unsurpassed by that of any other nation. This statement would be presumptuous were it not supported by an irrefragable amount of testimony both from friends and foes. Of late years the numerous foreign officers who have visited England for the purpose of making themselves acquainted with our army, many of them by no means prejudiced in our favour, have admitted that our batteries have in almost every respect attained a pitch of excellence closely akin to perfection. At the Salisbury manœuvres of 1872, the representatives of Prussia gave as their verdict of our troops : Infantry, good ; cavalry, very good ; artillery, absolutely incomparable.

In 1874, when in Prussia, I expressed to an experienced Prussian officer, in answer to his inquiries, my admiration for their infantry and cavalry; but I plainly stated that I did not consider their artillery quite up to the mark, whereat he was somewhat ruffled—the usual consequence, I have noticed in Germany, of the most delicate hint that there is ever so small an imperfection in any portion of their army. When, however, a bystander asked, “Then, is the English artillery really so very good?” his sense of justice prevailed; and after an evident mental struggle he replied,—“Yes; I must confess that it is most excellent. Men, horses, and equipment are turned out in a condition of perfection. Not a single article is out of its place or is ill-fitting. The guns and the horses are a marvel of cleanliness, while the iron-work on the latter is made to glitter like silver. In fact, to properly appreciate a battery of English artillery, you must yourself have seen it. Their working in the field is equally good.”

The above opinion was further confirmed by a somewhat unfriendly article in the ‘*Militair-Wochenblatt*’ of 25th December 1874, wherein it was admitted, with reference to our artillery: “It is certainly an incontestable fact that in their dress and equipment a splendour reigns of which our means do not admit. . . . An eye which is accustomed to the really graceful appearance of an English

battery on parade will certainly miss much in ours. We have not time to polish the trace-links and head-collar chains, the axle-tree arms, and all the iron-work of the equipment, so that they shine like silver. Our horses must be more used, and owing to the insufficient establishment of our batteries, cannot be saved so as to be as fat as they are in England; our method of draught, in addition to being suitable to the country, offers many advantages over the English. With regard to the treatment of the leather-work, there is certainly something to be required, and the English method might be tried."

I must now leave the reader to determine whether I have made good my statement that by more carefully turning our attention to the value of an arm which we possess in such perfection, by a more careful appreciation of the capacity of artillery skilfully handled, we may develop its innate power to an extent which we can as yet scarcely realise, and may be enabled to compensate to no inconsiderable degree for the numerical inferiority of the other branches of our service.

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