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INSTRUCTION

IN

MILITARY ENGINEERING.

PART II.—ATTACK AND DEFENCE OF FORTRESSES.

COMPILED AT THE SCHOOL OF MILITARY ENGINEERING, CHATHAM.

FIFTH EDITION.

1896.

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THIS book, embodying a portion of the course of instruction at the School of Military Engineering, Chatham, is published for general information and guidance. The system of instruction herein laid down is to be strictly adhered to.

H Wolseley

Commander-in-Chief.

WAR OFFICE,
June, 1896.

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INSTRUCTION IN MILITARY ENGINEERING.

PART II.

THE ATTACK AND DEFENCE OF FORTRESSES.

SECTION I.—INTRODUCTION.

Reasons for great changes in future siege warfare.

1. WITHIN the last few years immense changes have taken place in the construction and use of war material, of so sweeping a character, as to entail a complete revolution of all our previous ideas of attack and defence. This is, more especially, the case with regard to siege warfare, as will be evident when we consider, in detail, only a few of those changes.

Innovations in materiel.

2. The two special innovations which have done more than any others to force corresponding alterations in the conduct of siege warfare are, 1stly, The possibility of using, with great accuracy, the curved fire of howitzers, descending at a very steep angle; and, 2ndly, The introduction of high explosive bursters for shells.

Howitzers.

3. The present position of the howitzer has come about in this way:—With the introduction of rifled guns a means of correcting errors in shooting was put into the hands of the artillerist, of so far-reaching a nature, that soon the gun could place its projectiles, with almost unerring certainty, on any upstanding target within range, that was visible to it. This fact, which would be much discounted in the hurry and unpreparedness of a general engagement, would be much less affected in the precise and well-considered arrangements of a siege, and it soon became apparent that if two guns were put up to attack one another, with direct fire, at effective ranges, in such operations, a very short time would elapse before one, or both, would be out of action. Every attention was therefore directed to the possibility of hiding the guns, without impairing their efficiency, and the value of curved fire, if it could only be properly controlled, became, at once, evident. Furthermore, the use of a light howitzer, in the place of a heavy gun of equal shell power, was a matter for consideration as regards transport. The controlling of curved fire from howitzers has been a long and tedious business, but the introduction of a breech-loading, instead of a muzzle-loading, howitzer has finally so improved the shooting power of these pieces, that the B.L. howitzer has practically ousted the gun as the siege piece of the future, both in attack and defence.

Effects of the introduction of howitzers.

It is difficult to appreciate, at first, what vast differences the introduction of accurate curved fire has entailed on all future siege operations. The batteries of the attack and defence will probably no longer be visible to one another; they will be constructed in hollows or folds of the ground, or behind existing cover, from which their fire on any invisible target will be controlled from observing stations, not necessarily near the batteries themselves.

The batteries of the attack will have the forts, and possibly armoured defences, to aim at; those of the defence will, apparently, have nothing to aim at, as a target, in most cases. The immensely penetrative power of long shells, descending at steep angles, will render many of the existing forts, until remodelled, untenable. Shells will be rained upon them with such accuracy that nearly all will fall, with certainty, within the area of an ordinary-sized fort; and the attacking troops will be able to approach quite close to the forts, which are being bombarded, without fear from their own shells.

Furthermore, the two opposing artilleries will be firing at one another well over the heads of their infantry; and as the accuracy of modern howitzer fire allows of breaches being formed at long ranges, the former necessity for bringing guns up close to the forts is done away with. The infantry themselves will be fighting between the two zones occupied by the hostile artillery, and will, as in other warfare, consist of two opposing bodies, (though probably in this case intrenched), the one retiring, and the other gaining ground, or *vice versâ*, as either party succeeds.

Effects of high explosive shells.

4. The introduction of shells, filled with high explosives, is the second very important change of materiel mentioned above. These shells, very long in proportion to their diameter, of forged steel, have a large capacity, and carry an explosive about four times as powerful, weight for weight, as gun powder. Their effects for demolition purposes, when they descend at high angles, are enormous. Ordinary earth cover is useless, and most modern forts, unless strengthened and remodelled, would soon be wrecked by them.

Effects of howitzers and high explosive shells combined.

The use of curved fire, combined with high explosive shells, demands an entire modification of all the ordinary siege works of attack and defence, which it is our object in this book to explain.

Division of the subject.

5. When we begin to consider the attack on, and the defence of, a fortress we are at once confronted by a difficult question as to which of the two sides of the subject should first receive our attention.

The attack and the defence are mutually dependent, the one, on the other, and always must remain so. In order to attack successfully, we must have a considerable knowledge of the type of defences and of the materiel and personnel that have to be overcome; and similarly to defend, successfully, we must be acquainted with the probable method of attack.

There would necessarily be confusion if the two sides of the subject were approached simultaneously, and the difficulty, as mentioned, must therefore remain, on the understanding that the one portion of the book hangs on the other, and that all must be read, before the meaning of many parts can be properly grasped.

With this explanation, it is proposed to treat the subject in the following order :—

I.—A short description of MODERN FORTRESS DEFENCES in so far as they are likely to influence the attack.

II.—The ATTACK OF A MODERN FORTRESS.

III.—The DEFENCE OF A MODERN FORTRESS.

SECTION II.—MODERN FORTRESS DEFENCES.

General systems of defence.

6. It is not proposed to enter into a detailed description of the different systems of defence that have been suggested, or even of those systems that have been put into practice, but merely to describe the general types of defences that are used now-a-days, so that some idea may be formed of the targets, or objects, that are offered to the attack.

In all these systems of defence one general idea prevails, viz., that a certain belt of ground, which forms a rough circumference to an important central position, is occupied by works, as pivots of a main defensive position, so that to gain access to, or to bombard the central position, an attacker must, first, either capture or silence a certain portion of these works.

It is in the method of occupying the defensive belt that differences occur. The three most common methods are—(*a*) by strong forts, containing a certain number of heavy pieces of artillery, protected by armour, with others in the intervals between the forts, which latter occupy tactical positions specially strong from an artillery point of view, and partly so from an infantry point of view—(*b*) by strong forts in which heavy artillery (without armour) *can* be mounted, if thought advisable, but of which the artillery armament is usually placed in the intervals between the forts, the latter occupying sites which have the same tactical advantage as in (*a*)—and lastly (*c*) by storm-proof infantry works designed so as to bring out the full effects of close range infantry fire, and occupying sites specially strong from that point of view, whilst no arrangements for heavy artillery are made inside the forts, but all such pieces are outside in the intervals. In (*a*) and (*b*) the fort is designed to take more or less of a part in the distant struggle, in (*c*) its action is limited to the close attack and the flanking of the intervals between itself and its neighbours.

With either of these, field defences of all kinds would be combined so as to strengthen the intervals between the forts, and so form, as far as possible, a main defensive line which could not be taken without resorting to all the delays of a

regular siege. In actual practice these three methods of occupying the main defensive belt merge one into the other, but the distinction, as shewn, is one of the best to bear in mind in considering an attack.

The probable arrangements of the main defensive line are the objects of chief interest to the attacker, but he will have, as well, other obstructions to overcome, the details of which will be more fully explained, later on, in Sec. X.

Advanced defences.

7. Where the garrison is strong in numbers or moral, in all probability an advanced position will be taken up by them, a mile or more in front of the main defensive belt, to be occupied by infantry and light guns under cover of field fortifications, so as to meet the attack at a point as far to the front as possible. The artillery on the main position would be able to support their own infantry in this advanced position in the same way as the artillery of the attack supports the advance of its own infantry as described, later on, in Sec. III. The future siege will, in fact, differ but little from the defence and attack of any other position, except that probably more time will be spent over it. In both cases the infantry will be advanced to the front or kept at the front, under the cover of artillery in their rear; and until a superiority on the part of the artillery on one side or the other has been arrived at, no material advance of the infantry, the main factor of attack and defence, can be made.

(a) Forts with Armoured Defences.

Armoured defences.

8. It is probable that in the future the major portion of the artillery of the defence will consist of howitzers, but there must always be a small proportion of direct-firing guns for use in the distant and close defence; in the distant defence to keep the enemy's investment line on as large a circumference as possible by the fire of heavy long range guns; in the close defence to sweep the intervals between the forts by fire from light guns.

9. It has long been a recognized fact that to make a target of artillery, by placing it in a fixed uncovered position in a fort, means its rapid extinction. Where therefore it has been determined to retain guns inside the forts, after the besieger's heavy artillery has come into action, they must be covered by material protection, such as armour and concrete, capable of resisting the blows of the most powerful projectiles that can be launched against it.

Some continental nations have adopted such armoured defences inside their forts, and they must therefore be looked upon as possible targets and be studied as such.

These armoured defences for artillery are usually circular in plan; the larger types contain as a rule two heavy pieces, the smaller types one light one. They are known as *cupolas* or *tourelles*. Those for the heavier pieces have hitherto only had a rotary motion, those for the lighter pieces have the rotary motion, but are also of a disappearing type, *i.e.*, the cupola with the gun in

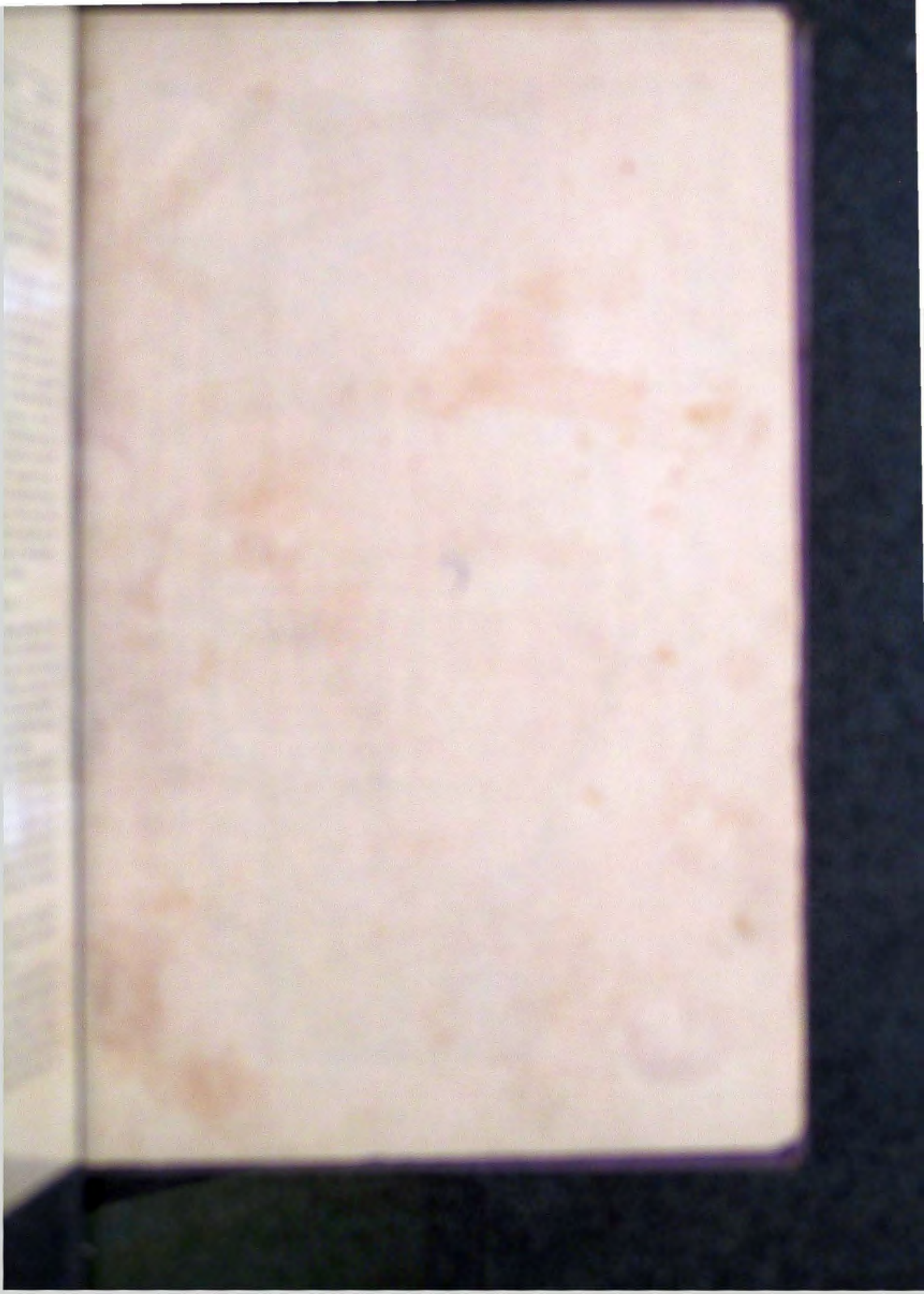
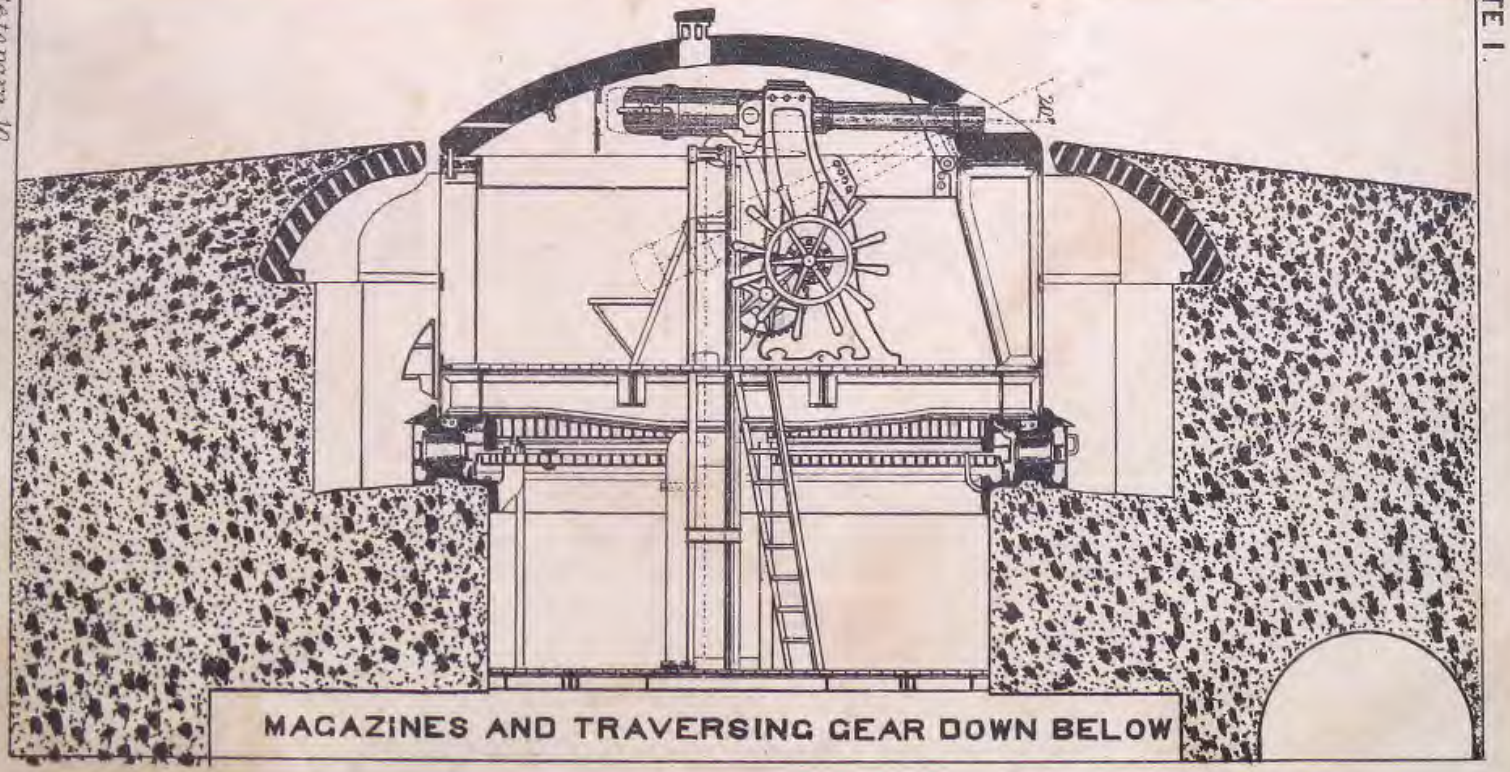


PLATE I.

CUPOLA FOR TWO 5 INCH GUNS



Opposite to para 10.

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MOVABLE SHIELDED MOUNTING FOR 6 PR. Q.F. GUN.

PLATE 3.

MOVABLE SHIELDED MOUNTING FOR 6 PR Q.F. GUN.

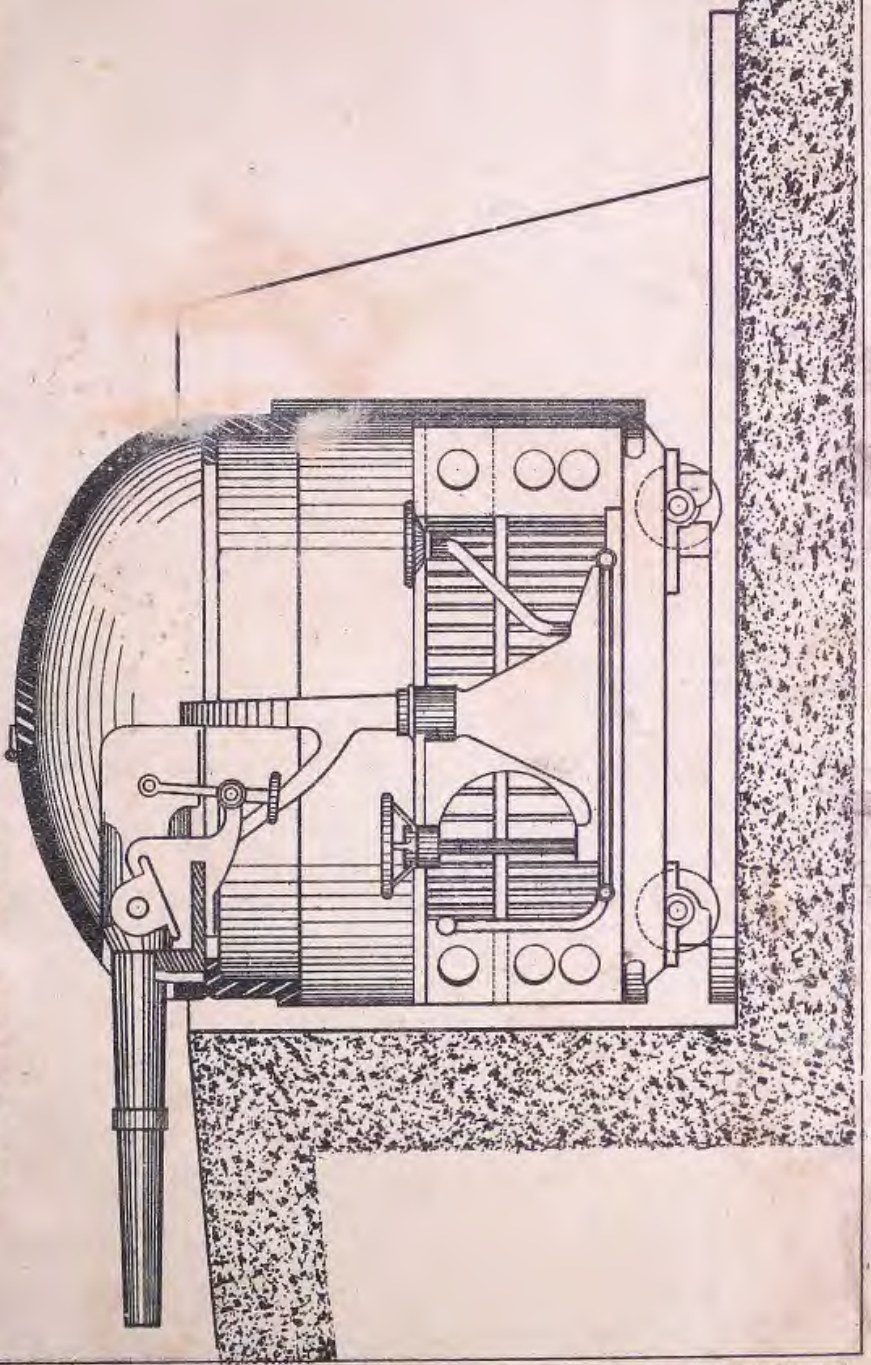

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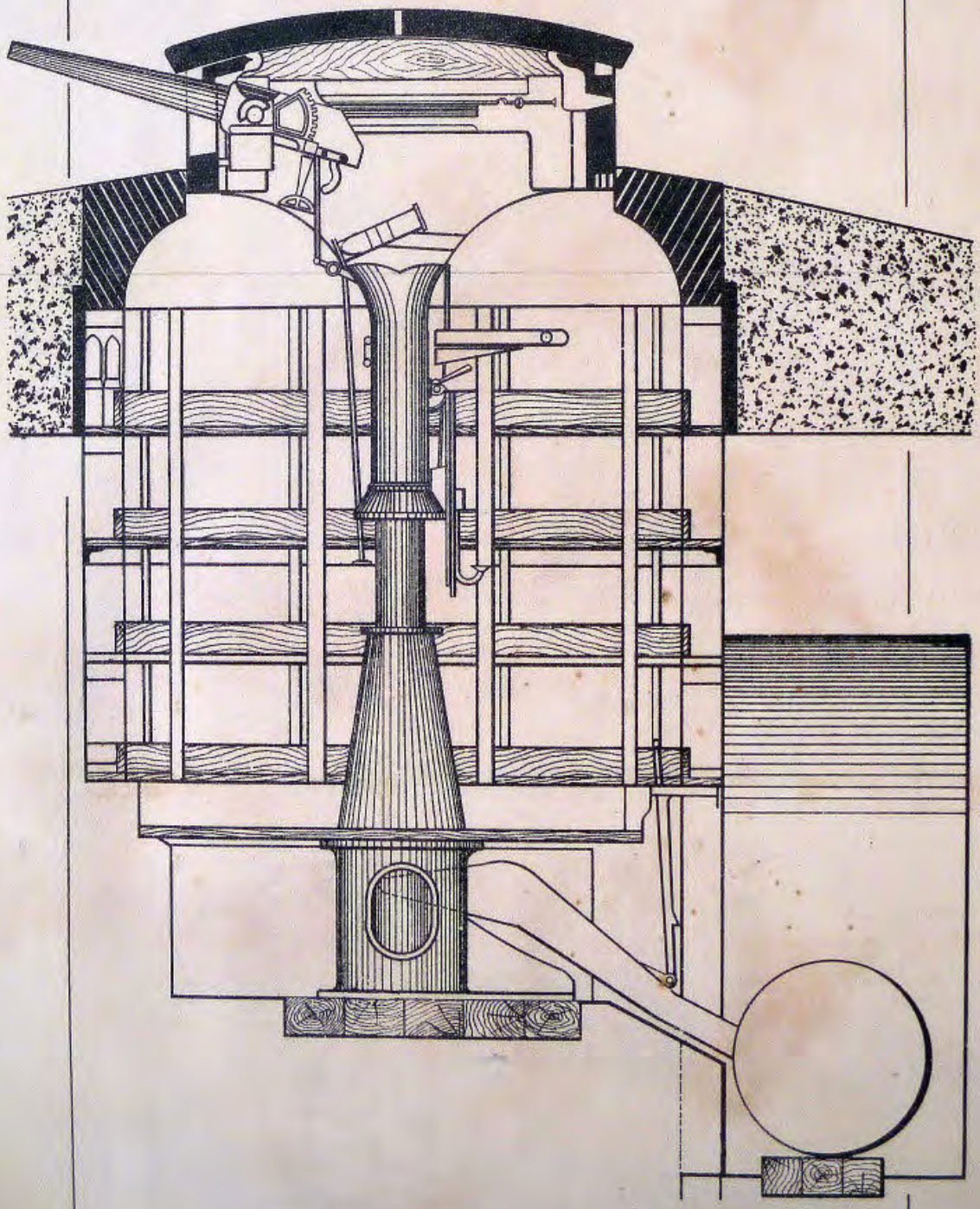
PLATE 2.

DISAPPEARING SHIELDED MOUNTING FOR 6PR Q.F. GUN.



Opposite to para. 11

it is raised by machinery so as to fire, and then is lowered again so that little or nothing appears above the surrounding ground. In the most recent cases disappearing cupolas have been designed for the heavier pieces also, and it is probable that, if the use of armouring is continued, all future cupolas will be of the disappearing type.

Cupolas for heavy guns.

10. Plate 1 shews a typical cupola for two heavy guns on the non-disappearing principle. The top of the cupola is a saucer-shaped dome of wrought-iron, in which the gun or guns are muzzle-pivoted. The cupola, guns, and mountings can all be revolved, on live rollers, by means of traversing gear down below. To protect the gun and the machinery a ring of chilled cast-iron (*avant cuirasse*), embedded in very hard cement concrete, encircles the cupola, allowing the latter to revolve freely inside it. The guns can, as a rule, only be elevated to about 20 degrees, but there are also designs for similar cupolas for howitzers which allow of very high angles of elevation. Whether there is any use in mounting howitzers in this way in forts, or any likelihood of finding them so mounted, appears very doubtful. We know that many guns are so mounted, and they are therefore objects of interest.

There are usually three or more cupolas in a strong fort, and they are to be found in the centre of the fort, immediately in rear of the edge of a high upstanding mound of earth. No doubt plans of the different forts would be supplied to the attacker's artillery, and the cupolas being fixtures, there should be no difficulty in ranging exactly on to them, as the burst of each shell, on such an upstanding target as a fort, could be easily located.

Cupolas for light guns.

11. For light Q.F. guns for the individual defence of the fort, and for sweeping the intervals, disappearing cupolas or tourelles are often employed as shewn in Pl. 2. When not in action the gun can be withdrawn and the cupola lowered by means of a counterbalancing weight, the top resting on the encircling ring. These guns being intended to resist the close attack, might very likely be difficult to silence, unless they could be attacked by heavy shells. They are generally to be found at the salient angles of the faces and flanks of a fort, or on the flanks themselves, where they can deliver a good all-round fire. Their small size makes them very difficult to hit, and would entail a large expenditure of ammunition.

Movable shielded mounting.

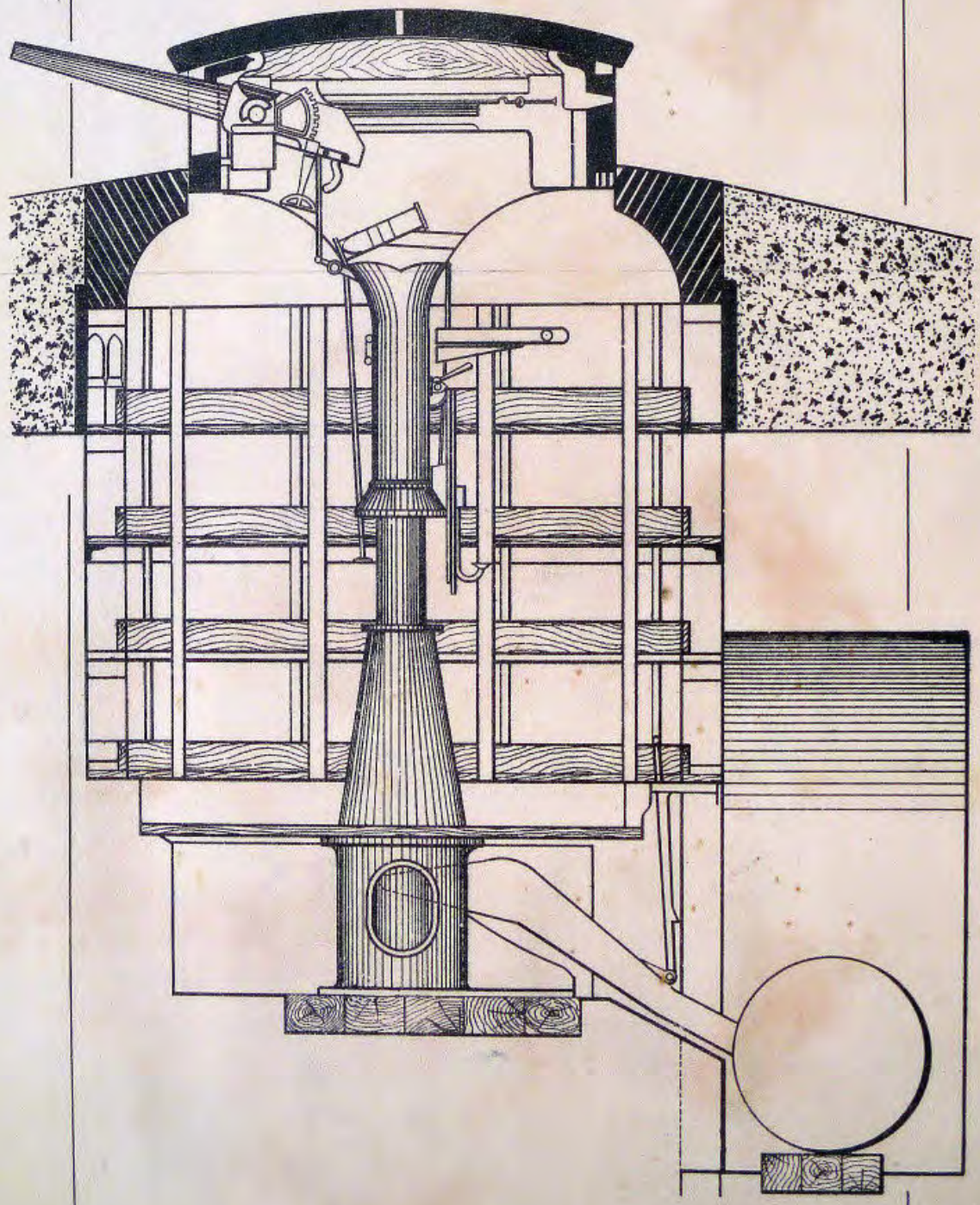
12. Another type of shielded mounting for Q.F. guns is shewn in Pl. 3. It is movable, and would probably travel on rails behind a concrete parapet, on the flanks of a fort. It would also form a very small target for field guns, and from its power of moving from point to point would probably be difficult to silence. The roof, with the gun, rotates on the lower portion of the mounting.

Other armoured defences.

13. Of other types of armoured defences in a fort we may possibly have to do with armour-faced counterscarp galleries, or

PLATE 2.

DISAPPEARING SHIELDED MOUNTING FOR 6PR Q.F. GUN.



Opposite to para. 11

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it is raised by machinery so as to fire, and then is lowered again so that little or nothing appears above the surrounding ground. In the most recent cases disappearing cupolas have been designed for the heavier pieces also, and it is probable that, if the use of armouring is continued, all future cupolas will be of the disappearing type.

Cupolas for heavy guns.

10. Plate 1 shews a typical cupola for two heavy guns on the non-disappearing principle. The top of the cupola is a saucer-shaped dome of wrought-iron, in which the gun or guns are muzzle-pivoted. The cupola, guns, and mountings can all be revolved, on live rollers, by means of traversing gear down below. To protect the gun and the machinery a ring of chilled cast-iron (*avant cuirasse*), embedded in very hard cement concrete, encircles the cupola, allowing the latter to revolve freely inside it. The guns can, as a rule, only be elevated to about 20 degrees, but there are also designs for similar cupolas for howitzers which allow of very high angles of elevation. Whether there is any use in mounting howitzers in this way in forts, or any likelihood of finding them so mounted, appears very doubtful. We know that many guns are so mounted, and they are therefore objects of interest.

There are usually three or more cupolas in a strong fort, and they are to be found in the centre of the fort, immediately in rear of the edge of a high upstanding mound of earth. No doubt plans of the different forts would be supplied to the attacker's artillery, and the cupolas being fixtures, there should be no difficulty in ranging exactly on to them, as the burst of each shell, on such an upstanding target as a fort, could be easily located.

Cupolas for light guns.

11. For light Q.F. guns for the individual defence of the fort, and for sweeping the intervals, disappearing cupolas or tourelles are often employed as shewn in Pl. 2. When not in action the gun can be withdrawn and the cupola lowered by means of a counterbalancing weight, the top resting on the encircling ring. These guns being intended to resist the close attack, might very likely be difficult to silence, unless they could be attacked by heavy shells. They are generally to be found at the salient angles of the faces and flanks of a fort, or on the flanks themselves, where they can deliver a good all-round fire. Their small size makes them very difficult to hit, and would entail a large expenditure of ammunition.

Movable shielded mounting.

12. Another type of shielded mounting for Q.F. guns is shewn in Pl. 3. It is movable, and would probably travel on rails behind a concrete parapet, on the flanks of a fort. It would also form a very small target for field guns, and from its power of moving from point to point would probably be difficult to silence. The roof, with the gun, rotates on the lower portion of the mounting.

Other armoured defences.

13. Of other types of armoured defences in a fort we may possibly have to do with armour-faced counterscarp galleries, or

armoured caponiers in the ditch. These require no special description for our present purpose.

Furthermore we may expect to find armoured defences for the installation of the electric light. These consist as a rule of disappearing tourelles very much like that shewn for the Q.F. gun in Pl. 2. They would be placed in a high position in the fort, probably on the top of the central traverse, if such existed. When once accurately ranged on by the attack their use by the defence would appear to be a very difficult matter.

(*b*) *Forts, prepared for heavy artillery, without armoured defences.*

Forts without armoured defences.

14. It is not probable that any forts will, in the future, be constructed on this plan, but many are still in existence, and therefore must enter into our considerations. It is hardly conceivable however, that now-a-days any artillery even when mounted on disappearing mountings could hope to exist in such a position except during the period prior to the arrival of the besiegers' siege artillery, and we may consider that, after that, the heavy guns would be found outside. The forts themselves being in existence with deep ditches will probably remain as they were designed, but will only be arranged for infantry fire, with possibly armoured tourelles, or open emplacements for Q.F. guns, at the salients and on the flanks.

(*c*) *Infantry redoubts.*

Infantry redoubts.

15. This is a comparatively new development of fortification. It fully recognizes the extreme difficulty, if not impossibility, as well as the uselessness, of keeping artillery inside the forts, and places the guns entirely outside the works, which are only prepared for infantry fire, except perhaps on the flanks, where arrangements are usually made for light pieces to be brought into action, at the last moment, for the close defence.

Bomb-proof protection, for the garrison, forms an important feature in this, as in most modern types of defence. It has hitherto been arranged under a central parados—which arrangement has been much criticised. Any parados immediately in rear of the firing parapets renders the attack by high explosive shells on the defenders of the parapet a comparatively simple matter, as many splinters from the shells would be thrown back on the defenders; and it would appear a better arrangement to place bomb-proof casemates under the front parapets, and to do away with the parados. This must be looked for in the future, and in place of the parados a series of splinter-proof traverses, to localize the effects of bursts from high-explosive shells will probably be adopted.

Details of redoubt.

16. Figs. 1 and 2, Pl. 4, shew the plan and section of one of these redoubts, as ordinarily constructed. A full development of the effects of rifle fire, and the formation of a target, that shall be almost invisible to the attacker, are the main points aimed at. An unclimbable steel fence is usually added at the bottom of the ditch.

INFANTRY REDOUBT.

Portions coloured black, concrete.

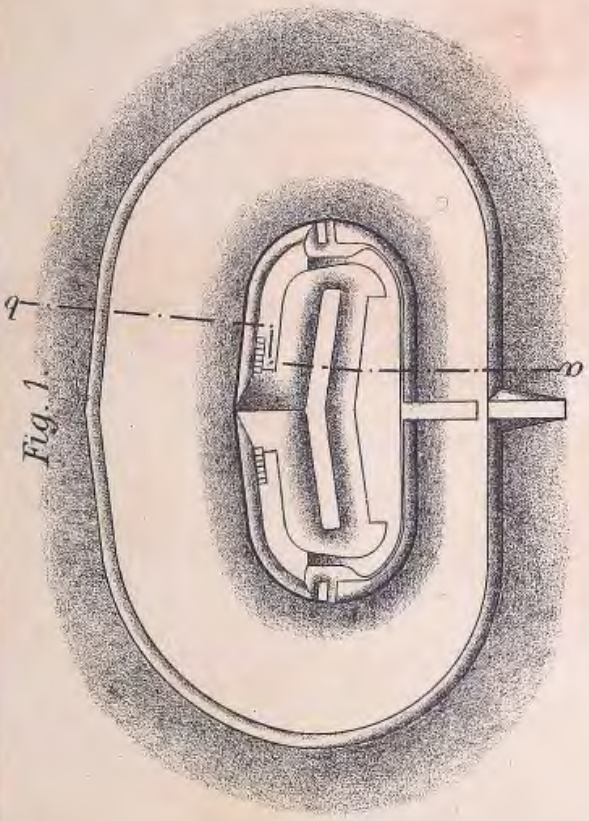
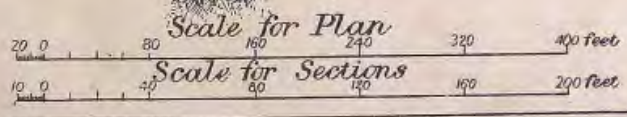


Fig. 1.

Fig. 2. Section a. b.

Fig. 3.



Opp. to page 12.

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Fig. 3 shews a section that has been suggested for the front parapet, where an attack by high-explosive shells is expected, in order to place bomb-proof casemates under the parapet, and at the same time to lessen the depth of dangerous area in the work, and to do away with the central parados. Many other similar types are being considered, and are likely to be met with, in the future. The earthen parapets themselves are very difficult to range on, and but little damage can be done to them, but the redoubts are infantry works, pure and simple, of low command, with a somewhat dispersed fire. Heavy howitzer shells could be dropped into them, almost up to the moment when the attacking infantry were on the glacis, and many gaps must inevitably be made by these shells through the obstacles which surround them. Furthermore, the glacis parapet would have lost a great deal of its value when covered with craters, formed by high explosive shells, which would act as so many shelter pits to the attack.

Siting of redoubts.

17. These earthen redoubts are, sometimes, placed in couples close together, with a continuous ditch between them so as practically to form one fort—or, sometimes, each redoubt acts by itself as a fort, and they are then placed some 1,000 yards to 3,000 yards apart. This distance cannot well be exceeded, if the defence of the intervals is to depend on musketry fire alone. In either case the heavy artillery is placed in the intervals between, or on the flanks of the redoubts, and often some considerable distance in rear, or even in front, of them.

Points common to all modern permanent works.

Observing Stations.

18. Accurate observation of the effects of fire being an absolute necessity to the efficiency of modern artillery, we expect to find observing stations wherever a commanding position can be found. These are usually the positions occupied by the forts, under (*a*) and (*b*) and so observing stations are generally located in these forts. It is a common arrangement to make use of the armoured defences for the electric light installation mentioned above, as observatories.

Obstacles.

19. Obstacles are freely employed in the immediate vicinity of all modern forts. One or more steel palisades commonly surround the fort, and any ground that can be swept by the grazing fire of musketry is covered with a network of plain and barbed wire entanglements, fixed to permanent steel posts—the posts being of different heights, so as to render the crossing of them by means of planks or ladders a difficult matter. Such entanglements are also found at the bottom of deep ditches, when there are flanking arrangements.

Railway communication.

20. In rear of the main defensive line in a modern fortress one would expect to find a railway system, communicating with the forts themselves and with the arsenal or town in rear. Such a railway gives the defence an opportunity of rapidly moving

guns and stores from point to point, and therefore must be taken into the consideration of the attack.

Retired line of defence.

21. As soon as the defenders ascertain what portion of the main defensive belt has been selected for close attack, it is probable that they will endeavour to gain further time, even after the fall of that line, by forming a second position in rear. The flanks of such a line would probably rest on forts of the first line, and temporary defences of all natures would be formed on it. (See Pl. 18.)

Defence armament.

22. Finally as regards information useful to the attacker there is the question of the armament of the defence. This will consist of the ordinary rifle and machine guns, and artillery of all natures. In existing defence armaments there is a large preponderance of direct firing guns, but these latter must sooner or later be, to a great extent, replaced by howitzers or mortars, if there is going to be any attempt to cope with the artillery of the attack. It is usual to divide the defence artillery under two headings, the "Armament for general defence" and the "Fixed armament," the former to resist attacks from troops and to assist in holding on to the ground already occupied, the latter specially to cope with the siege artillery of the attackers and to destroy its personnel.

Necessity for preponderance of high-angle pieces.

The armament for general defence, consisting of machine and field guns, field howitzers, and guns of position, all on travelling carriages, would be capable of rapidly moving from point to point of the defence, and would probably not look for either regular platforms or batteries; whilst the fixed armament of heavy howitzers, with possibly a few guns, if not permanent fixtures, could only be moved very slowly.

The armament for general defence will find its first use in the defence of the advanced infantry position, if there is one, and will be withdrawn simultaneously with the most advanced positions of defence; the fixed armament will rarely, if ever, be advanced beyond the main lines of defence. (See Section X.)

SECTION III.—THE ATTACK GENERALLY.

Mode of dealing with fortresses.

23. When an attempt is made to capture a fortress, and not merely to mask or observe it with a strong field force, four methods may be enumerated by which the operation may be carried out, viz. :—

(1) Blockade.
(2) Surprise, or assault by open force.
(3) Bombardment.
(4) Regular siege.

Blockade.

To blockade, or invest, a place is to surround and isolate it, preventing all renewal of the food, fuel, water, and ammunition consumed in it, so that at length it may be driven, by want, to surrender, and meanwhile the troops inside it may be hindered

from taking the field. The operation itself specially interests us at present in that it is usually employed to prepare the way for a regular siege ; and accordingly the process of blockading or investment will be described later on, in connection with that form of attack.

Surprise or assault by open force.

To effect an entry into a fortress by surprise only can hardly be possible, unless a very imperfect watch is kept ; but an assault by open force, which may take place after a vigorous bombardment, either at the commencement or at an advanced period of a regular siege, is generally arranged so as to partake of the nature of a surprise. The description of how such an operation should be carried out will therefore also be described when we come to the regular siege.

Bombardment.

The object of an attack by bombardment only is mainly to bring about a surrender of the place by aid of the adverse moral effect produced. With this view, fire is directed, night and day, upon the buildings occupied by the troops and inhabitants, so as to wear out their endurance, and so perhaps bring them to put pressure upon the commandant.

Bombardment of special points is resorted to, to allow of pushing forward the infantry, in a regular siege, and the method of carrying out such an operation will therefore be described, like the two previously mentioned methods of attack, under that heading.

Regular siege.

The different operations of a regular siege specially claim our attention in this book, but, as stated above, in describing them, we must necessarily embrace all the important phases of the other forms of attack.

24. In Section II. we have laid down all the general information, (apart from the special information which is peculiar to each individual case), that is likely to be of use to an attacker. We will now consider what his action is likely to be. We have no examples of such warfare to point to—we can only conjecture from peace experiments, and deductions therefrom, as to what is likely to be his line of action.

Arms of attacker.

Before actually doing so we must consider what weapons he is likely to have to fight with, and we will take, as an example, those likely to be used, in the future, by the British Army. These will consist of the ordinary rifles and machine guns in use, and of artillery. The latter may be grouped under four headings :—

Siege artillery.

(*a*) The *Mobile Armament* consisting of 15-pr. B.L. guns, and 5-inch field howitzers throwing a 50-lb. shell.

(*b*) The *Light Siege Armament* of 6-inch B.L. howitzers throwing a 118½-lb. shell.

(*c*) The *Heavy Siege Armament* of 8-inch B.L. howitzers throwing a 267-lb. shell.

(*d*) A *Special Armament* of 6-inch B.L. guns.

It is as well to note, however, that until supply is fully made it is probable we may have, in many cases, to use the

8-inch and 6·6 or 6·3-inch R.M.L. howitzers, in the place of the 8-inch and 6-inch B.L. howitzer; though the present book refers rather to the new armament.

Organization of Siege Artillery.

Siege howitzers will probably be organized in units of four pieces, corresponding to about half a siege company.

Objects of Siege Artillery.

It is as well to get a clear idea of the different objects for which these different armaments are intended, and this will be given, in detail, when we come to the descripton of the siege. At present we are merely concerned with the probable numbers and proportions of each.

The mobile armament will be always required, though in quantities varying according to circumstances. It will be formed from the field artillery of the besieging army.

The heavy and light siege armaments will carry out the main bombardment—the latter will, no doubt, be the principal siege pieces of the future, as the weight of the former and of their ammunition prohibit their use, except where special facilities of transport by rail or water exist. It is as well to remember that most modern inland fortresses would be provided with good railway communication, in fact the existence of the railway is often the cause of the existence of the fortress.

The 6-inch guns will only be employed where armoured defences are to be attacked, or very accurate fire from a long range is required. It is difficult to see how these guns with their direct fire could be sufficiently screened or hidden, except at a great distance from the defence works, and their use would probably be rare. The weight of any disappearing mounting is so heavy as to render its use prohibitory, in most cases.

Projectiles of the attack.

25. The projectiles for the 15-pr. gun will, for the most part, be shrapnel; for the field howitzer and for the heavy and light siege trains, forged steel common shell with high explosive bursters; for the 6-inch B.L. guns, common and shrapnel shell with powder bursters, and possibly some armour-piercing projectiles of special design.

The fuzes for the howitzers will be either direct action or delay-action percussion fuzes, the former for searching out works and destroying personnel, the latter for demolition purposes.

Carriages and mountings.

26. All the pieces, except those of the heavy and special armaments, will be on travelling carriages, so as to allow of their being moved from one point to another in a short time. The heavy armament will be on fixed mountings, but could be moved (but not quickly) by rail or water, or for short distances by hand. The 6-inch guns will probably be on disappearing mountings.

Nature of fire.

27. High angle fire from the howitzers, with high explosive shells, will form the main feature, in both the attack and defence. The angle of descent of these shells will vary from 75 to 50 degrees—the higher angles being specially employed for

demolition purposes with delay-action fuzes; the latter for destruction of personnel behind cover, with direct-action fuzes.

The fire at very high angles is necessarily more difficult of control than at the lower angles for the same range, and consequently we may infer that the lower angles will be employed against the attack, where destruction of personnel, and not demolition, is the main object.

The attack, then, may expect to have to meet a large preponderance of high explosive shells dropping at about 50 degrees, It is worth noting at this point that experiments have shown that the most destructive action, against personnel, from a high explosive shell, fired at a low velocity, occurs when it bursts, on a hard surface, immediately in rear of a line of men, and hence we must, as far as possible, avoid in our designs of attack works the use of any reverse banks which might hold shell, without being soft enough to allow them to penetrate, and so smother their burst.

Having now considered the modern types of defence, and the armament of attack and defence, we are in a position to consider what is likely to be the system of attack made use of in a modern siege.

General description of operations of Regular Attack.

Rapidity of movement.

28. When once the attack of a fortress has been decided on, the movements of the officer, to whom the operation is entrusted, should be rapid and energetic. As quickly as possible the complete investment of the fortress should be carried out and all communication with the outer world cut off.

Cavalry investment.

This is secured, in the investment of an inland fortress by the use of an advanced force of cavalry and horse artillery, which conceals the march of the main body, prevents the defenders from getting in supplies, or destroying bridges and other communications necessary to the attack, and cuts off all connection by telegraph, rail or road, between the garrison of the fortress and other bodies of the enemy.

Officers of the Staff, Artillery and Engineers, should accompany the cavalry to make a preliminary reconnaissance of the fortress and its surroundings.

Cavalry pioneers or mounted engineers should be attached to the force to carry out necessary demolitions; and the bridging units should be ready to make or restore communication, if required, on, or in the rear of the line of investment.

Complete investment.

29. On the arrival of the main body, the defenders' outposts are driven in under cover of the artillery fire of the place, and the complete investment is effected by a force of all arms, whose strength will depend upon the extent and character of the line to be held, and of the garrison of the fortress.

Immediate assault.

30. With the main body will probably arrive the mobile armament with its field howitzers, and this has led to a growing opinion that in cases where a fortress is weak, or ill prepared, it

is quite possible to at once bombard the forts and outlying positions and to deliver a successful assault. This view is usually considered somewhat optimistic, though the spirit of it is evident in all modern writings on siege warfare. In such a case there would be no object in complete investment.

In ordinary cases, a more systematic attack is evidently necessary, and, to prepare the way for the infantry attack, pieces throwing a heavier shell than that of the field howitzers must be brought up and employed before it will be possible for the attack to advance into the zone of infantry fire from the defensive belt, or hope to drive the defenders back from the positions which they have probably taken up in advance of the forts, and afterwards to retain them.

Line of investment.

31. The extent of the line of investment depends upon the nature of the country, upon the size and armament of the fortress, and upon the distance to which it is possible to drive the defenders back from any advanced position they may have taken up. If the surrounding country be open, with no rivers, inundations, or other obstacles to restrict the offensive action of the garrison, the line of investment must be more or less continuous; and the main line must be beyond the effective range of the "fixed" artillery of the place—generally from $2\frac{1}{2}$ to 3 miles from the main line of defence. The outposts must be pushed in as far as possible, possibly to within $1\frac{1}{2}$ or even $1\frac{1}{4}$ miles of the same line.

Division of zone of investment.

32. The zone of investment is divided into sections, each of which is allotted to a brigade, division, or army corps, which at once proceeds to reconnoitre its section and to make good its position. In order to guard against sorties, villages, houses, walls, &c., must be put into a state of defence, entrenchments thrown up where necessary, and field artillery positions protected by breastworks and gun-pits. The communications, by rail and road, between the different sections should be improved as far as possible, and telegraphic or telephonic communication established from section to section and to headquarters.

At this period, whilst waiting for the special siege artillery, field observatories should be erected, and captive balloons used to give early notice of sorties and to assist in reconnoitring, and shelter for the troops should be provided.

Fighting for the possession of outlying villages and other strong positions will be of daily occurrence in the attempts of the attack to advance the zone of investment.

Choice of front for further attack.

33. Every effort, too, must be made to thoroughly reconnoitre the position and determine in which direction any systematic advance shall be attempted.

To facilitate a decision on this point, a reconnaissance in force may be necessary, a general attack, supported by field artillery, being made on one or more sides in order to drive in the defender's outpost line, and thus gain a closer view of the defences, and the ground in front of them. In deciding which front to

attack, the considerations which would have to be borne in mind are :—

(1) On which side the best communications, either by road, rail or water, exist towards the base of operations.
(2) On which side success on the part of the attack will lead to the most decisive results.
(3) On which side siege railways can best be made.
(4) On which side good sites for the high angle fire of the attack can be found.
(5) On which side digging can best be carried out.
(6) On which side good positions for the observation of fire occur.

The first consideration so far outweighs the others now-a-days, when ammunition and stores are so heavy, that it will often not be possible to consider the others at all.

34. In determining the extent of the front of attack, it is usually considered necessary to push a direct attack on at least two of the main forts, and to silence those on either side of them.

Extent of front of attack.

35. When once the front of attack is decided on, sites for the field arsenal and main engineer park must be chosen and prepared, close to a good line of communication with the base, probably at a suburban railway station.

Sites for field arsenal and main engineer park.

The artillery park will be in or at the field arsenal (see Regulations for Supply of Stores to an Army in the Field) and stores issued therefrom by the O.S.D. to the R.A. will go direct to the advanced depôts and batteries.

In selecting sites for the siege parks we must look for (1) proximity to, or the possibility of making good covered communications to both front and rear by railway, water, or road ; (2) security so as to be beyond risk from artillery fire or sorties ; (3) a position which will fall in with the general line of communication to the batteries and the front.

The sites for the main engineer park and field arsenal, which would probably be close together, would be at some considerable distance from the enemy's batteries, probably 4 or 5 miles, but the intermediate parks, which would only contain siege material, would be as close to the attack batteries as possible.

The positions of the parks having been fixed, connection between the main and intermediate parks should be at once commenced.

36. The main engineer park will be quite apart from the field arsenal, and will be under the C.R.E. It will contain the workshops, and machinery, and stores of unmanufactured materials. For finished stores passed into it by the O.S.D. it will probably eventually be little more than an unloading station where the break of gauge from that of the regular railway of the country to that of the siege railway will take place. All finished stores will probably be, as soon as possible, passed off to intermediate right, left, and central parks so as to clear the way for the

great demands which will be put upon the siege railways by the heavy artillery material required at the front.

Artillery position.

37. A most important point that also requires to be decided is the fighting position for the artillery, towards which the railways from the intermediate parks must be pushed forward as soon as possible. These advanced railways should be able to transport howitzers or guns already mounted so that there may be as little delay as possible when they are once brought up into the fighting position.

Choice of artillery position.

38. From what has been already remarked, it is evident that the artillery position chosen must be suitable for the most advantageous use of howitzers, both as regards fire effect and cover, firing at considerable angles of elevation, generally not less than 50 degrees, and exposed to a somewhat similar return fire. These are entirely different conditions from what formerly had to be considered, and will probably be a great gain to the attacker. They give him a great choice of range, and allow him generally to entirely screen his pieces from the destructive action of direct-firing guns, as well as to render them, comparatively, very difficult to hit by high angle fire.

If possible, there should only be one position.

Other considerations that will probably weigh in the choice of the general position are: that with the accuracy of modern artillery fire it should, in most cases, be possible to select one single artillery zone, from which not only bombardment, but also any special breaching operations, could be carried out, and that at the same time it is necessary to be at some moderately safe distance from the defence works, whilst they are still practically unharmed. A zone lying from 2,500 to 5,000 (or 4,000 with R.M.L. howitzers) yards from the main works of defence, would probably allow of all this, and such a position is shown on Pl. 18. Concealment of position is more important than shortness of range, but the question hangs a good deal on how far it may have been possible to drive back the defender's outposts.

Batteries should not be established close to any conspicuous object, such as a tower, on which the defenders could range their guns.

Observing effects of fire.

As the accuracy of fire from the batteries depends entirely on the possibility of observing its effect, there should be good positions for observing, from which observations can be made and reports sent in to the batteries. The distance of the observing stations from the batteries is not of great importance, provided good telephonic communications are established. (See Observing Stations.)

Communications to the rear.

Another point to be borne in mind is that there must be free and concealed communication from the field arsenal up to the different magazines and batteries. Such communications must be selected with a view to a free use of siege railways.

Sites to be large.

The actual sites on which the artillery is placed should be invisible to the fortress over some considerable area, so that it

may be the more difficult for the defence to search it thoroughly with their shell fire. A large site, too, allows of a shifting of batteries into alternative positions, if it is evident that the defence have accurately fixed the site of any particular battery.

Sites sloping to the rear.

The advantage of having the actual site of a battery on ground sloping to the rear, and so rendering the battery, and its communications, difficult of detection, is explained in paras. 60, 78.

Construction of batteries.

39. As soon as a final decision has been come to as to the sites for the batteries, additional efforts must be made to draw the investment still closer on those portions of the attack where they occur. The outpost line must be rendered specially strong here against sorties, and at the same time pushed forward to the furthest possible point. The batteries may be commenced in those positions where they are likely to take more than one day to execute, otherwise it is better to wait till the actual arrival of the siege train, and employ all available labour and time, till then, in connecting up the artillery positions with the advanced artillery depôts and arsenal. On the arrival of the siege train, every effort should be made to get the pieces into action as soon as possible, so that a simultaneous and continuous bombardment of the enemy's position may be commenced. It would be fatal to commence bombarding before every piece was ready to fire, or before thorough communication was established with the rear.

First bombardment.

40. The main object of the first bombardment by the siege pieces will be to destroy the personnel and materiel of the defence, so as to allow the infantry to make a further advance, and to drive the defenders back to their main defensive line. The mobile batteries would be employed to assist in this object by deceiving the enemy on other fronts, and drawing them away from the real front of attack, and in assisting in the capture of advanced positions held by them.

Parallels.

41. During, and after, the first bombardment the outposts will be gradually pushed forward towards the fortress, the limit during the daytime being just out of range of the rifle fire from the advanced works, or, at this time, about 1,000 or 1,200 yards from the main defensive line as a minimum, unless especially favoured by the ground. At night, however, the grip on the fortress will be tightened, the enemy's sentries being forced back on the line of works throughout the entire circuit. The object of this is to allow of the unhindered construction of an advanced intrenched position, on the front of attack, in which a large body of infantry can always be kept up at the front.

This operation will be repeated on several successive evenings with a view of deceiving the enemy as to the true object of the advance. The piquets of the outposts should be provided with tools so as to intrench themselves and the sentries. By judiciously selecting the sites for such hasty intrenchments, many can, afterwards, be converted into deeper and stronger trenches, so as to allow of a large body of infantry being kept at all times up

at the front. Such infantry trenches are commonly known as "parallels," as they are roughly parallel to the direction of the enemy's front, and the trenches connecting one parallel to another, which are usually zig-zagged, so as to be defiladed from the fire of the defences, are called "approaches." The number, extent, and distance of the parallels from the enemy will depend on the lie of the ground, the length of the enemy's front to be attacked, and the strength of his resistance. The most advanced of the parallels will be used as the outpost line.

The final parallels, used as an infantry position, should be as close as possible to the forts, consistently with the safe use of the artillery in rear who are assisting the infantry attack. If the artillery position was at 2,500 to 5,000 yards, probably the nearest distance to a work for the final infantry position would be 250 to 300 yards. Troops at this distance from a target would not be absolutely safe from splinters of shells, but the risk, considering the object in hand, would be very small.

Further duties of siege artillery.

42. As soon as the siege pieces have gained a genuine mastery over those of the defence, some of them will select the forts or redoubts for their targets, their object being to render such strongholds untenable, to destroy obstacles, to form breaches, and to be able to range so accurately on any particular fort that they can assist their own infantry in an assault till the latter are almost on the glacis.

43. The final stages of the attack in the future are necessarily difficult of description.

Sapping.

Deep saps may still be employed, even in daylight, when the enemy is so far crippled, that, although he can prevent work in the open, he cannot bring a telling fire on any special point. Under any circumstances they could be employed at night if the search lights have been extinguished.

Mining.

Mining, too, may be resorted to, though this is most unlikely. The possession of the glacis is no longer of all-important to the attacker—nor are modern defences provided with a system of countermines. The danger too from countermines is comparatively so trivial that their presence is hardly likely to deter an attacker from advancing above ground. Mined saps, *i.e.*, galleries driven a foot or two below the ground level, and afterwards converted into open saps, may be employed where ordinary sapping is impossible. The operations of mining are described in Part IV.

Breaches.

As, however, high explosive shells falling at very high angles of descent, will intentionally or otherwise have formed many breaches in any vertical escarp or counterscarp; and by the same means most ditch defences will have been destroyed before the final infantry position is arrived at, in all probability the

Final stage of Attack.

final stage of the attack will be the delivering of a powerful infantry assault by men collected in the trenches, immediately after a continuous bombardment of the defensive belt and forts from every available gun and howitzer of the attack. The

front of attack will probably be on at least two forts and the interval between them.

In this final assault, obstacles are sure to be met with in large quantities, and these should be destroyed, as far as possible before the actual assault is delivered (probably on the previous night); but even then a large body of engineers should be employed to clear the way for the attacking infantry.

SECTION IV.—ORGANIZATION OF ATTACKING FORCE.

Classification of siege troops.

44. In the consideration of the duties to be performed by a force employed in the attack of a fortress, the troops may be roughly divided into three classes—

1. Investing force.
2. Covering parties and guards of the trenches.
3. Working parties.

The two last classes are commonly known as "siege troops," as they form no part of the regular field army.

Investing troops.

Duties of investing force.

45. The first complete investment is mainly a passive defence. Its lines must be held against all efforts of the garrison to break through, and they must be more continuous than in the case of an ordinary field position.

Every effort, however, will be made to draw the investment closer by advancing from the first position, so that the latter will soon be looked upon as a second line of defence.

The batteries and particularly the communications will be constructed, as far as possible, by the investing force, in order that there may be no delay in opening fire after the arrival of the siege train; and the earliest siege works will therefore have to be protected by the outpost line of the investment.

Strength of investing force.

It is not possible to lay down definite rules for calculating the strength of the force required for the investment and siege of a fortress, as so much depends on the particular circumstances of each individual case.

Assuming, however, that the investing troops are secure from attack or interruption from without, it may be stated generally that a force of from twice to three times the strength of the garrison is necessary for the simple investment of an inland fortress, and from three to four times for the active prosecution of the siege.

If, however, the action of the garrison is limited by obstacles, or if the features of the country or the armament of the fortress permit the investing line to be drawn nearer to the place, or if the garrison consists of inferior troops, the investing force may be proportionately reduced.

Siege troops.

Siege troops.

46. The siege troops will, on arrival, be told off to reinforce the corps or divisions holding those sections which face the front or fronts selected for attack, in order to assist in supplying the necessary working and covering parties, and guards of the trenches, and the detachments for working the guns in the siege batteries.

Duties of covering parties and guard of trenches.

47. After the arrival of these special siege troops and trains, the operations, as regards the section facing the front or fronts selected for attack are those of offensive, rather than of passive, defence. It will be necessary to push back the enemy steadily and continually in order to gain ground to the front, to protect the working parties engaged in the construction of the siege works, and to defend those works from assaults by the garrison, who will do all in their power to destroy them and thus retard the progress of the siege.

Working parties.

48. The whole of the siege works will be constructed by working parties of engineers and infantry, and the successful progress of the siege depends much upon their organisation.

Queen's Regulations regarding working parties.

"It is of the utmost importance that at sieges and on field-service, working parties should be detailed by companies, battalions, brigades, and divisions, as required, and not be formed of detachments from different companies and corps. The officers should be with their respective companies or units. The officers and non-commissioned officers of the working parties will be held responsible for the *amount* of work done; the duty of the engineers being to see that the labour is *properly applied*" (par. 37, Sec. VIII, Q.R., 1895).

Reliefs.

49. Working parties should be divided into *reliefs*. These should never exceed eight hours of actual work at a time, or three in 24 hours; but for works that have to be executed in a short time, it is better to give four-hour reliefs (that is 4 hours' actual work) so that the men may be relieved by fresh hands before they become unduly fatigued. When it is necessary to get a great amount of work done in a given time, it is a good plan to have present twice the number of men required to work at any one time, the men being told off in pairs to each task, and relieving each other in turn as they become fatigued. The men will thus be able to work with intervals of rest, enabling them to put forth all their energies.

This of course entails larger working parties than are required by the ordinary method, but cases may occur in the field when the tools *available for use* are below the requirements of the working parties that can be provided, and in such cases the arrangement above detailed may be adopted with advantage. If it be not possible to provide two men to each task, a certain proportion may nevertheless be available as a reserve to relieve individual diggers at the discretion of the superintending officer. When the work is carried out in the presence of the enemy, and

casualties may be expected, a reserve of 10 per cent., at least, of the strength of the working party should be provided to replace losses.

R.E. reliefs.

As a general rule, the engineers should work in eight-hour reliefs, and, when the work takes more than eight hours to execute, should not be relieved at the same hours as the infantry working parties.

When the work is to continue for any length of time, as in the present case, the working parties—both engineers and infantry—should, if possible, have three tours off duty to one on.

Tasks.

50. With regard to the amount of work to be expected from soldiers, it may be assumed that, in easy soil, a soldier untrained to the use of the pick and shovel should in four hours' actual work excavate 100 cubic feet, or very nearly 1 cubic yard per hour, throwing the earth a maximum horizontal distance of 12 feet, and lifting it out of a trench having a maximum depth of 4 feet, and that the same man, if kept at work for six hours, would not do very much more, as his energies would be pretty well expended after the first four hours' work.

After some practice, however, the same man may excavate, under similar circumstances, 1 cubic yard per hour for six hours, but, on service, it is not usual to calculate on more than 120 cubic feet in six hours.

Taskwork.

Whenever circumstances permit, it will be found best to work by the task. A considerable amount of supervision is thereby saved, and a spirit of emulation is set up among individual men, companies, &c., causing the work to be more quickly and cheerfully performed. Tasks should be set for each unit, and then subdivided among the men, and the officer in command of a working party should be given to understand that he is responsible for the execution of the entire task allotted to his unit.

Strength of siege troops.

51. The strength of the force, required to supply the covering and working troops, is generally reckoned with a view to its furnishing three reliefs, each equal, in the case of the covering troops, to the probable field force of the garrison. Two reliefs may, however, suffice. The precise number of troops required will, however, vary according to the extent of the fortress and the condition of the garrison. In proportion as the fortress and its garrison are larger, the strength of the covering troops may be relatively smaller, and *vice versâ*; because the length of the lines held will be more equal.

Total strength of attacking force.

52. Taking, as an example, a fortress surrounded by a girdle of detached forts, on a radius of about $2\frac{3}{4}$ miles, and having a garrison of, say 40,000 men; the investing force would be about $2\frac{1}{2}$ times the garrison, or 100,000 men—say five army corps of 20,000 infantry each; each army corps having a front in its main line, of 6 or 7 miles, and being opposed to about $3\frac{1}{2}$ miles of the periphery of the fortress. This extent of $3\frac{1}{2}$ miles is about that which would probably be embraced in the attack, and towards

which the siege works would converge. In this case, as the front of the attack for the garrison, or of defence for the besiegers, would not be more than 4 miles, and the trenches may be firmly held by 4,000 men to the mile, 16,000 men would be the greatest number of troops required in the trenches to guard them; 16,000 at three reliefs gives a total of 48,000 men, or 28,000 in addition to the 20,000 originally employed in the investment of this part of the line.

The investing force would therefore have to be more than doubled in infantry at this part of the line, so as to afford sufficient troops to hold the trenches. When an assault was imminent, or a sortie from the garrison was expected, additional troops would be drawn away from other parts of the investment line, and moved to the theatre of attack.

Strength of working parties.

As regards working parties, if we allow 1,000 to 1,200 men per mile of trench and that we shall have a maximum of 4 miles of trench to construct at one time, this gives, at 4 reliefs, 16,000 to 19,000, say 18,000, additional men.

Thus the total addition, as regards infantry, to the investing force, for the vigorous carrying on of the siege would be 28,000 + 18,000 = 46,000 men; and the troops employed in the investment and siege would be 100,000 + 46,000 = 146,000. In addition it would be necessary to allow a proportion, say $\frac{2}{10}$ for the duties connected with the internal economy of the army and for casualties, thus making a total of about four times the garrison.

The relative increase of the investing force will be greater in proportion as the fortess is smaller and the line of investment shorter, because the proportion of the investing line included in the active operations of the siege will be greater, and the working parties cannot be much diminished.

Cavalry.

The proportion of cavalry may be less than with an army in the field, but on the other hand, that of the artillery and engineers must be much greater.

Artillery.

It is usual, for purposes of rough calculation, to allow, as an estimate of armament of a fortress, that it will have one fortress (fixed) piece for every 40 yards of perimeter, facing the attack. With a perimeter of $3\frac{1}{2}$ miles, we should therefore expect a defence armament of $3\frac{1}{2} \times 44$, or 154 fortress pieces. The number of siege pieces for the attack should considerably exceed this, say $154 \times 1\frac{1}{2}$, or 231 pieces. This would be exclusive of the mobile armament.

It is desirable that artillerymen be provided at the rate of about 30 (10 at three reliefs) per siege piece. The numbers for the mobile armament will be in accordance with "Field Army Establishments."

Engineers.

The engineers should not be less than $\frac{1}{10}$ the strength of the infantry: considerably more if possible. There should also be from twenty to fifty or sixty additional engineer officers; at Sebastopol, in 1855, the average was 35.

Ammunition.

The amount of ammunition required for a siege cannot be

definitely laid down, but it would require to be, probably, 1,000 rounds per piece. This would mean, for every 100 six-inch B.L. howitzers, a weight of about 5,500 tons, for ammunition alone.

Organisation and arrangement of Siege Parks.

53. As already stated there will probably be a main siege park situated on an existing line of railway (or other communication) at which the break of gauge in the railway will take place, and at which all stores will be handed over to the C.R.E. from the O.S.D.

Workshops and machinery will here be arranged to work up unmanufactured materials, and the finished articles will, as soon as possible, be passed on to the intermediate parks. Revetting materials, made up by the troops, will be made as near as possible to the intermediate parks, and at once be placed in them. Only reserve stores and unmanufactured materials will, as a rule, be kept in the main park, so that, in most cases, it will eventually become merely an unloading station, with workshops, &c.

In addition to the main and intermediate parks, movable trench depôts would have to be established in the approaches and elsewhere at the front to contain supplies for immediate use.

Organisation of siege parks.

54. The main and intermediate parks will require careful organisation, and a special staff of their own. One officer will be in charge of the whole, and he will be responsible for all supplies for siege purposes, and be able to show at all times the amount and position of all siege material that is available, or is being manufactured.

The following detail shews what would probably be the minimum staff required:—

1 captain R.E. in charge as director, who will also have charge of all the arrangements for supply.
1 lieutenant R.E. in immediate charge of the main park.
1 staff clerk in charge of books and correspondence.
2 non-commissioned officers at the main park, and 1 at each intermediate park in charge of stores, each having at least 3 storemen under him.

Each park will be laid out on some definite plan, with separate spaces for stores, materials, tools, and sheds for perishable articles, so as to avoid confusion, and aid supervision. The main park will require quarters for the officers, workshops, machinery shop, stables, &c. The stores will be so arranged that sidings from the siege railway can run between them and so avoid carrying, as much as possible. Water supply is also an important point.

It is worth noting that:

100 brushwood gabions take up a space of 13 feet by 16 feet if stacked on their sides in four piles of five tiers, seven gabions in the bottom row and three in the top—height of piles, 8 feet

6 inches; and 100 fascines take up a space of 18 feet by 18 feet if stacked in five layers of twenty fascines, each layer being at right angles to the one underneath—height of stack, 4 feet.

SECTION V.—SIEGE RAILWAYS.

Gauge.

55. In any future siege, narrow gauge railways will, without doubt, play a most important part as a means of forwarding up to the batteries and engineer depôts, the immense weight of ammunition, guns, platforms, &c., that will be required. It is advisable to have only one break of gauge, and this will, conveniently, take place at the field arsenal and main engineer park, which will, probably, be on, or near, the existing line of railway of the country, so that there need be only one change of carriage for the heavier stores. From these establishments railway communication will be made with all parts of the front.

56. A good gauge for a siege railway is from 18 to 24 inches. We use the former, the French the latter. The trollies can be drawn by horses in lasso draft, the tugs being attached to the side of the platforms, so that a horse would not have to walk over the sleepers, thereby disturbing the adjustment of the line; or men can haul the trollies along with very much greater facility than when using trench carts, &c. A description of the method of laying such lines, with full details of the materiel and personnel required will be found in Part VI. An hour and a half to two hours are required for laying a quarter of a mile of permanent way for such a line, but a great deal depends on the amount of levelling and packing required.

The average load of a train is about 30 tons net.

The weight of the different pieces of artillery, their carriages, &c., can be found in the table shewing details of Siege Ordnance.

During a continuous bombardment it may be assumed that a 6-inch or 8-inch B.L. howitzer *might* fire 12 rounds per hour by day, or 6 rounds per hour by night, or roughly 200 rounds in 24 hours. This would mean 25 tons of ammunition for each 8-inch howitzer and $11\frac{1}{4}$ tons for the 6-inch, each day.

57. To make the most of a siege railway a thoroughly methodical system of working must be enforced, to prevent blocks, useless detention of rolling stock, &c. The method of carrying this out is all described in Part VI.

SECTION VI.—ARTILLERY ATTACK.

Batteries.

58. We must now consider how we can form batteries for siege pieces so that they can be worked to the best advantage and at the same time have the best chance of security.

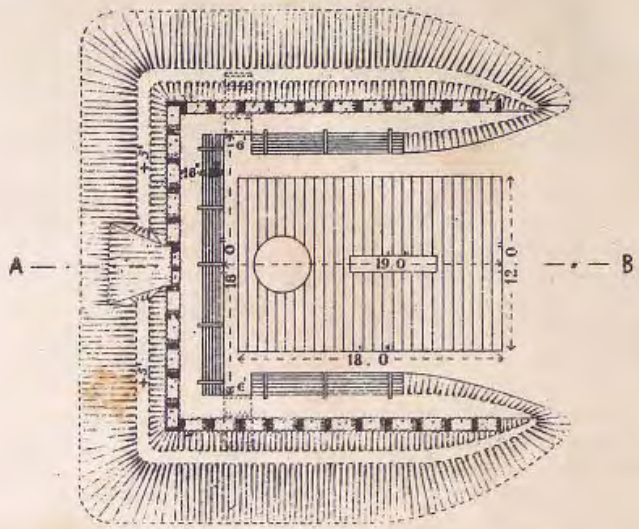
Nature of siege artillery.

These siege pieces, as previously stated, will consist almost

PLATE 5.

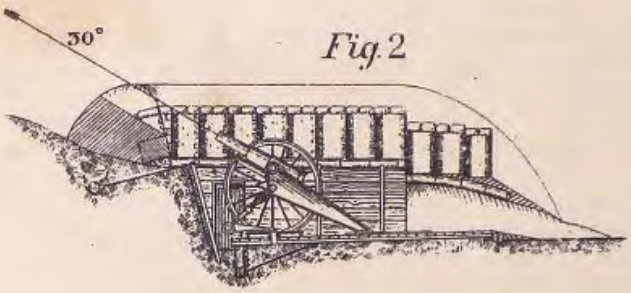
EMPLACEMENTS ON SLOPING GROUND.

Fig.1



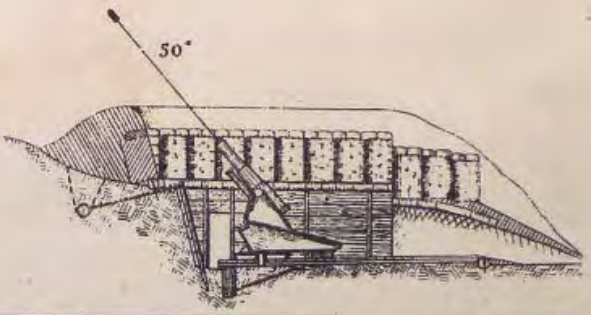
PLAN

Fig.2



SECTION A B

Fig 3



Opposite to para 61

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entirely of howitzers, though for the attack of a first-class fortress a few direct firing guns, firing at a long range, may be employed. The use of the latter will be rare, and they will then be so far away from the artillery of the defence, that it is probable that little cover will have to be provided for them. Our attention will therefore be now directed to cover for the main artillery armament of howitzers which would be collected on the artillery position, probably distant some 2,500 to 5,000 yards from the main defensive line.

Invisibility.

59. There is no object in putting a battery of howitzers on the sky line, where its existence could be but short against the artillery of the defence, so that these batteries will be in hidden positions of some sort, either on the reverse slopes of hills, at the bottoms of valleys, or behind woods or buildings. Occasionally it may be necessary to throw up an artificial screen, to cover a battery that would otherwise be visible, but there would be great difficulties in keeping up communications, except at night, with a battery so placed, and such a site should be avoided, as far as possible. The penetration of howitzer shells is so great, and their effects so powerful that it is impossible in the field to throw up cover which will resist them. As a rule the artillery of the defence will be firing at an unseen target whose actual position cannot be fixed, and their system of fire will be rather on what is known as the "pendulum" system, *i.e.*, dropping shells systematically backwards and forwards over the area to be searched, than any direct attempt to hit a special object. Freedom from danger will therefore depend almost entirely on invisibility—but still such cover may be designed as will at any rate localize the effect of shells, even if not of much use in protecting the howitzers and men from the falling shells themselves. Furthermore, we must look for ground which will not give a back wall to the battery.

Advantages of sloping ground.

Best slope.

60. These requisites can generally be most easily obtained on the reverse slope of a hill, and, especially, at points where the slope of the hill allows of the howitzers being sunk almost entirely behind the unbroken soil, and yet there is no backwall to the battery. Supposing the howitzer to be covered by the natural soil up to the greatest practicable height, say 6 feet, it would mean that the best site would slope at about $\frac{1}{4}$ to allow of the emplacement, some 24 feet long, having no backwall. A steeper slope than about $\frac{1}{4}$ would cause difficulties in communicating with the battery—an easier slope would entail either a great amount of excavation or the building up of a high parapet in front and on the sides of the emplacement.

Typical emplacement on sloping ground.

61. A typical emplacement of this nature for a 6-inch B.L. howitzer is shown on Pl. 5. The ground slopes so conveniently that a full height of 6 feet of undisturbed soil comes in front of the howitzer and yet there is no reverse bank at the rear of the emplacement to hold a shell. The earth excavated from the emplacement is piled up round it, so as to stop splinters

from shells which burst on the front or flank. Of shells which may fall in the emplacement, it is useless to take account, for they cannot be kept out, nor can cover be provided against them. Very good cover from shells that fall in front of the emplacement is obtained by the detachment when standing with their backs against the front wall; at other times, they must take their chance with shells that fall in front, or elsewhere. Figs. 1 and 2 shew plan and section, for a howitzer firing at low angles; Fig. 3, a section for a howitzer firing at 50°.

This is an example of an emplacement on a most suitable site, and such can often be found; if an easier slope has to be selected the rear of the emplacement should be on the natural ground level, and at least six feet of height in front of the howitzer must be made up by gabions, sods, or other revetment.

Emplacement on level ground.

62. It will sometimes, however, happen that the emplacements must be on level, or practically level, ground, as at the bottom of a valley. In this case the platform for the howitzer would be on the ground level, and the traverses and front parapet, revetted or unrevetted, entirely thrown up, would surround the gun, to protect it from splinters. It would be worse than useless to sink the howitzer in a pit, as this would merely act as a shell trap. It may even sometimes be advisable to add a splinter-proof traverse some 8 or 10 feet in rear of the platforms, which would not burst a shell, but would stop splinters from shells that burst in rear.

The battery.

63. A battery consists of a series of emplacements, probably four in number, so that they may be worked in action by one battery commander. The covering of such a collection of pieces in battery is best explained by the design for a level site shown on Pl. 6. The platforms are on the ground level, and the howitzers are spaced 45 feet apart. This distance would probably have to be 60 feet if there was a want of revetting material. Instead of solid traverses between the pieces, which are useless and cost much labour, a shallow trench is excavated which provides earthen splinter-proof cover on either side, the trench further acting as a shell trap. A space is left between the front parapet and the traverses to allow of free communication. When the howitzers are more than 45 feet apart, it is not always necessary, or even advisable, to have a continuous parapet between them. The front parapet, which is also only splinter-proof, is provided from a ditch of its own, which also acts, in a small way, as a shell trap.

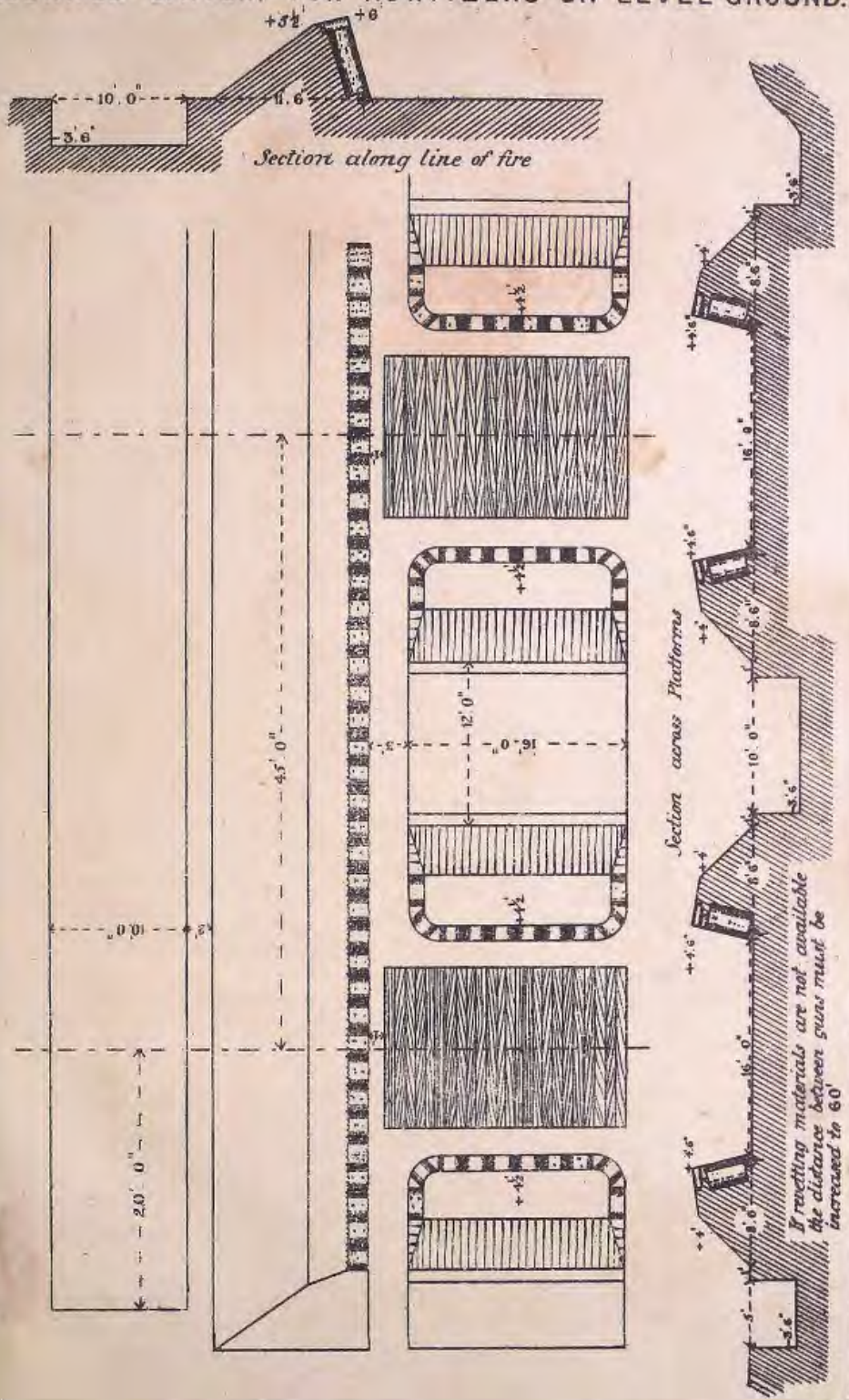
Execution of work.

For the execution of the typical battery, for four howitzers, on a level site, as shown on Pl. 6, the detail of men, tools, &c. (p. 31) has been found to be sufficient for two reliefs, each of 4 hours' duration, in which time the work should be completed.

Unrevetted battery on level ground.

Where revetting materials cannot be obtained, the working party will be about the same, but all would be diggers. This

ELEVATED BATTERY FOR HOWITZERS ON LEVEL GROUND.



Opposite to para 63

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DETAIL of Men, Tools, &c., for 4-Howitzer Battery on Level Site.

Portion of Work.	Tasks.	Men.			Materials.						Remarks.
		Diggers.	Shovellers or Revetters.	Total.	Gabions (Special).	Sandbags.	Fascines.	Pickets, 3′ 6″	Picks.	Shovels.	
1st Relief.											
Front parapet	—	—	18	18	84	400	10	50	—	18	The gabions here are of the steel band pattern — 18 bands high for the front parapet, 15 bands for the traverses, with special pickets. 8 tracing tapes, 50 tracing pickets, 2 mallets, 1 field level, and 1 measuring tape would also be required.
Front ditch	5′ × 5′ × 3½′	35	—	35	—	—	—	—	35	35	
Traverses	—	—	24	24	80	300	8	40	—	24	
Ditch of traverses ..	5′ 4″ × 5′ × 3½′	24	—	24	—	—	—	—	24	24	
Platforms	—	—	24	24	Special tools.—*See* "Platforms."						
Total (1st Relief) ..	—	59	66	125	164	700	18	90	59	101	

2nd Relief, for Parapet, Front Ditch, and Platforms only, as for 1st Relief.

comes about because it would be necessary to space the howitzers at a further distance apart, probably 60 feet. Revetting materials should always be used, if possible, especially in front of the howitzers, but they are not of much importance between them.

Battery on sloping ground.

64. A battery on sloping ground would consist of a series (probably 4) of emplacements of the type shewn on Pl. 5. The distance apart of the howitzers will be much the same as in the battery on a level site, but the amount of excavation for each emplacement will vary with the site, and as the work is very simple there is no object in giving a calculation of the working parties. The time required to complete a battery on sloping ground will ordinarily be longer than for one on level ground, as the platforms cannot be started until the emplacements are finished.

There is no object, in this case, in having a continuous parapet joining the *fronts* of the emplacements as shewn for the battery on level ground, since communications cannot easily be arranged there. It is better to arrange for communication between the rear ends of the emplacements by means of an excavation of the nature of a deep shelter-trench, entered at either end by steps from the emplacement. Such a trench can, in cases of urgent necessity, be manned by the gunners with their carbines, and if continued beyond the flanks of the battery will give fair splinter-proof communication with the plotting stations and magazines. (See Pl. 7.)

Platforms.

65. A more important point now-a-days than the provision of cover for siege artillery is the provision of a good reliable platform for the pieces to be worked on. From a badly laid platform, or from one that will not keep its shape, or is constantly shifting, it is very difficult to get good results from a gun, and quite impossible from a howitzer.

The objects aimed at in designing a siege platform should be briefly these:—The platform should be as simple as possible, and easily repaired, it should not be too heavy, it should retain its shape and should not shift under continuous firing, and it should be capable of being easily and quickly laid. Furthermore, if a holdfast or anchorage is considered a necessary adjunct to it, this should, if possible, form part and parcel of the platform, so that there may be no necessity to carry out much additional excavation or work beyond what is required to lay the platform.

Platform, siege, double-decked.

66. By far the commonest platform for siege purposes is the "double-decked platform." This can be used for the field howitzer, but it is too light for use with the 8-inch B.L. howitzer, and is of no use with any disappearing mounting for the 6-inch B.L. gun. It is specially employed for the working of the principal siege piece, the 6-inch howitzer, with or without its wheels.

PLATE 7

TYPICAL POSITION FOR HOWITZER BATTERIES

Opposite to para 29.

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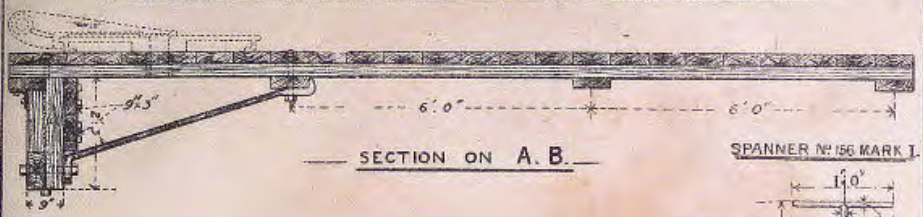
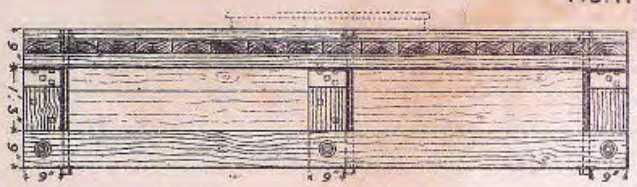
DOUBLE DECKED PLATFORM WITH PIVOT PLATE AND ANCHORAGE



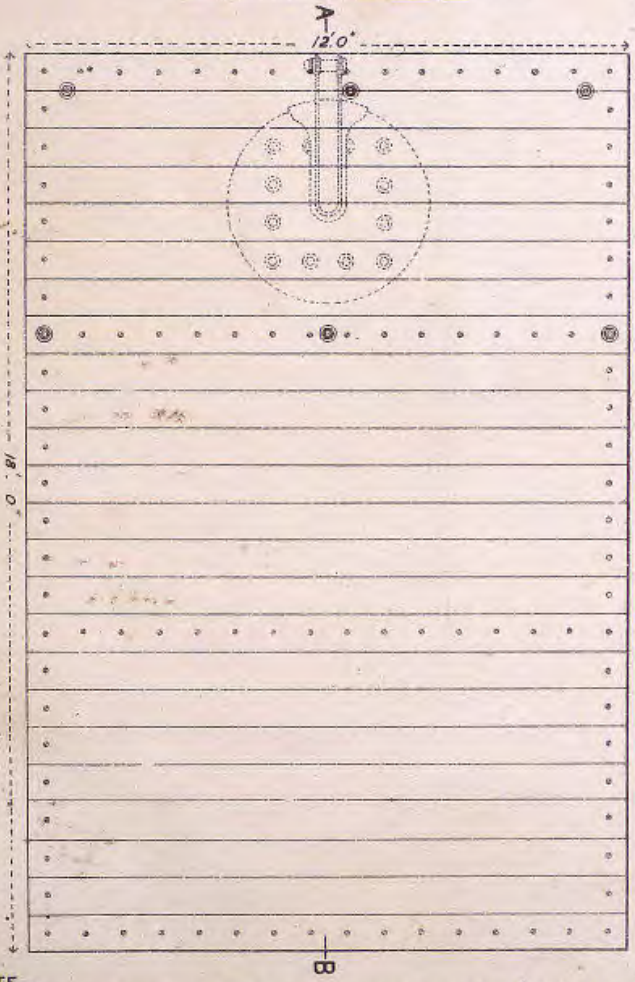
SECTION ON A. B.

SPANNER № 156 MARK I.

FIG. 1.



FRONT ELEVATION OF ANCHORAGE



NOTE.

THE PLATFORM IS LAID AT A DOWNWARD SLOPE OF $\frac{1}{24}$ TO THE FRONT

Opposite to para 66.

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PLATE 9.

— 6. INCH B.L. HOWITZER ON D.D. PLATFORM —

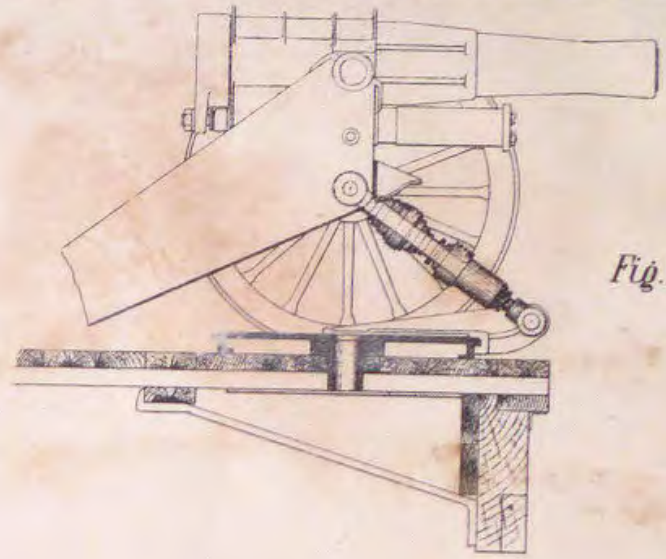

Fig. 1.

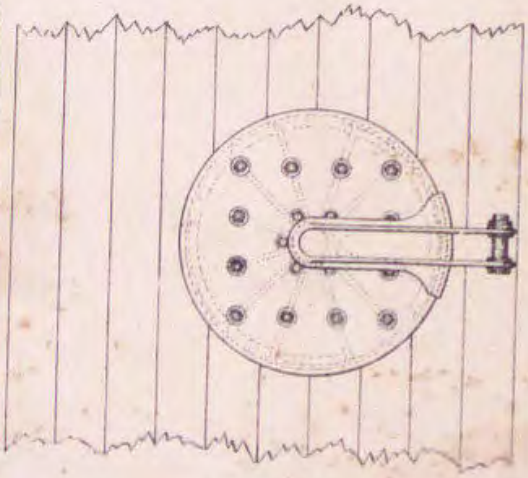

Fig. 2.

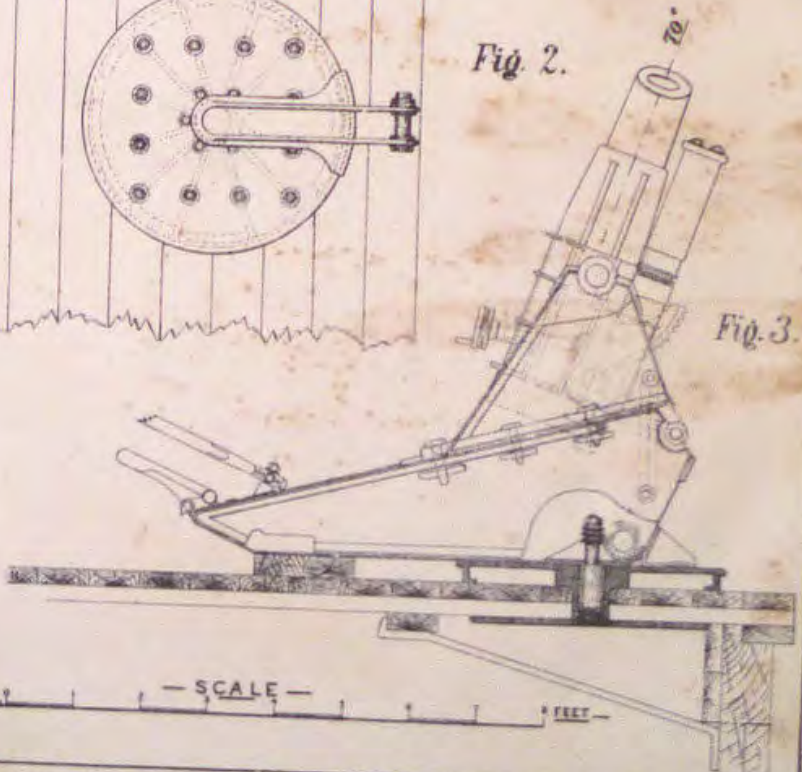

Fig. 3.

Opposite to para 68.

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Pls. 8 and 9 give details of the platform as arranged for this piece.

The platform itself consists of two layers of 3-inch fir planks, the bottom layer being parallel to the line of fire, and the top layer at right angles to it; under the bottom layer are placed four transverse planks similarly to those of the top layer; one at the front, another at the rear, of the platform, the other two as shewn in the plates. The layers are connected together by 5-inch coach screws, except where the lower four transverse planks come: here the three thicknesses are connected by 9-inch screws, 16 to each transverse plank. The heads of the coach screws are countersunk into the top layer.

One platform consists of—

Bottom layer, 16 planks, 18 feet × 9 inches × 3 inches.
Top layer, 24 planks } 12 feet × 9 inches × 3 inches.
Transverse, 4 „ }
40 5-inch square-headed coach screws, $\frac{5}{8}$ inch diameter.
64 9-inch „ „ „ $\frac{5}{8}$ „ „

The platform should be laid at a downward slope of 1 in 24 (2° 23′) to the front, with a clear space of at least 1 foot between the front of the platform and the foot of the interior slope. The object of this arrangement is (1) to leave a sufficient gangway between the front of the wheels and the interior slope, so as to enable the officer, or No. 1, who lays the howitzer, to pass round to the front of the trunnions when the howitzer is in the firing position, to lay "reverse"; (2) for convenience of drainage; (3) to prevent the earth and stones shaken down by the shock of firing falling on the platform. It is usual also to allow 2 feet between either side of the platform and the base of any slope, that may be met with there.

The weight of a double-decked platform as above described is about 35 cwt.

Platform for 6-inch howitzer.

67. The above description is of the platform alone, without pivot plate or anchorage, as it might be used for pieces of the mobile siege train.

For use with the 6-inch B.L. howitzer it is provided in addition with an anchorage, which is attached to the front of the platform to prevent its shifting to the rear, and with a steel central pivot plate, to which the buffer of the carriage is attached.

Anchorage to platform.

This anchorage can be best understood by studying Pls. 8 and 9. It consists of three blocks, 27 inches long and 9 inches square, to which are attached two transverse planks 9 inches × 3 inches, and one 9 inches × 9 inches. It is attached to the platform in front by three bolts and iron brackets, and behind, at the position of the second bottom transverse planks, by three $1\frac{1}{4}$-inch iron tie rods attached to the bottom of the anchorage. The bolts' heads and nuts are countersunk in the top layer.

Pivot plate.

68. The pivot plate is a circular steel casting with a flat top surface and a socket in the centre (Fig. 2, Pl. 9). It is fixed

in position by twelve bolts, which pass upwards through a washer plate, and through the planks, and which are secured by nuts countersunk into the face of the plate at top. When used with the travelling mounting with wheels (as in Fig. 1, Pl. 9) the springs and buffer of the carriage are attached to a cast steel radial arm, pivoted at the centre of the plate, which allows a certain amount of traversing to be given; when used with the mounting without wheels, as in Fig. 3, a bolt is employed to hold the mounting steady through the centre socket.

69. The approximate weights of the different portions of a double-decked platform, fitted completely for use with the 6-inch howitzer, are as follows:—

					T.	c.	q.	lb.
Timber of platform and anchorage				..	2	2	0	0
Tie rods, bolts and nuts for anchorage				..	0	2	2	8
Pivot plate ..	..	0	6	0 24				
Washer plate..	..	0	1	0 3				
Bolts and nuts for plate ..	..	0	0	1 22	..	0	7	2 21
Radial arm..	..	..		..	..	0	2	0 12
Coach screws	..	..		..	..	0	0	1 14
1 Trail plank	..	..		..	..	0	2	1 7
2 Wheel plates	..	..		..	..	0	3	0 6
Roughly..		..		..	..	3	0	0 0

The radial arm, trail plank and 2 wheel plates would not be required when the piece was fired from the mounting without wheels, but a bolt weighing about 60 lbs., and two extra planks, 12′ × 9″ × 3″, to go under the trail, are required. These latter should be of hard wood, by preference.

The whole of the above, except the trail plank and wheel plates, are carried and laid by the Royal Engineers. Siege companies of the Royal Artillery are also trained in laying the platform when at siege practice.

Mode of laying.

70. All platforms of this nature should first be fitted together in the R.E. park before being sent down to the batteries; each part being carefully marked so that there may be no difficulty in fitting them together on the spot.

With a working party of 1 N.C.O. and 6 men, the platform can be put together in the park in from 6 to 8 hours, when all holes have to be bored, and no special difficulty is met with in fitting together the iron work. The same party can take the platform to pieces again and load it on wagons in about 3 hours.

Supposing this to have been done, the actual work of laying the platform on the floor of the emplacement is carried out as follows:—

(*a*) Commencing from ground level in rear of the platform, level all over to a slope of $\frac{1}{24}$ downwards to the front, and excavate front trench for anchorage

2 feet deep, 1 foot 6 inches wide, and 12 feet 6 inches long, and make grooves for tie rods.

(*b*) Fix lower end of tie rods to anchorage and lower it into position.

(*c*) Lay second transverse plank on the upper end of the tie rods, and put bolts through to receive the deck.

(*d*) Lay pivot washer with bolts ready to receive the deck.

(*e*) Lay other transverse planks and deck, and screw down coach screws till their tops are flush with the deck, mount pivot plate and fix all nuts.

Front trench.

No special precautions are necessary in excavating the front trench, except that in sandy or loose soil it may be necessary to revet the rear face of it with sandbags. It is important to make the rear face give a good bearing surface to the anchorage; the shape of the other sides of the excavation is not important. It is not advisable to ram earth round the anchorage, but rather to let the anchorage take up its own bearing, which it will do after the first round or two has been fired from the platform.

Placing anchorage

Lowering the anchorage into the front trench requires some care. Two methods have been tried with success. In the first case it was lowered into the trench, after resting on two of the 12-feet planks across the opening, by means of ropes passed under it; in the second case it was supported by steel railway bars used as levers, and lashed to the anchorage at either end in the direction of its length, and then lowered down.

Completion of platform.

To complete the platform a ramp of earth, with possibly a fascine, is made, in rear, to allow of the howitzer being run on to or off the platform, but it is not advisable to pack earth round the sides or front, as it is apt to get drawn in under the platform during firing, making it uneven.

Time, men, tools, &c.

71. One N.C.O. and 6 men, with slight help to get in the anchorage, can lay a platform, with anchorage and pivot-plate, previously fitted together in the park, in seven hours. The tools required are 4 pickaxes, 4 shovels, 4 socket spanners (No. 156) for coach screws, 1 spanner for large bolts (special), 1 6-foot rod, 1 bundle of pickets, 1 tracing tape, 1 field level, 2 handspikes or rails, and 2 lashings of 2-inch rope, 5 fathoms long. The socket spanner is shown in Fig. 1, Pl. 8.

Additions to platform.

72. The exact distance from the centre of one platform to that of the next in a battery is often a matter of great importance to the Artillery in arranging for the laying of the pieces, and this distance should therefore be marked up in a conspicuous position in each emplacement, or painted on the platform itself. The distance should be given in feet and inches from No. 2 pivot. When timber is plentiful, and the platform is likely to be much used, it appears advisable in laying for the 6-inch howitzer, to add two or more extra transverse planks

under the wheels and trail of the howitzer in addition to the four that are usually provided, so as to give extra resistance to the downward blows.

Mounting for 8-inch B.L. howitzer.

73. The mounting for the 8-inch howitzer is still under trial. It is necessarily very much more complicated and much heavier than that for the 6-inch. Here the double-decked platform is of no use, and a special platform is required. A platform, with an experimental mounting, was laid at Lydd in 1894 by 20 men in 3 working days, the different parts being carried to the battery by the siege railway. The total weight of the piece, mounting and platform, was 14 tons, pointing to the fact that this piece can only be used for special work, under special conditions.

Mounting for the 6-inch gun.

74. There are several mountings for the 6-inch gun which have been tried, all on the disappearing principle. Each type of mounting requires special holdfasts of its own, but the whole is in the experimental stage, and need not be described here, except to mention that all such mountings are very heavy and take some days to get into position, ready for action.

Magazines.

Types of Magazines.

75. In the present day, when cordite is likely to be the propelling agent in all siege pieces, magazines will be very much more simple and easy of construction than was the case when gunpowder was used. Cordite is slightly affected by changes of temperature, but is almost unaltered by dampness; and it is doubtful if any explosion would occur even if it was struck by a shell. Consequently the magazine of the future will be a weather-proof and possibly splinter-proof protection, but nothing more.

In the construction of such magazines, Jones's steel-band gabions, small timber scantlings, tarpaulins, and corrugated iron are all of great use.

The temperature of magazines for cordite should not exceed 100° Fahrenheit, so that a corrugated iron covering should not be used without earth over it.

The sites of the magazines would in most cases be on the flanks of the batteries or emplacements, not more than 100 yards away from the flank pieces, with probably some splinter-proof connecting trenches between them and the battery.

Pl. 10 shews typical magazines, but they may be of almost any shape that is convenient, provided they are proof against weather and splinters.

Receptacles for high-explosive shells in batteries.

76. In addition to the magazines necessary for the storage of cordite cartridges, other arrangements will have to be made for the storage of shells filled with high explosives. These shells are liable to be detonated, if a shell, similarly filled, detonate *in contact* with them, and, consequently, in order to limit the loss of shells, and the quantity of fragments scattered

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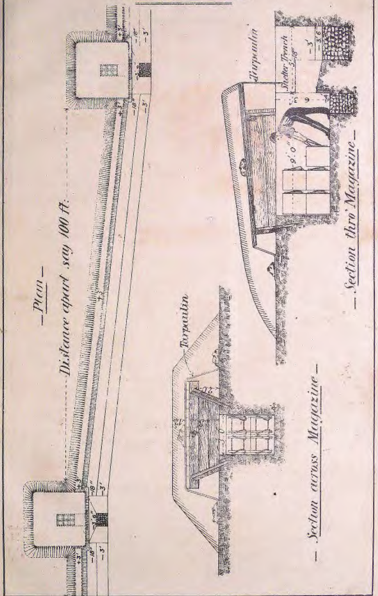

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about, the shells should be dispersed, in small receptacles, on the flanks of the batteries.

Though shells may stand, on their bases, in a hole containing some water (having noze fuzes) it is still undesirable that they should be so stored, as they may be detonated by being struck by a blind shell or large fragment. The receptacle should, therefore, be designed so that the shell lie on their sides, with a splinter-proof covering of earth thrown up round them, to prevent the lateral dispersion of fragments; with splinter-proof overhead cover, if the latter can be arranged.

Observation of Fire and Observing Stations.

77. There are two separate and distinct methods of observing fire, known as :—

(*a*) Ordinary observation, by eyesight.
(*b*) Exact observation, by instruments.

When (*b*) is employed arrangements would be made, whenever possible, to fall back on (*a*) in case of any break down in (*b*).

Ordinary observation usually takes place from the firing point itself, or from its immediate vicinity, and can only be used when the target is well defined and clearly visible ; and in this way the absolute necessity for such power of observation, or otherwise, may influence the choice of site for a battery and of its communications. Ordinary observation.

It is evident, however, that this method of observation can, rarely, be employed in the cases where hidden batteries, either of the attack or of the defence, are firing at one another.

Neither the target, or the burst of the shells will, then, as a rule, be visible from the firing point.

Under these circumstances the use of captive balloons, as portable observatories, will, doubtless, be resorted to, as an aid to ordinary observation.

78. The normal military balloon has a capacity of 10,000 cubic feet, and is filled with hydrogen gas. A balloon complete with car, carpocket, hoop, net and canvas cover, weighs 147 lbs. Use of balloons.

The principal limitation to the use of a captive balloon is inability to work, under ordinary circumstances, with a wind blowing over 20 miles an hour. In England, it may be assumed that captive work would be possible for three days out of five in the summer months ; and two days out of five in the winter.

On a clear day, with a light wind, an altitude of, at least, 1,000 feet could probably be attained. Two miles may be looked upon as the normal minimum distance from the enemy's field guns, and three miles where heavier guns are employed. Sudden ascents might possibly be made for a short time, at a slightly shorter distance, by keeping the balloon constantly in motion, both horizontally and vertically.

It is evident therefore that, under the most favourable

circumstances, a balloon could only search, with ordinary observation, the reverse slope of a hill which was not steeper than $\frac{1}{10}$, so that there must still remain many sites for batteries which cannot be searched at all.

Exact observation.

79. Exact observation would be carried on, with accurate observing instruments, from regular fixed observing stations. Such stations would be in the most commanding positions possible, often in a lofty building or a tree, where the target and burst of the shells were plainly visible. There is no necessity for them to be close to the battery provided that they are in good telephonic communication with it (see Pl. 7), though they should not, *as a rule*, be far away, in order that the battery commander may visit them, if he wishes to do so. There would usually be two observing stations to each battery; one should, if possible, be close to the line of fire, as the nearer it is, the more accurate will be the observations for *line*. It is usual to have one station on either side of the line of fire, but both may be on the same side. Practically, it has been found that, on the whole, the best results are obtained with a base (*i.e.* the distance between the observing stations at equal distances from the target) of about $\frac{1}{6}$th of the range, but it is quite possible to work with a base as small as $\frac{1}{10}$th. The stations must be so chosen that a good view of the target can be obtained, but should not be so conspicuous as to invite attack, from which they should be screened by slight natural or artificial cover. Where there is no means of telephonic communication, flag signalling or even black boards can be employed. The observing stations themselves would be of the simplest possible nature, often similar to the deep shelter pit used in field defences, with, if possible, sitting accommodation for the observer at the instruments, and for the telephone operator, and some weatherproof roofing.

Observing stations.

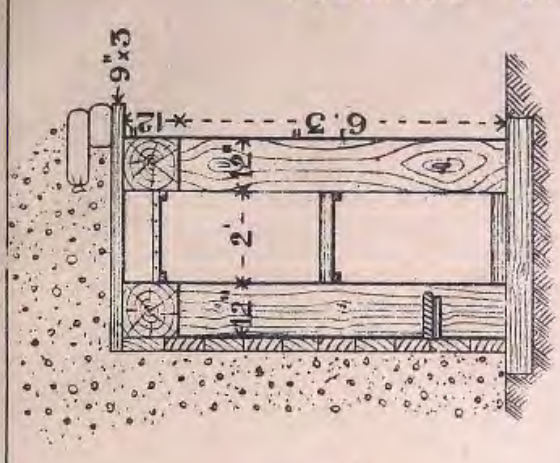
As the distance between the two observing stations of a battery must be determined, it is advisable that they should see one another.

It is doubtful if exact observation could take place from balloons.

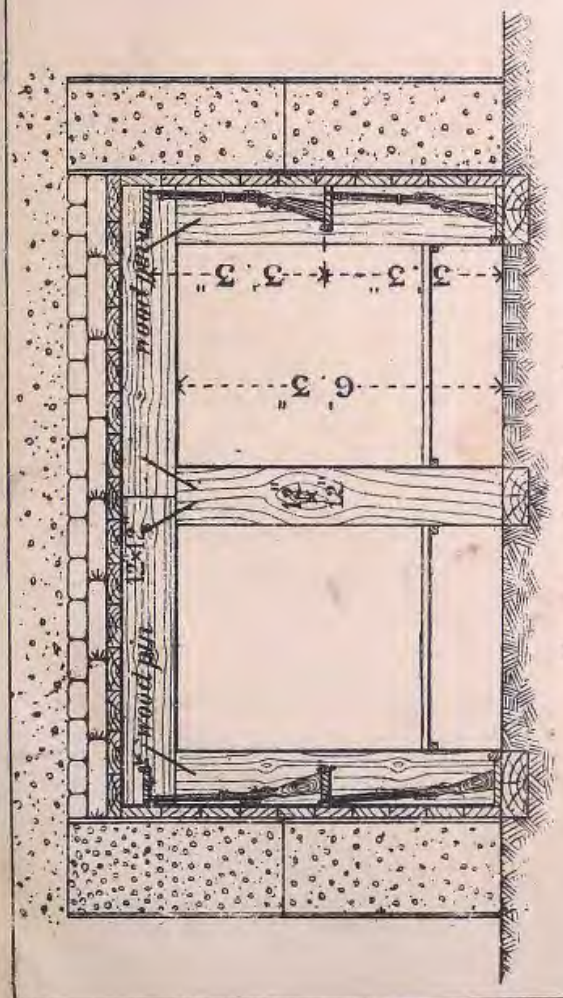
Plotting Stations.

80. From the two observing stations of a battery the bearings of the burst of each shell are sent into the plotting station and the position of the burst plotted. As the battery commander may have to be first on one flank of the battery and then on the other to get a good view of the working of his guns, and yet should be in communication with his plotter, it would appear, at first sight, that an alternative plotting station would be required on either flank; but as alternative plotting stations complicate the telephone arrangements and require much extra labour, we may take it that, as a rule, there would probably be only one plotting station, and that near the

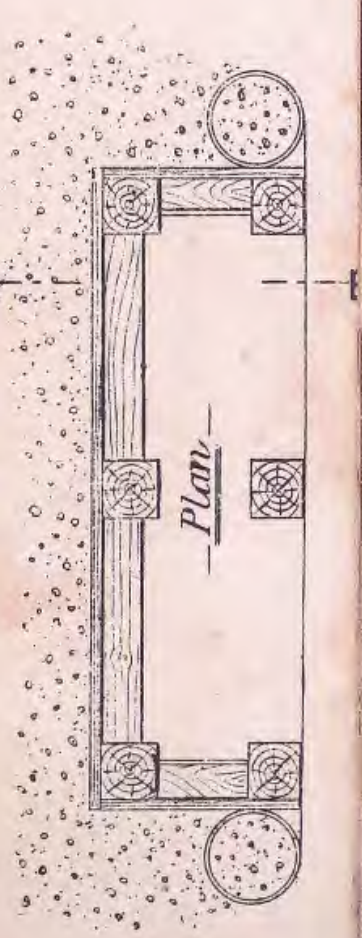
PLOTTING STATIONS.



Section on A.B.



Sectional Elevation



Plan

Opposite to para 80.

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guns, on one flank. An alternative station would be somewhat of a luxury, and could be built when the first press of work of getting the guns into action was over. Such a plotting station should contain accommodation for 2 telephone operators, and 1 plotter, and can, conveniently, be used also as a store for the gunners' carbines, for which purpose it should contain racks for 6 carbines per gun. No regular table is required; a rough bench or seat is sufficient. The battery commander would not remain in the plotting station; he would, as a rule, be keeping his eyes on the working of his howitzers, and possibly on the results of his fire, if he chanced to be in a position to observe it from the vicinity of the battery.

Such a plotting station should be, as far as possible, splinter-proof and weather-proof, but nothing more. Plate 11 gives the details of one of the plotting stations at Lydd, which was found very satisfactory.

Arrangement of the Artillery Position.

81. Having considered the details of the batteries, with their accessories in the way of platforms, magazines, observing stations, &c., we must next consider how the batteries could be sited on the artillery position.

It is probable that a group of batteries, having more or less one common object of attack, will be arranged on each portion of the artillery position. These batteries will be connected with one another and with the advanced depôts and field arsenal in rear by means of the siege railway, or by the existing roads, near which latter they will, consequently, often be sited.

Pl. 7 shows two such batteries sited behind a hill—one on the slope of the hill, the other on the level ground at the bottom of the valley. Shelter trenches and obstacles have been arranged on the front of the hill to assist in the defence of the batteries against a sortie from the garrison.

Casemate accommodation, proof against weather and splinters, for the shelter of the gunners, at times when they are not actually working the guns, or for wounded men, is also shown. It would probably not be possible to arrange for this at the early stages of the attack.

SECTION VII.—INFANTRY ATTACK.

Siege Trenches.

Covering party.

82. In order to carry out successfully such a large operation as the formation of great lengths of trench for a parallel, a very strong covering party must be detailed to occupy the ground in front, and so endeavour to prevent any molestation of the working parties whilst digging. These covering troops, composed almost entirely of infantry, should be on duty for 24 hours, and carry with them cooked provisions for that period.

Their formation should be very much that of a line of outposts on an ordinary defensive position. In addition to reconnoitring patrols in front, who must pay particular attention not to discover themselves, an ordinary line of piquets and sentries, with supports, should be pushed out some distance in front of the working party, the line of sentries being if possible 200 or 300 paces away from it. The reserves should be massed at from 500 to 1,000 paces in rear of both flanks. At day-break, the working parties being withdrawn, the covering parties should occupy the newly made trench. Large bodies of troops should also be concentrated in any cover in the vicinity to repel any attack, especially on the flanks.

Advance of covering troops.

The advance of piquets and supports should take place simultaneously just before the commencement of the tracing of the trenches, the parties for which would immediately follow them. The reserves would take up their position by routes previously laid down, so as not to interfere with the advance of the working parties.

Duties of covering troops.

The duty of the covering troops being, firstly, to prevent the discovery of the opening of the work by the enemy, and secondly, to protect the working parties in the event of such discovery, they should avoid, as much as possible, attracting the enemy's attention, and should not fire unless there be no doubt of the enemy's intention to attack in force. In this case, as a rule, the sentries fall back upon the piquets, the latter pushing forward to join them, and being joined by the supports. In this manner the attack will probably be repelled without interfering with the working parties, in which case the troops resume their original position. Should, however, the attack be pressed forward with such vigour as to force back the covering troops at any point, the line of the trench (especially if the work has been going on any time) will afford a strong point for repelling it. Retiring on the working parties should, however, be resisted to the utmost.

The reserves would usually be employed on the flanks of an attack, or as circumstances directed.

If a second or subsequent parallel requires to be formed the covering troops would be in much the same formation, but the distances they are pushed forward would have to be reduced, on account of the proximity of the fortress. Thus for a second position the chain of sentries might be about 150 paces in front of the proposed trench, the piquets about 50 paces in rear of the sentries, and either extended in files at 2 to 3 paces interval, or divided into small groups so as to admit of a rapid extension; the supports, by companies, about 50 paces in front of the working party, and reserves in the first parallel.

Tracing Trenches.

83. It is usually advisable to trace out the different siege trenches and approaches, even when they are merely formed by

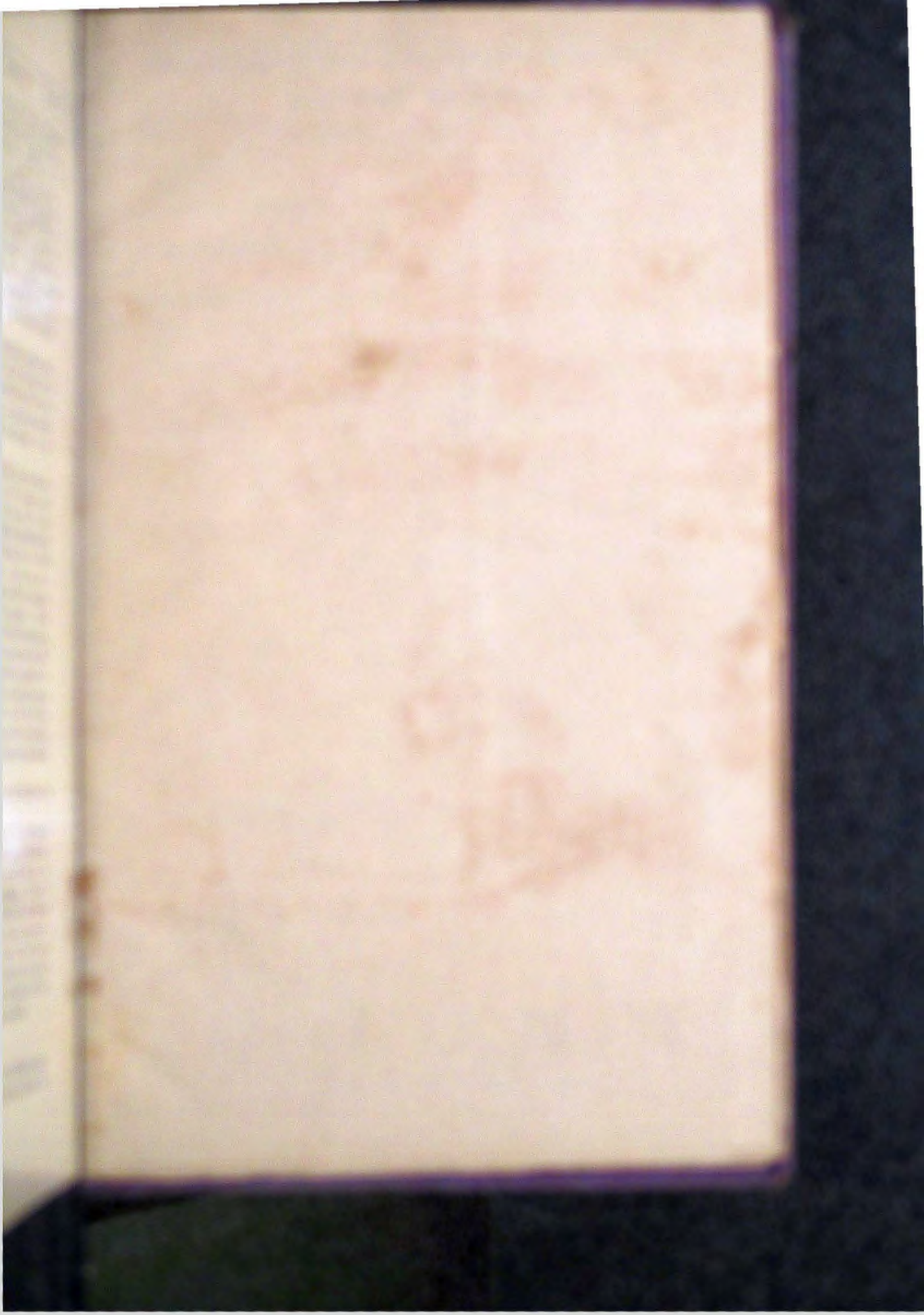


PLATE 12.

TRACING TRENCHES AND EXTENDING WORKING PARTIES.

Fig. 1

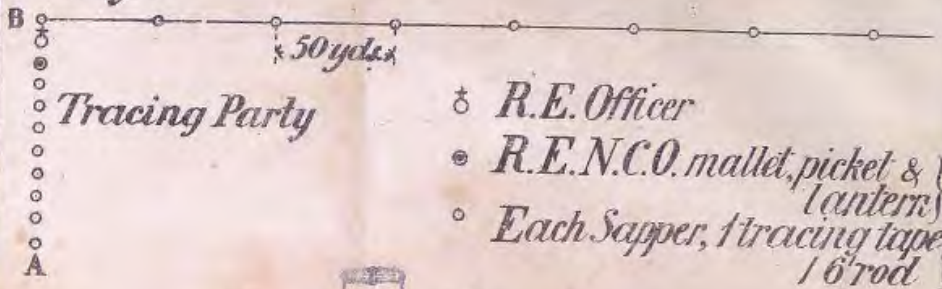


Fig. 2 *Tracing Lantern*

Fig. 3

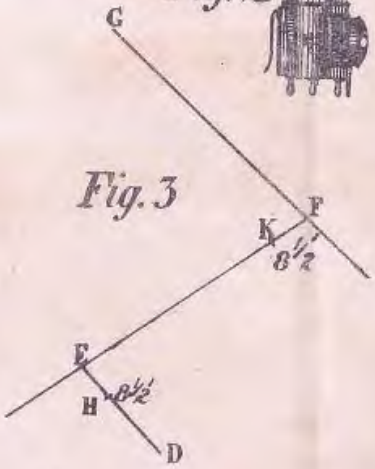


Fig. 4

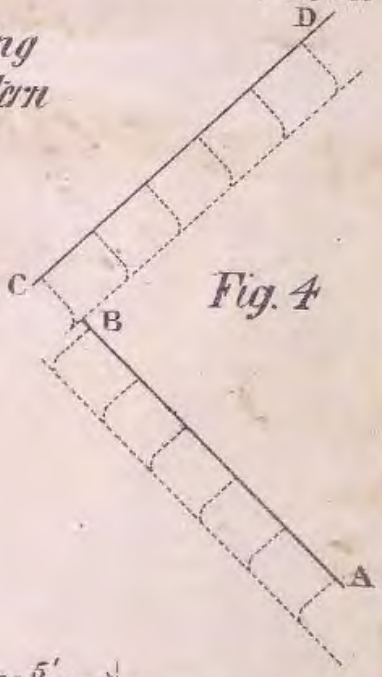
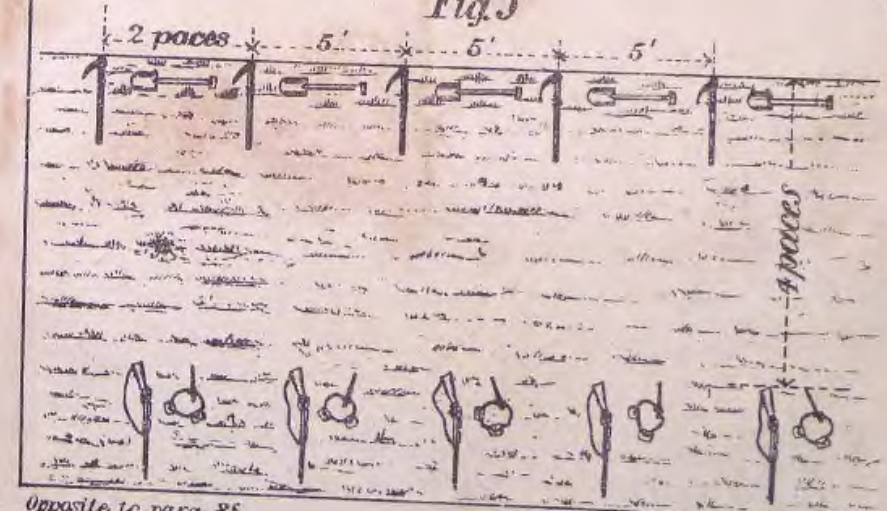


Fig. 5



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the conversion of existing shelter trenches, so as to ensure their correct position when made at night. With this view the ground on which they are to be placed should be most carefully examined beforehand by the engineer officers told off to the duty. The positions of different points in the line of the trench may be marked on the ground in such a manner that no difficulty will be experienced in finding them in the dusk, provided nothing is used for this purpose that would give a hint to the enemy of the real intentions of the besiegers. Every effort should, on the contrary, be made to deceive him as to the true object. If any points occur in the lines which are screened from the fortress, a sapper should be stationed there during daylight to await the arrival of the tracing party. These animate points can more readily be found, however dark the night may be, and thus one risk of delay or error in laying out the work is avoided.

Observations on marked points should be taken at the time of making the reconnaissance of ground for the first trenches, with a view of tracing in the required and correct direction.

Method of tracing.

84. The tracing is commenced in the dusk of the evening, when sufficiently dark to conceal men from the view of the besieged at the distance fixed on for the trench, while objects in the immediate neighbourhood are still visible.

The tracing is executed by the Engineers. It should be done in sections, corresponding to the strength of the working parties to be furnished by each battalion. These parties will rarely exceed 500 men per battalion—the section for such a party is 800 yards, or 750 yards, allowing for a reserve of 10 per cent. of men.

85. For tracing trenches, white tape 1½ inch wide is kept as an article of store.

Tracing parties and tools.

Each tape is 50 yards long, and may advantageously be marked at intervals of 5 feet with short pieces of tape sewn on it; it is wound upon a white picket, and has loops of line at its ends. Each tracing party consists of one engineer officer and one non-commissioned officer, and one sapper for every 50 yards or fraction thereof.

The party parade at the required hour in single rank, each sapper being provided with a tracing tape and a 6-foot rod, and the non-commissioned officer with a special tracing lantern which allows of a little light being thrown down directly upon the ground (Fig. 2, Pl. 12), a mallet (head muffled with felt) and a picket. The officer, followed by the non-commissioned officer and men in single rank, proceeds as from A to B (Fig. 1), the point from which he is to commence tracing. At B No. 1 sapper halts and gives the end of his tape to the officer, who marches along the line followed by the remainder of the *men*. The sapper drops the ball and lets the tape run out through his hands, checks it when the ball is nearly finished, and, when it comes to an end, pushes the picket into the ground between his

heels. The picket is then secured by a few taps from the mallet of the non-commissioned officer, who remains behind with each sapper for this purpose, until his tape has run out, moving on to No. 2 as soon as the picket has been driven. The officer places No. 2 sapper at the end of No. 1's tape, takes the end of No. 2's tape, and continues tracing as before; No. 1's tape is fastened to No. 2's picket, and so on. As each sapper's tape is fixed he lies down facing the direction from which the working party will come up, ready to assist in extending them.

Each sapper should be instructed as to the particular point in the trench which he marks, thus—"100 or 400 yards to the right *or* left of the starting-point of the.....section," the sections being numbered from one flank to the other in the trenches, and lettered in the approaches. In this way, should any deviation from the proper route occur in bringing the working parties up, the Engineer officer conducting them will be readily able to remedy the mistake, and bring them on to their proper sections of the work.

Tracing approaches.

In tracing approaches, the zigzags DE, EF, FG, Fig. 3, usually from 50 to 100 yards long, are first traced, so as to be defiladed from the fire of the defence works; at points H and K, 8 feet 6 inches from E and F, the tapes are cut (to be clear of the trench to be executed), and the cut portions extended in prolongation of FE and GF, to form "returns." These returns are usually made 10 to 20 yards long, to conceal the angle of the approaches; they are traced with the required length of tape.

As soon as the tracing is finished, the officer returns to meet the working party and conduct them to the point of extension, and the non-commissioned officers of the tracing parties help to extend them, each sapper assisting over his own 50 yards, and, afterwards, to superintend the execution of the work.

The greatest care should be observed in handling the tracing lanterns; the light showing through the bottom is all that should be used, and on no account should any ray of light be thrown towards the fortress.

Extending Working Parties.

Detailing working party.

86. The tracing having been executed in sections, to correspond with the length of line required for the various working parties, the latter should be provided with a reserve of 10 per cent. with picks and shovels to replace casualties, and relieve individual diggers at the discretion of the officer in charge. It is undesirable, under any circumstances, to extend more than 500 men from one point. The working parties parade in fatigue dress, with rifles slung as for escalading, waistbelts, bayonets, ammunition pouches with 20 cartridges, and filled water-bottles. They are marched to the intermediate parks, to receive the tools, one pick and one shovel for each man of the working party, and of the reserve. They are drawn up in quarter

column, with the reserve of 10 per cent. in rear of the column; sappers, in about the proportion of 1 to every 30 men, being on the reverse flank of each company.

Laying out tools.

87. Although it is very desirable that the Commanding Royal Engineer should be supplied—on the morning of the day fixed for the opening of the trenches—with a return showing the strength of the working parties likely to be furnished by the different companies, yet, owing to exigencies of the service, it is not likely that these numbers can be strictly correct. It will, therefore, be impossible to lay out the exact number of tools for each company. Arrangements should be made for the speedy distribution of the tools, either by having them laid out in rows, or by having a proportion in rows and the remainder in heaps, as may appear desirable.

In laying out tools in rows the sets should be one pace apart, with an interval between the rows of three paces. The pick is placed on the left, and rather in front of, the shovel.

For the "Formation of working parties" and "Issuing and returning tools," see *Infantry Drill*, 1893, paras. 213–(10), and 214.

Cautions to working parties.

88. Before leaving the park, it is advisable that the method of extension should be explained to the working party, even though many of them may be acquainted with it, and they should also be specially cautioned with regard to the following points:—

(1) The task each man is required to execute.
(2) That covering troops are posted in front for their protection, and that their arms, when laid down to commence work, are not to be taken up again, even in case of attack, except by order of the commanding officer.
(3) Silence to be strictly maintained, and care taken to avoid the noise caused by the tools or arms clashing together.
(4) Words of command to be given in an undertone of voice.
(5) No lights or smoking to be allowed.

Extension of working parties.

89. The extension should be made as foreshadowed in para. 216, *Infantry Drill*, 1893.

On arriving in the vicinity of the work, but at such a distance from it that the words of command cannot be heard by the enemy, quarter column will be formed, and the commanding officer will give the command:—FROM THE RIGHT (OR LEFT), TO SINGLE RANK-EXTEND.

The working party is then advanced towards the site of the trench and halted about 20 paces in rear of the point from which it is proposed to extend.

If the extension is to be to the left, the commanding officer will then give the command:—BY SUCCESSIVE COMPANIES EXTEND

TO THE LEFT. The captains of the companies will then give the executive orders, *No. — Company, right turn, quick march, left wheel*, and when the leading man is two paces in rear of the tape, *left wheel, at two (or more) paces interval, right form.* (See caution (4) above.) The captain will generally supervise the extension; the guides and supernumerary non-commissioned officers will assist him.

Each man as he forms on the tape will wait till his task is measured out, when he will drive his pick into the ground on the left of it, placing his shovel on the ground in front of him, at right angles to the pick (blade to the left), and lie down until ordered to commence work.

After the tools are laid down, and the ground in rear is clear of the rest of the party, the men will, without word of command, turn about, take four paces to their rear, lay down their rifles, butts towards the tape, take off their accoutrements, and return to their former positions. (Pl. 12, Fig. 5.)

The sappers of the tracing party, as the men form up, measure off portions of 5 feet along the tape, each being relieved by the next sapper at the end of his 50 yards. The sappers with the working parties assist in placing the men.

The reserve party of the working column is posted in rear of the centre of the extended section it belongs to.

Extending on approaches.

In extending men on approaches, when the angle of a zigzag has been reached, the order of forming up must be reversed in continuing the extension in a new direction. Thus, if the column from *a* to *b* (Fig. 4, Pl. 12) was forming to the right, it must, when extending on *c d*, form to the left.

Time.

About 100 men can be extended in five minutes.

Execution of Trenches.

Conditions that a parallel should fulfil.

90. A parallel, for use as an advanced infantry position, should give good cover to a strong firing line and supports, with a passage in rear of them; and it is advantageous if the trench can be got out with steps, on which the troops can sit, when not on sentry. There is no object as a rule in attempting to make the parapet of the trench proof against heavy shells, or (at any rate on the first night) in making the bottom of the trench wide enough for wheeled traffic, except for an occasional handcart or machine gun.

Section of trench for a parallel.

91. Pl. 13 shows a trench, which is suitable for the first night's work on a parallel. A party, commencing work at sunset, should complete everything before sunrise, and the trench would then be ready for occupation by a strong body of infantry. If it is thought advisable to revet the parapet, or to widen the trench, this work can be carried out, under cover, at any subsequent period.

Section of trench for an approach.

For an approach the same section may be used if it is intended to keep large bodies of men collected there, or the sides of the trench may be shaped off as shown by the dotted lines

SIEGE TRENCHES.

INFANTRY POSITIONS.

Fig. 1.

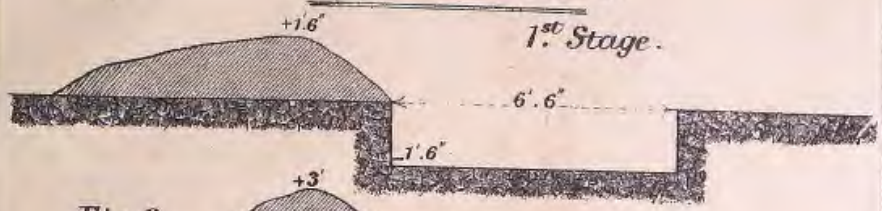


Fig. 2.

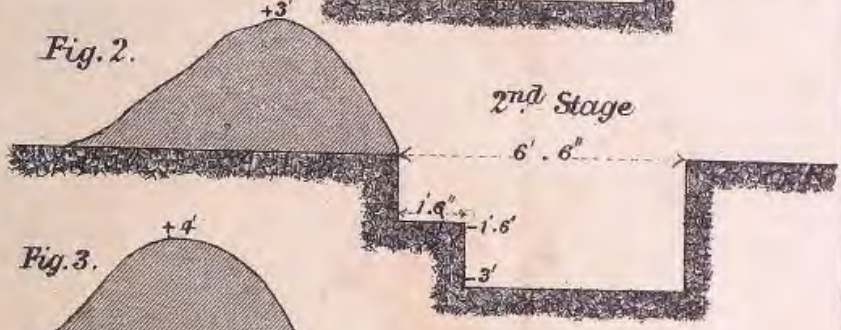
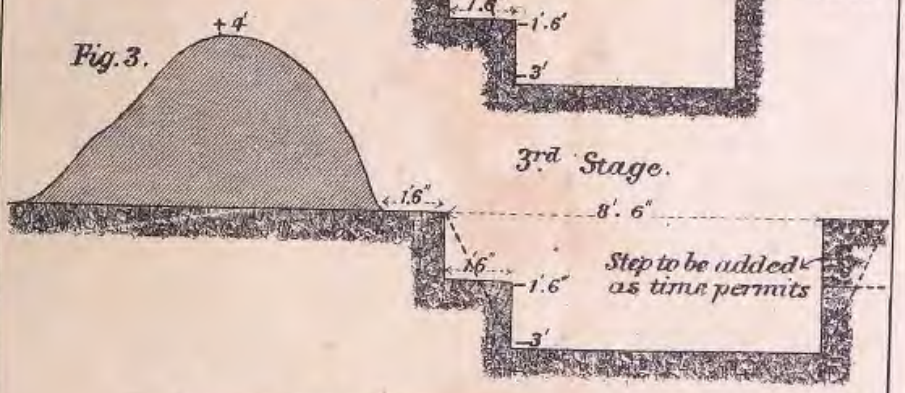


Fig. 3.



CASEMATES BEHIND TRENCHES.

Fig. 4.

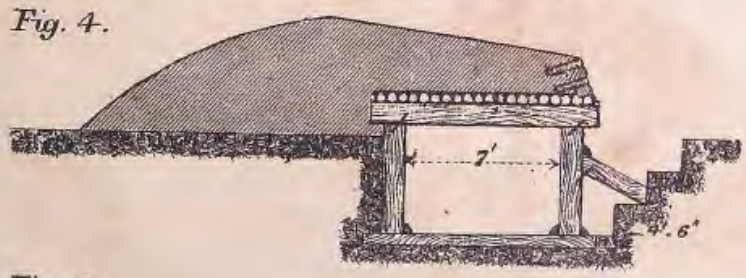
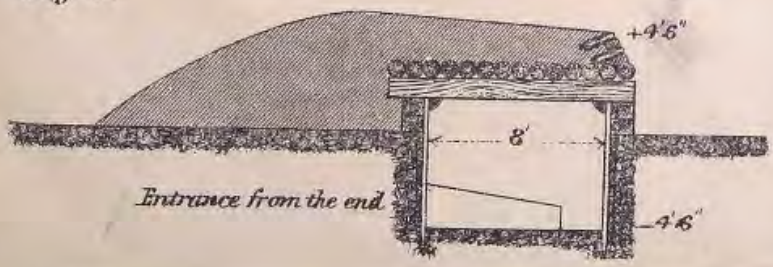


Fig 5.



Opposite to para. 91

in Fig. 3, so as to allow of handcarts, &c., passing up to the front.

Execution of the work.

The actual execution of the work requires but little explanation. It is best to get it out in stages as shown in the plate. The working party should be given to understand that at the order to commence work they should at once throw out a shelter trench of the ordinary depth, but 6 feet 6 inches wide (Fig. 1). By this means a continuous line of cover along the front would be thrown up in an hour, or thereabouts, which would make a strong rallying position in the event of a sortie by the garrison. The second and third stages are shewn in Figs. 2 and 3.

Stepping the parapet.

In the final parallel, if it is proposed to deliver an assault from it, it may be advisable to step the parapet, using fascines, boards or anything else that can be obtained to act as revetments to the steps.

Splinter-proof cover.

92. As soon as possible after the completion of an infantry trench, the construction of splinter-proof accommodation for the use of a portion of the guard of the trenches, for latrines, and for dressing the wounded, should be commenced.

This may be placed in the returns of the zigzag approaches, or in rear of the trench at the spots most sheltered from fire, and connected with it. Ordinary field casemates, covered with corrugated iron or rails or fascines and the excavated earth (as in Figs. 4 and 5,) are all that are required. More earth can, if necessary, be obtained from an excavation in front of the casemate, but this would only be required in exceptional cases when the casemate was exposed to the fire of direct-firing guns. Slight splinter-proof transverse partitions should be provided in these casemates, to localize the effects of bursts inside. Even a row of filled gabions would be better than nothing.

Drainage.

93. Every effort should be made to drain the trenches. This is no easy matter. French drains may be made and led to points where the natural lie of the ground allows of a surface drain being formed to carry off the water, but, at the best, deep trenches get very muddy in wet weather.

Sapping.

Sapping.

94. If the fire of the defence produces many casualties, or their vigilance is so great, that ordinary trench work can only be carried out with great difficulty, it is possible that the more certain but much more tedious process of throwing out the trenches by means of sapping may have to be eventually resorted to.

Sapping is usually executed by the R.E., and consists in constantly advancing a trench in the direction of its length by a party who work standing on the bottom of the trench and throw up a parapet on the exposed flank and end of the trench to protect themselves.

Possibility of sapping.

Progress by sapping has been rendered much more difficult now than it formerly was by the introduction of small quick-firing and machine guns, which cannot easily be altogether silenced and are very effective against sap heads, but it may probably still be resorted to against an enemy who is too demoralised for accurate fire, or who is in want of ammunition. The hours of darkness give great opportunity to the sapper; if no search light can be worked by the defenders, as would probably be the case in the later stages of an attack. Saps can always be driven at a greater depth if by that means security is obtained, and false sap heads would soon be started by the attackers, if it was found that the defenders were prepared to waste ammunition upon them.

Right and left-handed saps.

95. Saps are designated as right or left-handed, according to the direction in which they run: if to the right when facing the fortress, the sap is called right-handed, and the sappers use their tools in the ordinary way that a right-handed man does, viz., with the right hand on the T-head of the shovel; if to the left, the sap is called left-handed, and the sappers hold the T-heads of their shovels in their left hands.

General principles.

96. Sapping is necessarily a slow process, and as at this period of the siege rapidity of advance is of the utmost importance, owing to the number of casualties usually suffered, every effort should be made to push on the saps. To this end, it is necessary that ample reliefs should be provided, especially for the sapper at the sap-head who regulates the rate of the advance, and that weak men should not, if possible, be chosen for the work.

It will usually be found advisable to adopt task-work, as the men will do their utmost to get away as soon as possible from a position in which they are so much exposed to fire; but above all, every opportunity of resuming ordinary trench-work must be seized.

The service sap shield (Shield, sap, with handles, Mark II.) used as shown in Fig. 5, Pl. 14, may be substituted for the head parapet of earth or sandbags when the enemy's fire is only with bullets and is not plunging. The labour of moving the sandbags is thus saved. The existing shields are not proof against the direct fire of small-bore rifles, but with modern steel it is quite possible to make a shield of the same dimensions and weight, capable of resisting their penetrative power; and this is being considered.

Breaking out.

97. In breaking out a new sap from a parallel, the great object to be aimed at is to have the opening into the parallel covered as soon as possible. Supposing that such a breaking out will always take place at night, one or two men can creep over the parapet, get themselves under cover as soon as possible, and then work in both directions, one towards the front, the other through the parapet, towards the parallel, to meet the remainder of the party who work from the inside of the parallel. (Fig. 2, Pl. 16.)

SAPPING TOOLS.

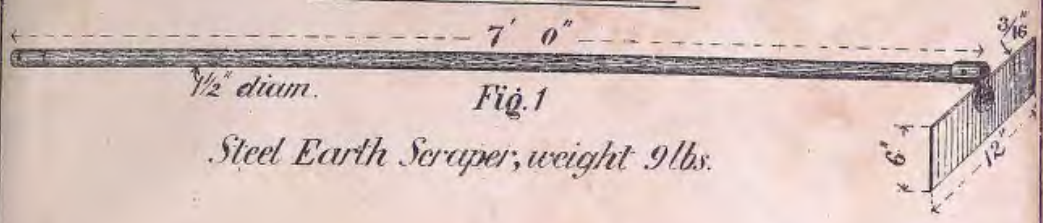


Fig. 1

Steel Earth Scraper; weight 9 lbs.

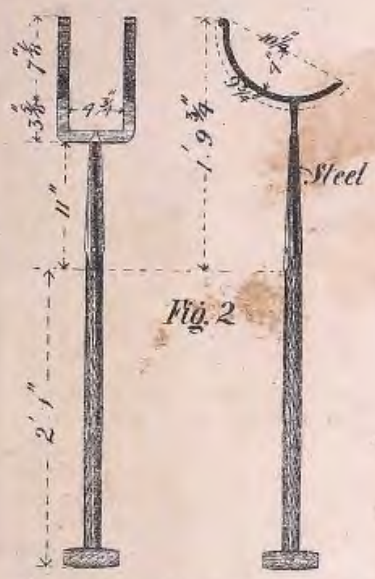


Fig. 2

Sandbag Fork, weight 5 lbs. 10 oz.

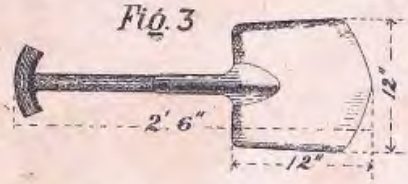


Fig. 3

Miner's Shovel, weight 6 lbs.

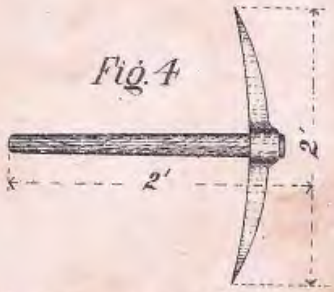


Fig. 4

Miner's Pick, weight 6 lbs.

Steel Sap Shield

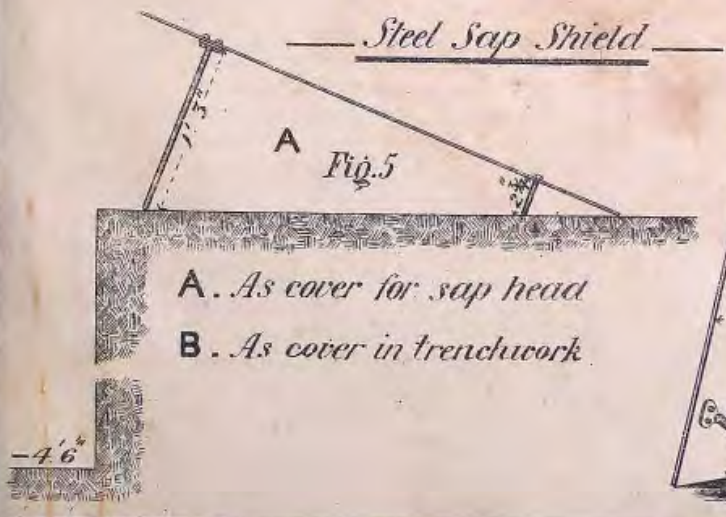


Fig. 5

A. *As cover for sap head*

B. *As cover in trenchwork*

Fig. 6

Opposite to para. 96.

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A portion of the interior of the parallel may be removed during the day previous to breaking out, in which case the earth must be distributed over the reverse of the old trench, so as not to indicate the position of the "breaking out" to the enemy by any mounds of earth.

98. Plan and sections of a left-handed sap are given in Figs. 2, 3, and 4, Pl. 15.

It is executed in two stages. In the first, a trench is excavated 4 feet 6 inches deep, 3 feet wide at the top, and 1 foot 6 inches at bottom, the side nearest the enemy having a slope with a base of 1 foot 6 inches, and the reverse side being vertical, if the earth will stand so. No berm is left.

In the second stage this trench is widened an additional 2 feet, and a berm of 1 foot 6 inches is formed, always allowing the front portion 9 feet of start.

The side parapet in the first stage is 2 feet 6 inches high, and thick enough to resist rifle bullets (*i.e.*, about 2½ feet or 3 feet at 18 inches above ground level). The head parapet or screen stretches across the head of the sap from the side parapet to the rear, where it is about 2 feet high, and is composed of about 60 or more sandbags painted or rubbed with mud so as be of the same colour as the ground, and about one-half or two-thirds filled, which are pulled down one by one, and either lobbed over the others by hand or placed in position by means of a special fork provided for the purpose (Fig. 2, Pl. 14) as the sap advances, a few spare sandbags being always kept ready filled in a convenient position in the trench to be used as occasion requires.

Strength of working party.

99. Each sap-head requires a detachment of 1 non-commissioned officer and 8 sappers, who are on duty for a relief of eight hours, when not on task-work.

The ranks work alternately, relieving each other on the completion of each yard in advance; the unemployed rank supplying casualties when necessary, and unless a detachment be reduced to less than four, it will have to continue without any additional sappers to push the sap-head for the remainder of its relief.

Each time a rank resumes work the men change rounds, the front sappers Nos. I and II becoming III and IV.

Execution of the work.

No. I, kneeling or squatting to his work, commences by undercutting the ground in front of him about 9 inches, pulling the stuff down at his feet. When sufficient earth has been loosened, he steps back and is replaced by No. II, who at once commences to shovel it on to the side parapet towards the head of the sap. When this has been done, No. I again resumes his position, and proceeds to throw or place the sandbags one by one just over the others, taking care to preserve a good musket-proof parapet in front, using the sandbag fork where necessary, until he has uncovered about a foot of ground at the head of the sap. He then proceeds to remove this in a similar manner.

To use the sandbag fork, No. I squats at the head of the trench and holds the fork upright, with the hollow of the top towards the rear, and grasping the handle near the steel head with one hand, and the T-head with the other. No. II then places a sandbag across the top of the fork, No. I lifting the fork up and down to see that the bag balances. No. I then slowly lifts the bag till it is above the position in which he wishes to deposit it, taking care not to expose himself, and then by turning round the T-head of the fork drops the bag and comes into position to receive another from No. II.

No. II, in addition to getting rid of the earth picked down by No. I, trims up the slope and sees that the task is got out to the proper dimensions.

Nos. I and II change rounds in the middle of their task, that is after the sap has been pushed forward 18 inches.

Nos. III and IV, working together at not less than 9 feet from the sap-head, widen the trench 2 feet throughout, and also form a berm of 18 inches. They throw their earth obliquely forwards towards the head of the sap, and regulate the height of the parapet by means of an earth-scraper of the form shown in Fig. 1, Pl. 14, pushing the earth on to the exposed side.

When the sap has advanced 1 yard, the non-commissioned officer gives the word *Relief*, and all the numbers rest their tools against the slope on the berm side, and pass to the rear, being immediately relieved by the other rank.

Rate of advance.

100. The sap advances at from 2 feet to 4 feet per hour. Right-handed sap generally progresses quicker than left-handed. The non-commissioned officer, R.E., in charge of each detachment is responsible for the proper direction of the sap, the rate of progress, and the correctness of the profile. The arms, while the men are at work, are laid on the reverse of the trench, as shown in Fig. 2.

Tools, &c.

101. The tools, &c., required are :—

For No. I, a miner's pick (Fig. 4, Pl. 14) ; a miner's shovel (Fig. 3) ; a gauge 4 feet 6 inches long, marked at 3 feet for the width of his task ; a sou'-wester hat, or a clean sandbag, and a sandbag fork. (Fig. 2.)

For No. II, a common shovel ; a gauge 1 foot 6 inches long for the width of task at bottom.

For No. III, a common pick ; a common shovel ; a gauge 5 feet long, marked at 4 feet 6 inches for the depth of the sap.

For No. IV, a common shovel ; an earth-scraper, with handle 7 feet long, for regulating top of the parapet. (Fig. 1.)

In addition are required for the detachment :—

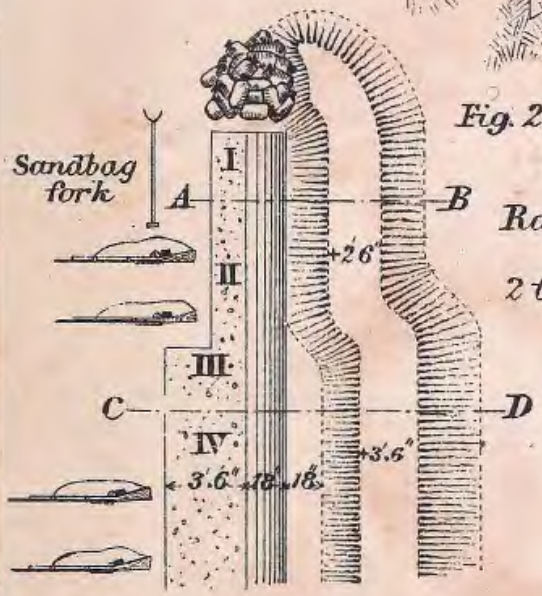
One 6-foot rod (for the non-commissioned officer) ; 4 pairs of knee-caps, for Nos. I and II of both ranks ; two shovels and one pick in reserve.

A crowbar, felling axe, and bill-hook may sometimes be required to remove stones, roots, &c.

SAPS

Fig. 1.

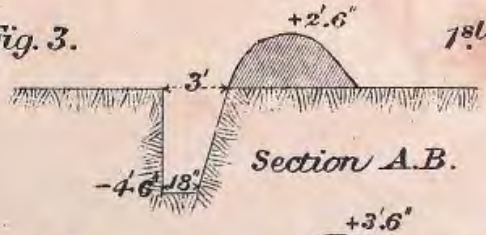
Fig. 2.



Rate of advance

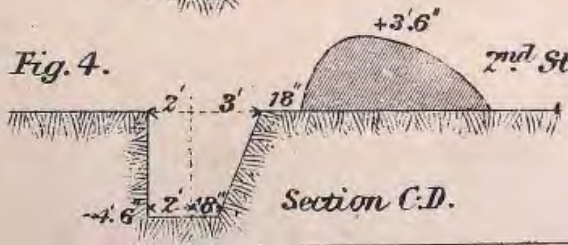
2 to 4 feet per hour

Fig. 3. 1st Stage



Section A.B.

Fig. 4. 2nd Stage



Section C.D.

Opposite to para 100

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SAPS.

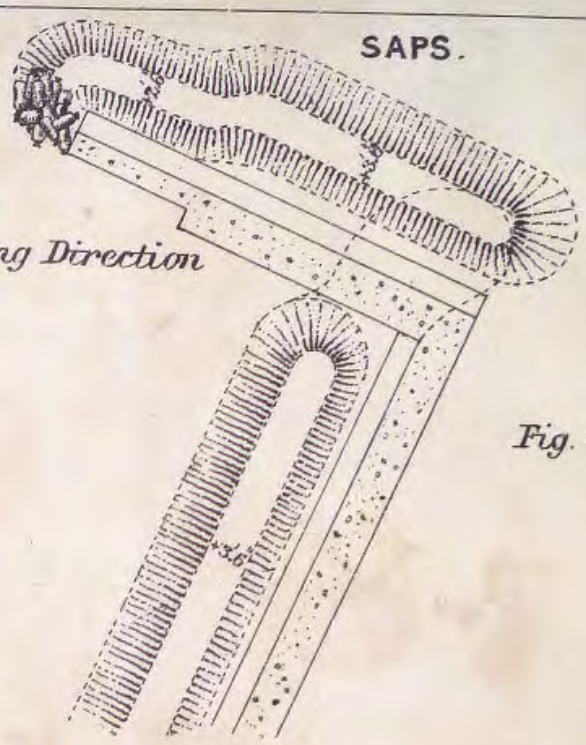
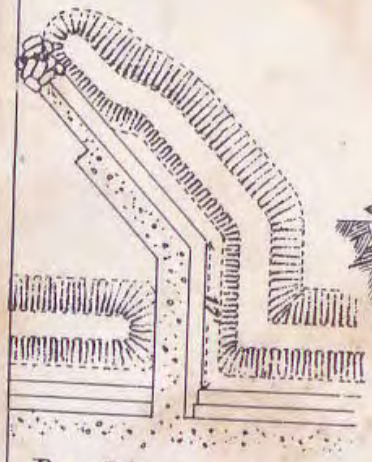


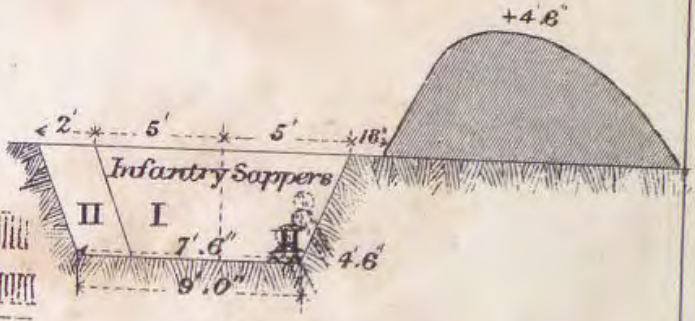
Fig. 1.

Fig. 2.



Breaking out a sap from a trench.

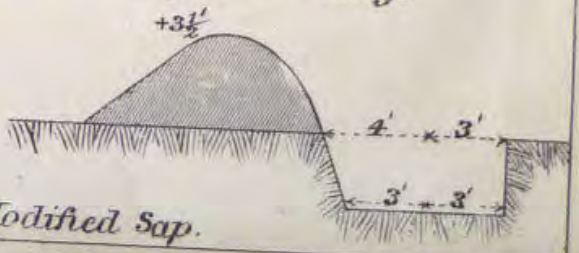
Fig. 3.



Widening Sap.

Fig. 4. 1st Stage.

Fig. 5. 2nd Stage



Modified Sap.

Opposite to para 103.

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Changing direction.

102. To change the direction of a sap, No. I turns in the new direction, No. II throwing his earth on the opposite side of the trench to what he formerly did, and over the sandbags of the old head parapet, which are gradually removed and placed in their new position as No. I works through the old side parapet. It is advisable to have 20 or 30 additional sandbags ready at hand in changing direction, to make up for those which cannot with safety be removed from the old head parapet.*

Nos. III and IV. commence widening in the new direction as soon as the sap-head has advanced 9 feet as before. (Fig. 1, Pl. 16.)

Returns.

The construction of the return of a zigzag is carried out later on by another detachment of sappers, who work in the usual way, except that no head parapet is required, the side parapet being kept about a yard in advance of the sap-head.

The return is made about 10 yards long, or longer if required.

Widening the sap.

103. The sap is widened by parties of infantry, who do not approach within less than 25 feet of the sap-head. When the trench is intended as an approach which does not require to be stepped, the task of the infantry widening party would be exactly the same as the task taken out by the sappers, and should then be completed in one relief. When however the parapet has to be made available for musketry fire, two reliefs would probably be required, the second relief forming the steps and widening the trench. (Fig. 3, Pl. 16.)

Modified sap.

104. When, on account of the presence of rock or water near the surface, a sap $4\frac{1}{2}$ feet deep cannot be used, it may yet be possible to make a sap 3 feet deep. In this case the duties of the detachment are the same, but Nos. I and II both work kneeling. The dimensions of the sap are shown in Figs. 4 and 5, Pl. 16. Nos. III and IV must take care to throw their earth well towards the sap-head, without scattering it, to keep up the height of the parapet; and to improve the cover it is better to omit the berm, which can be afterwards made by the widening party. The rate of advance is much the same as that of the deeper sap; but as the cover is much inferior, it probably could only be used against an ill-armed enemy, or on ground falling from the fortress so as to assist in its defilade.

Blinded sap.

105. To protect a sap against light vertical fire it may sometimes be covered over with earth and splinter proofs, supported on timber framing, leaving enough head room for men to walk upright. It is then called *Blinded Sap.*

It is very doubtful if blinded sap will ever be possible in the future, though an advance may be attempted for a short distance over specially difficult ground, by means of the ordinary mining galleries, just below the surface of the ground till night or some other favourable opportunity allows of pushing forward the sap by the ordinary methods.

* If the head parapet be of earth it is left undisturbed.

SECTION VIII.—THE ASSAULT GENERALLY.

Assault on one fort only considered.

106. The final assault on the main defensive line will probably be directed against a considerable front, embracing, at least, 2 forts and the interval between them.

The arrangements for such a large and complicated operation are somewhat beyond the scope of this work, and it is proposed to treat, in detail, only that portion of the general assault which has for its special object the capturing of one of the forts.

Information required.

107. Previous to the assault of a fort or redoubt, the Engineer officers must obtain as much information as possible relative to the obstacles to be surmounted, viz., the number of the ditches to be crossed, the heights of the counterscarps and escarps, the positions of any entanglements, abatis, palisades, barriers, &c. As much as possible of the information, such as the depth of the ditches, and the practicability of the breaches, should be obtained by personal observation. The whole of the Engineer and other officers employed at such an assault should be thoroughly acquainted with the arrangements for the general assault, and, as regards their own object of attack, should know every detail as to the number and positions of the several columns, the obstacles likely to be met with, &c., and the Engineer officers especially should know the details of the fort, so as to be able to inform the commanding officer which way to go.

Time for general assault.

108. The best hour at which to deliver the general assault depends on whether the intention be to destroy the works attacked, and then abandon them, or to hold them after they are taken. If the former be the design, a good hour for assault would probably be about midnight, which would allow of the works being destroyed and the retreat made good before daylight. But if it be intended to hold on, as is usually the case, the assault may probably be most advantageously given about an hour and a half before daybreak, in order that if unsuccessful the assailants may retire in the dark, and if successful may be able to establish themselves before daylight. It may, however, in some cases be advisable to assault by daylight; there cannot then be any fear of columns losing their way, and the assailants' artillery can then render more efficient aid.

False attacks.

109. In the general assault it is sometimes advisable to make several attacks, some of which may be false, in order to distract the enemy's attention, and make him divide his forces. False attacks must be made of such strength as to command respect, and to act, if required, as though they were real attacks. It is worthy of remark, that, in several instances, the false attacks have succeeded while the real attacks have failed. All the attacks should be made at nearly, if not quite, the same moment, and each attacking party should be clearly instructed in which

direction to move, in case they gain a footing in the defensive line, so as to ensure concentration and mutual support.

Parts of a fort to be assaulted.

110. The parts of a fort selected for assault should be, if possible, unflanked parts of the work, and each column of assault should have as great a front as possible with reference to the work to be attacked; the front would seldom exceed two companies.

111. Previous to the advance of the assaulting columns they will have been collected in the most advanced infantry positions and behind any natural cover, whilst a constant bombardment of the heaviest possible nature will be kept up from the batteries in rear on the points to be assaulted. At a preconcerted moment the last shell will be fired and then the attacking infantry will at once move forward. The time at which the last shell is to be fired from the batteries in rear, is best fixed by watches, very carefully compared beforehand.

Formation of assaulting column on a fort.

112. It is of the utmost importance that parties for the assault should be detailed by companies, battalions, brigades, and divisions, and not be composed of detachments of different corps. The column for a fort is usually made up as follows :—

1. A Covering party.
2. The Stormers (and a carrying party if required).
3. Engineer party.
4. Supports.
5. Artillery party (for destroying guns, &c.).
6. Working party.
7. Stretcher party.
8. Reserve.

This order will generally be found the best, and is therefore given as an example; but it may of course be modified, if necessary, according to circumstances. It will have to fit in with the general arrangements for the assault.

It may, for instance, be useless to send the covering party out first, as there may be no advantageous position for it to take up, or it may be impossible to fire with effect owing to the darkness; under such circumstances the covering party would be kept in the advanced trenches to cover a retreat.

Again, there may be palisades or other obstacles which must be broken down before the stormers can enter the work, and to do this it will be necessary to send the Engineer party in advance of the stormers, in order that, protected by the covering party, they may clear the way.

It may sometimes happen that it is desirable to keep the reserve close up to the main body, instead of in rear of the artillery and working party, but it is usually advisable to make a lodgment as quickly as possible, and for this purpose to bring up the working party early.

Covering party.

113. The covering party, unless in exceptional cases as noted above, advances first in extended order (say, at four paces

interval), one or more intervals being left for the stormers and others to pass through. It advances to the crest of the glacis or other convenient position close up to the enemy's works, where the men lie down, making the most of any cover that is to be found. They are to remain silent, and on no account to fire without orders, as the stormers should, if possible, surprise the garrison. If the defenders show themselves on the parapet to oppose the assault, the covering party will open a very brisk fire on them, and keep it up until the advance of their own column renders it dangerous to the latter. In many cases an assault may be assisted by the fire of machine and field guns placed on the flanks so as to sweep the parapet, or to disorganise the enemy's supports as they are being brought up. The covering party remains the whole time ready to cover the retreat should the assault be unsuccessful.

114. The senior subaltern of Royal Engineers usually conducts the advance of the storming party. Picked troops should, if possible, be employed as stormers.

The stormers.

A storming party should always advance with as much celerity as possible, consistent with the men being fresh when they close with the enemy. Their great object should be to close with the enemy as rapidly and in as compact order as possible; they therefore should not halt to fire, but rely chiefly on the bayonet. No one must be allowed to fall out to take to the rear wounded officers and men; the wounded must find their own way back or wait for the stretcher party, which should follow in rear of the working party. An entrance being effected, the assailants move right and left, to clear the parapet of defenders, and endeavour to open gates, &c., according to previous arrangement or to the circumstances of the case.

Carrying party.

Unless it is certain that no entanglements, military pits, V-shaped ditches or similar obstacles will be met with in the assault, a certain number of the stormers (say, front rank of leading half-company or company) will be told off as carrying party. They will be provided with bags of hay, shavings, wool, &c., boards, ladders, fascines, or whatever is thought most suitable, and conducted in their position at the head of the stormers by an Engineer officer; and while advancing will bridge or fill up these obstacles according to his instructions, and continue their advance into the work, followed by the remainder of the stormers, who will close up to them. (See "Passage of Obstacles" in Part I.)

Engineer party and tools.

115. If there be any obstacles such as wooden or steel palisading to be removed the Engineer party must precede the stormers, and clear a way for the column, with axes, explosives, &c. Should there be no obstacles either before reaching the ditch or in it, the Engineer party follows the stormers into the work.

The party may consist of 10 or 20 men or upwards, under one or two officers; they should carry their rifles slung as for

escalading. If there be not sufficient engineers to furnish this party, pioneers or artificers from other corps should be obtained.

The description of tools, &c., to be carried by them varies according to the nature of the obstacles to be overcome; but if this cannot be ascertained, the following may be taken:—

Tools for an Engineer Party of 2 Non-Commissioned Officers and 20 Men.

	Front rank.	Rear rank.
Portfires or vesuvians - 2 N.C.O.'s.		
2 Crowbars	1	1
4 Felling-axes	4	–
1 Handsaw	–	1
1 Hand axe and 1 tool-bag*	–	1
2 2″ Ropes (25 feet) with hooks	2	–
3 Pickaxes	–	3
3 Shovels	–	3
2 Made-up charges of 6 lbs. of gun cotton with primer and detonator attached, 1 hammer, 2 gimlets, 6 spikes	2	–
	Front rank 9	Rear rank 9

If the party consist of only 1 non-commissioned officer and 10 men, they may carry

1 Portfire, or vesuvians, N.C.O.	1 Rope with hook.
1 Crowbar.	1 Pickaxe.
2 Felling-axes.	1 Shovel.
1 Handsaw.	2 Made-up charges, 1 hammer,
1 Hand axe and 1 tool bag.*	2 gimlets, 6 spikes.

If the party consists of more than 20 men, a larger number of the tools and explosives, most likely to be wanted, will be carried.

It should be distinctly explained to men carrying tools that they are required to show their gallantry and steadiness, not in the use of their arms, but in the very important services to be rendered by the implements they carry.

Supports.

116. The supports follow about 30 paces in rear of the stormers and Engineer party with the greatest front possible; they are accompanied by one or more Engineer officers, to afford technical advice to the officers in command.

Artillery party.

117. A party of artillery should be told off to follow the main body, for the purpose of turning against the enemy any

* Each tool-bag is a sand-bag, containing 6 empty sand-bags, 1 claw hammer, 2 gimlets, spikes; this bag, with the mouth tied up, can be carried with the hand axe in the left hand.

guns that may be found, or of destroying them in case of a repulse. They should be provided with charges of guncotton made up.

Working party.

118. A working party of engineers, or of infantry under the direction of Royal Engineer officers and sappers, should follow the storming party, for the purpose of forming lodgments, if the place is to be held, or destroying it, if it is to be abandoned.

They must be provided with tools, sandbags, &c., according to the nature of the work to be done.

Stretcher party.

119. The stretcher party, with stretchers and appliances for staunching wounds, will follow in rear of the working party, for the removal of the wounded to the field hospitals established in the first surgical line.

Reserve.

120. The reserve, under the superior officer who has charge of the whole operation, should move up rapidly after the main body and working party, and take up a convenient advanced position, ready to reinforce quickly any portion of the troops engaged, that may appear to require support, to occupy any part of the captured works which may be vacated by the stormers making a further advance, and, if necessary, to protect the working parties and occupy any lodgment they may make.

In short, the officer in command, who must be guided by circumstances, and be keenly alive to every change of situation in front, is to render all possible assistance to the troops engaged, and at least make sure, by securing a hold on some part of the works seized upon, that in case of a reverse after the first rush the whole operation may not prove a failure.

Strength of assaulting column for a fort.

121. The relative strengths of the different portions of the column must vary according to the circumstances of each case,—the chief point is to employ sufficient numbers. As it has been well expressed in the "Military Opinions" of the late Field-Marshal Sir J. F. Burgoyne, "the miserable doubting, unmilitary policy of "small storming parties on the plea that *if we fail we can't lose* "*many men*, causes more mischief, loss, and disgrace than any "other proceeding in war."

The covering party should be sufficient (after allowing liberally for casualties during the advance) to occupy every available spot from which a fire can be kept up on those works which bear upon the assaulting column.

The stormers may consist of from one to four companies according to the width of front on which the assault is to be delivered.

If ladders are used there should be from 25 to 75 per cent. of spare men to the ladders, according to the distance to be traversed under fire, to replace casualties.

The strength of the carrying party is regulated according to the number and weight of articles to be carried, allowing liberally for casualties.

The engineer party may consist of 20 men with 2 non-commissioned officers—often it may be advisable to employ as many

as 30 or 40 men: when it is expected that only slight obstacles will be met with, 10 men with 1 non-commissioned officer may suffice.

The main body should be at least twice or three times as numerous as the stormers; when the latter consist of two companies, the former will generally be the remainder of the battalion, and perhaps the rest of the brigade, or even of the division, according to the strength of the garrison.

The artillery party will be from 10 to 50 men, according to the nature of the position attacked and its armament; usually 20 to 30 gunners, with one or two offices, will suffice.

The working party may be from 40 to 200 or more strong, say one or two companies of engineers, or a few engineers with two or three companies of infantry.

The strength of the stretcher party will be determined by the principal medical officer.

The reserve will consist of a battalion, brigade, or division, according to the strength of the defenders and other circumstances.

Counter-attacks.

122. During the assault on a fort or forts, it will usually be necessary to have large bodies of men collected to prevent sorties on the flanks, and to cope with the enemy in the intervals, and it may be further advisable to place a proportion of field or Q.F. guns on the flanks of the attack to support it. The necessity for these, as also their position and numbers, would depend on the nature of the works of attack, and a variety of other points. Preparation would be necessary for these guns, but they might perhaps be placed in rear of the trenches, so as to fire over them, and be run into them when no longer required.

SECTION IX.—ESCALADING.

123. In assaulting a fort with deep ditches there may be cases in which from want of time or ammunition, or from other causes, no really practicable breach has been formed, and the attackers have to use ladders to assist them to cross the ditch.

Such a form of attack is a hazardous enterprise, and to have a fair chance of success must be to a certain extent a surprise, for which reason it is likely to be attempted just before day-break, after such a vigorous bombardment that the fort is practically wrecked, and the defenders will not venture out of their casemates, and are attacked so suddenly that they have not time to man the parapets. It will therefore be seen how absolutely essential it is that the operation should be carried out rapidly, without the slightest confusion, and in perfect silence; to ensure which, the troops to be employed should be well instructed in escalading drill, and practised beforehand, by night, in rehearsing the part they will have to perform. Any noise, confusion, or delay in escalading, may be fatal.

Heights of ladders, &c.

124. An escalade is hardly practicable if any of the walls to be descended or ascended are over about 30 feet in height. At least 3 feet at the head of each ladder must be above the wall against which it is placed, to assist the men in getting on and off, and although the butts of the ladders should not touch the wall, yet the inclination of the ladders ought not to be less than $\frac{2}{3}$, or there will be danger of their being broken by the weight of the men.

Description of ladders.

125. The ladders used for escalading may be entire, or formed of lengths joined together; in many instances they would probably be roughly made from trees cut by the troops themselves. They are carried by parties of men varying in number, according to the length and weight of the ladders, four men being sufficient for an 18-feet ladder weighing about 100 lbs., six men for a 24-feet ladder weighing about 133 lbs., and two men for every additional 6 feet; each ladder party must, however, include spare men to replace casualties as they occur.

Scaling ladders in lengths of 6 feet (Figs. 1, 2, 4, Pl. 17) and 12 feet are articles of store.

The whole of the ladders are of similar construction; they taper from butt to tip, the tip of one fits inside the butt of another, and is kept there by means of iron straps, of which there is one fixed near each end of the side pieces; the 12-feet ladders have 13 rounds, and the 6-feet 6 rounds, one near the butt and one near the tip being in each case flat rounds; two lashings of 1-inch rope, 6 feet long besides the eye, are spliced to the flat round near the tip; by means of these lashings the lengths are secured together, and prevented from slipping out of the iron straps. (Fig. 4.)

A 36-feet ladder is the longest that can be turned over, if formed of the 6-feet lengths, and 48 feet if formed of the 12-feet lengths.

For an escalade by night the tips and the joints of the ladders should be muffled to prevent noise.

Ladder companies.

126. There must be a line of ladders for every wall that is to be ascended or descended. The men told off to one ladder (4 files or more, according to length of ladder) form a "ladder detachment," and the detachments for one line of ladders form a "ladder company." If possible it would be better that the ladder companies should consist entirely of engineers, as the carrying and placing of ladders without noise or confusion is an art that requires some practice, but usually infantry are employed, an engineer officer accompanying each ladder company, and a sapper accompanying each ladder detachment.

Great care must be taken to keep the ladders in line, and to preserve the intervals decided on between them.

Laying out the ladders.

127. Escalades would usually be made from the cover of the most advanced infantry trenches (assault position), or from some natural cover found close to the work to be assaulted, an the

ESCALADING.

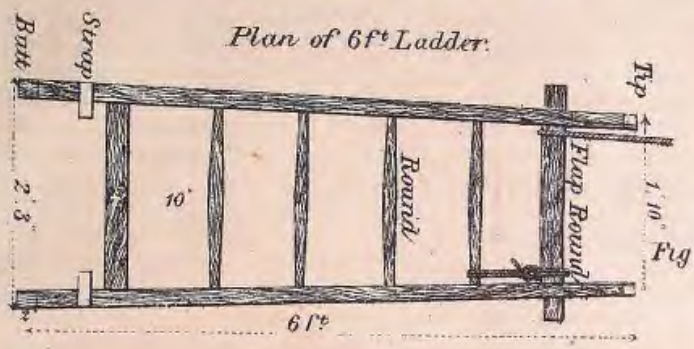


Fig. 1.

Fig. 2.

Joint

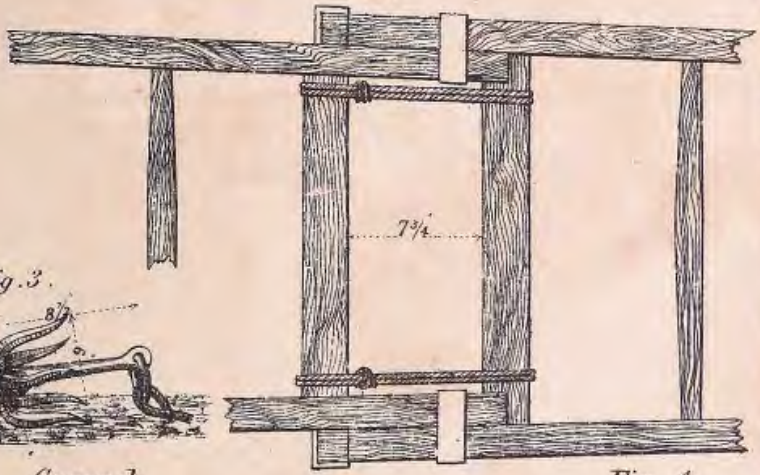


Fig. 3.

Grapnel

Butcher's Hook

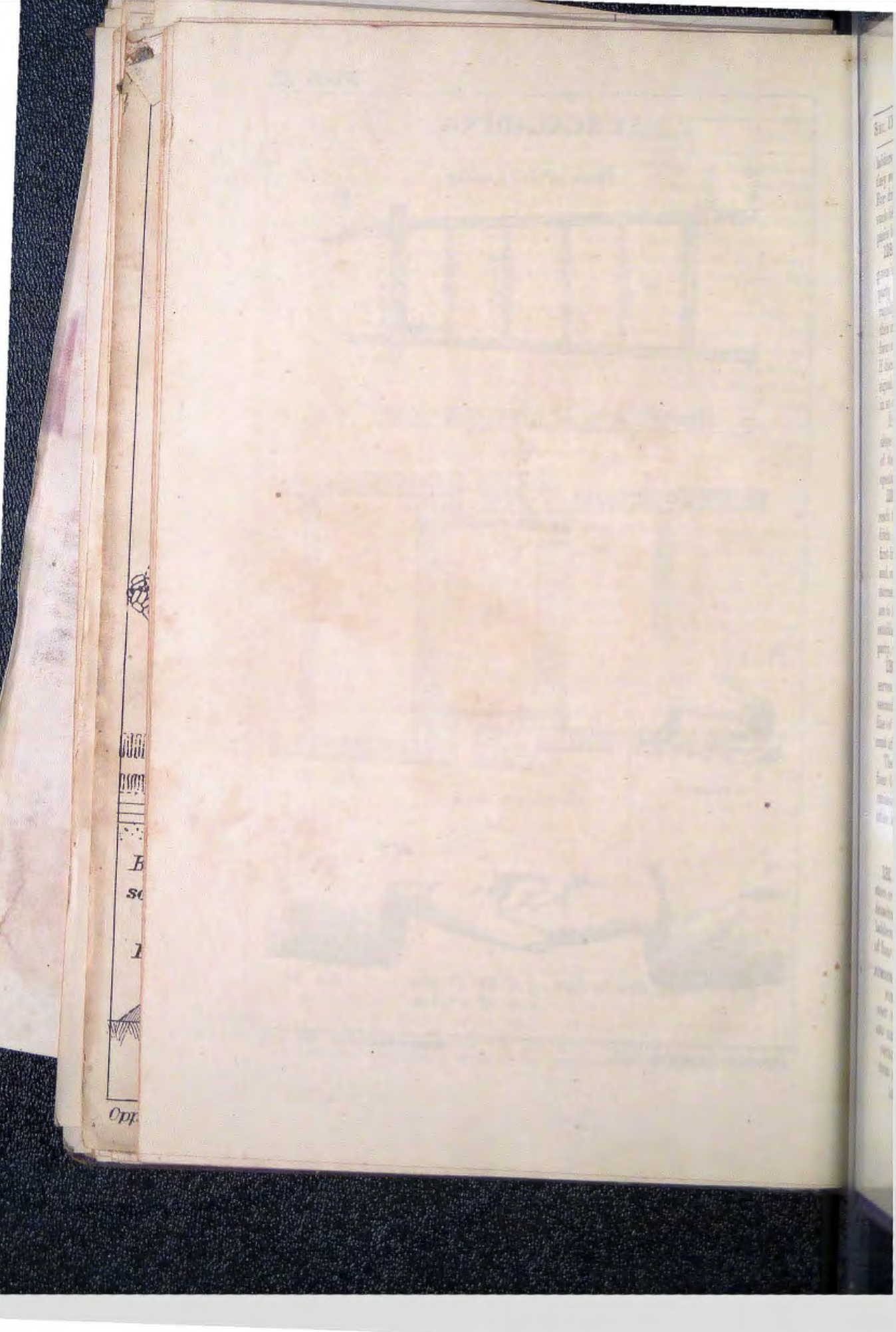
Fig. 4.

Scale figs. 1-2 24 ft 1 in.
3-4 12 ft 1 in.

Fig. 5.

Opposite to para 125.

Wyman & Sons, Ltd, Lith. 7252. 6 95.



ladders will, of course, be arranged out of the enemy's sight; they would probably be brought up during the preceding night. For drill purposes the ladders will be laid out in two lines, at such distances from each other as will allow of the ladder companies being drawn up in rear of them.

Storming party.

128. The usual formation of a column of attack on a fort is given in para. 112. In an assault by escalade, the storming party usually carries the first line of ladders; they move out rapidly, lower their ladders, and descend into the ditch. They then move their ladders across the ditch, ascend the escarp and form on the berm as quickly as possible, fixing their bayonets. If discovered, or at the word *Advance*, or on the commander's signal, they rush over the parapet, closing in towards their centre in so doing, that they may enter the work as a compact body.

If there be not any berm, each man remains on the exterior slope in the same way. If there be a hedge on the berm, some of the engineer party must ascend the ladders first, and cut openings in it to the right of each ladder.

Supports.

129. The supports carrying the second line of ladders should reach the counterscarp as the first line is moving across the ditch; they lower their ladders into the place from which the first line has been removed. The supports will then descend and, *without moving their ladders across the ditch*, will follow the stormers up the first line of ladders and into the work. They are to leave their ladders where they are first lowered so as to establish a complete line of communication by which the working party, reserve, &c., can advance into the work.

Retiring.

130. In the event of the escalade being unsuccessful, the reserves will first retire, then the supports, carrying away the second line of ladders, and afterwards the stormers, with the first line of ladders, the covering party remaining till the last on the crest of glacis to protect the retreat.

The following exercise is drawn up for ladders formed of four 6 feet lengths, but with slight modifications, and the omission of part of the preliminary exercise, it will apply to any other ladders.

Preliminary Exercise.

Forming and telling off detachments.

131. The men will be formed up two deep in front of the store or piles of ladders, and facing from them, and told off in detachments of four, five, or six files, according to the length of ladders. For drill purposes the detachments will usually consist of four files, and it is assumed here that this is the case.

NUMBER BY FOURS FROM THE RIGHT—DETACHMENTS—RIGHT FORM—QUICK MARCH—HALT.

POST COMMANDERS AND SIZE LADDER DETACHMENTS FROM RIGHT TO LEFT.

The instructor or captain posts a *commander* to each detachment. Each commander sizes his detachment from right to left of both ranks, so that the ladders may rest as equally as possible on the men's

shoulders, and falls in on the directing flank.

TELL OFF THE LADDER DETACHMENTS. At this order the commanders of ladder detachments take one pace to their front, turn to their right, and tell off their detachments, from front to rear, as No. 1, No. 2, &c.

NUMBER. Each detachment is numbered from right to left.

NOS. 1—SPARE MEN.
NOS. 2—TIP MEN.
NOS. 3—CENTRE MEN.
NOS. 4—BUTT MEN.
NOS. 2 TO 4—LADDER MEN.

The instructor will then tell the men off, and prove them, explaining that the spare men are intended to replace casualties in the ladder numbers. The tip men, centre men, and butt men are for carrying ladders.

SPARE MEN—TRAIL ARMS.—TIP MEN—TRAIL ARMS.—CENTRE MEN—TRAIL ARMS.—BUTT MEN—TRAIL ARMS.

SPARE MEN—ORDER ARMS.—LADDER MEN—ORDER ARMS. PILE ARMS.—STAND CLEAR.

Bringing up Ladders.

Bringing up ladders.

132. MOVE OFF BY SUCCESSIVE DETACHMENTS FROM THE FRONT (*or as may be ordered*). The commanders of detachments take post on the pivot flanks of their detachments.

No.—Ladder Det. Quick march, &c. Halt. At this order each detachment is marched off in succession by its commander, to the place where the ladders are stacked, and halted, one rank on either side of a pile of four lengths of ladders, the butt men in line with the butts, the tip men with the tips.

Shoulder ladders. In shouldering ladders, the men turn inwards, stoop down, and with both hands raise the ladders as high as their shoulders, turn towards the butt, and put the ladders on their inward shoulders, holding them there with their inward hands, and letting their outward hands fall to their sides.

Quick march, &c. Ground ladders. Each pile of ladders is brought out and grounded about four paces to the left of the pile of arms. In grounding ladders, the men raise their outward hands, support the weight of the ladder in both hands, turn inwards and lower the ladders gently on to the ground, the tip men being the last to quit hold of them. The men then come to attention, the spare men closing up to them. The commander falls in on the right of the butt men of front ranks, and stands his men at ease.

Stand at ease.

ATTENTION. COMMANDERS 7* PACES TO THE FRONT—QUICK MARCH. ABOUT TURN. COVER YOUR LADDERS. LEFT DRESS. *Steady.*

The commanders advance the number of paces specified, turn about, and close to their right until they cover the centre of their piles of ladders; they then dress by their left.

Joining Ladders.

133. BY NUMBERS JOIN LADDERS.

Joining ladders by numbers.

At the word *Ladders*, the butt men stoop down, seize with both hands the upper length of the pile, carry it out at the double, and place its butt at the feet of their commander; they then move smartly to the tip end, and raise it 6 inches from the ground (holding it by the second round), and assist to fit the next length; when that is completed they come to attention opposite the joint, facing inwards.

TWO. When the butt men have taken away from the pile the upper length, the centre men stoop down, seize the next length; double out with it, and fit it on to the first length; this done, they move to the tip of the length, and act as detailed for the butt men.

THREE. The tip men act in the same manner.

FOUR. The spare men fit on the last length, and then fall in one pace from the tip of the ladder.

Lashing.

CAST OFF LASHINGS. At the word *Lashings*, each man stoops down, and kneeling on the side of the ladder, casts off the lashing in front of him; he then comes to attention with the point of the lashing in his right hand.

PREPARE TO LASH. At the word *Prepare to lash*, all the men turn towards the tip of the ladder, kneel on the side of the ladder with the inward knee, inner foot close to the ladder; bring the splice of the eye of the lashing to the upper edge of the flat round, press the eye close the side of the ladder, and wait with the point of the lashing in the right hand.

LASH. At the word *Lash*, pass the lashing twice over and under the two flat rounds, no part of the lashing being allowed to lie across another, haul taut, and make fast, with two

* When more than four lengths of ladder are used, 2½ paces additional should be taken for each additional length of ladder.

(or more) half hitches, round the whole lashing close to the lower flat round; then come to attention, facing the butt of the ladder.

While the lashing is going on, the commanders move about to see that they are properly made, and when they have satisfied themselves that the joints are home, the eyes properly placed, the lashing taut, and the half hitches secure, resume their positions at the butt ends of the ladders facing the captain or instructor, and in succession report *All correct.*

All correct.

134. *Disconnecting Ladders.*

Unlashing.

UNLASH. At the word *Unlash*, all the men stoop down, and kneeling on the side of the ladder cast off the lashing in front of them; then come to attention with the point of the lashing in the right hand.

PREPARE TO SECURE LASHINGS. At this word, the men turn towards the butt of the ladder, kneel on the side of the ladder, with the inward knee, inner foot close to the ladder; bring the splice of the eye of the lashing to the lower edge of the flat round, and wait with the point of the lashing in the right hand.

SECURE LASHINGS. At the word *Secure lashings*, go through the same motions as at the word *Lash* in joining ladders, except that the lashing is secured round the two top rounds of the length to which it belongs; then come to attention, facing inwards.

Disconnecting.

DISCONNECT. At the word *Disconnect*, the whole stoop down, and each file takes hold of a length of the ladder, shakes them asunder, and piles them in succession one on top of the other, spare men taking the first length.

The men take post on the pile of ladders facing the butt.

Slinging Arms and Carrying Ladders.

135. The detachments, having been practised in joining and disconnecting ladders, will then be instructed in slinging arms and carrying ladders as follows:—

The ladders being connected, the instructor proceeds:—

FILE ON YOUR ARMS; QUICK MARCH. HALT. The commanders move off with their detachments.

STAND TO—UNPILE ARMS. LEFT TURN. The men file on their ladders, front rank on the right, and rear rank on the left, and

FOR ESCALADING, TAKE POST ON YOUR LADDERS. take post, the butt men at the butt, the tip men at the tip, and the centre men distributed at equal distances between them.

ON THE OUTWARD SHOULDER—SLING ARMS. As described in "Rifle Exercises." Slinging arms by numbers.

SHOULDER LADDERS. As before described when in pile; the front rank stepping forward and the rear rank back half a pace to prevent the butts of rifles coming in contact.

The detachments are now ready to carry the ladders to the place where they may be required for escalading, either in line, if the ground be open, or in column of ladders; if the latter, on arrival at the place, line is formed on the leading ladder.*

FORM LINE TO THE FRONT (or RIGHT or LEFT) ON THE LEADING LADDER. HALT. GROUND LADDERS.

136. If any obstacle, such as a low wall, railing, &c., has to be passed, the butt men on arriving at it will place the butts of their ladders on the top and pass the obstacle rapidly; the other men will push the ladders forward until they in their turn arrive at the obstacle, which they will also pass as soon as possible; the men first over will seize the ladders, and the others will regain their places quickly; the ladder must always be supported in several places along its length, or it is liable to be injured. When all the men belonging to each ladder detachment have passed, they will shoulder the ladder and move forward. Obstacles must be passed as expeditiously as possible, so as not to check the advance of the column. Passing obstacles.

Escalading Drill.

The men will then be taught escalading drill, first as a company, as follows:—

137. The ladders being joined up and laid out in line, the ladder company will be brought up and halted in front of the ladders. They will then be told off into ladder detachments of three, four, or more files according to the length of the ladders, and form into column of detachments to the right. Forming the ladder company.

Commanders will be posted and detachments sized from right to left, told off, and proved, as already laid down.

LADDER COMPANY, ATTENTION, LEFT TURN. FOR ESCALADING The men file on their ladders, front rank on the right, and rear rank on the left, and take post, the butt men at the butt, the tip men at the tip, and the centre men distributed

* The distance between the ladders should be equal to the front of the detachment.

TAKE POST ON THE LADDERS. QUICK MARCH. SLING ARMS. SHOULDER LADDERS.

at equal distances between them, the spare men covering in rear of the ladders at intervals of one pace.

As previously instructed.

Escalading by Numbers.

Escalading by numbers.

THE LADDER COMPANY WILL ADVANCE BY THE CENTRE. QUICK MARCH.

138. The company advances at a very steady pace, without noise, the commanders on the inner flanks of detachments keeping the dressing and distance very correctly; the spare men keeping close up, ready to replace casualties.

As soon as the line of ladders reaches the edge of the counterscarp, the instructor gives

HALT.

the word *Halt*, when the *commanders* regain their places on the right of the butt men.

LOWER LADDERS.

On the word *Ladders*, the butt men lower the butt on the ground, fall back to the tip of the ladder, face each other, and grasp the top round with the hand nearest to it, back of the hand up. The centre and tip men lower the ladder from their shoulders, but support it with their hands, and push it forward about 4 feet over the edge of the counterscarp.

TWO.

The ladder is pushed forward about 6 feet, the first file of centre men fall back to the rear of the butt men, face each other, and with their hands nearest the ladder seize the hands of the butt men, with a grip commonly called the *butcher's hook*. (Fig. 5, Pl. 17.)

THREE.

The ladder is again pushed forward about 6 feet, and the next files in succession fall back to the rear, turn inwards, and, with the hands nearest the ladder, grip the hands of the men previously formed up, the spare men completing the chain.

(FOUR. FIVE.)

These words are required if there be five or six lengths, but not for only four.

DOWN.

The ladder is to be lowered into the ditch without noise.

Each *ladder detachment* then covers in file, facing the work, the *commander* being on the right.

The commanders are responsible that the butts of the ladders are about 18 inches from

the foot of the counterscarp, and that they do not incline to the right or left.

FORM IN DITCH. The *commanders* lay hold of the right side of the ladder with their left hands, and resting on their left feet, swing the right foot round on the ladder and descend, holding by the sides of the ladder.* The men follow their commanders as quickly as possible, getting on to the ladders and descending in the same manner. In advancing the front rank man of a file always precedes his rear rank man. On getting to the bottom of the ditch the men form up in file, still facing the work, the spare men having their backs against the counterscarp wall, and the others as close to them as possible, on the right and left of the foot of the ladder.

CROSS THE DITCH. The butt men turn inwards, lay hold of the second round of the ladder, raise it 6 inches, move the butt very slowly and steadily across the ditch, place it across the foot of the escarp, and keep it there with their feet when it is being turned over against the revetment. The centre men move out 2 or 3 paces, and receive in their hands the centre of the ladder as it descends, and afterwards support it in the bend of their arms. The tip men stand fast to receive the tip of the ladder, which they place on their shoulders. The spare men assist. If the ditch be very broad, the ladders must be shouldered, carried across, and the butts lowered against the foot of the escarp. Crossing ditch.

TURN OVER. The centre and tip men turn the ladder up, smartly, the butt men keeping the butt firmly on the ground; all must take care that the ladder falls lightly against the escarp; to do this it is advisable to balance it, when vertical, for a few moments, and then lower it gently; the butt men must be careful not to get squeezed between the ladders and the escarp. The butt men, when the ladder is turned over, pull the butt out 18 inches from the wall. The commanders see that the

* If men hold by the rounds in descending they are liable to get their fingers trodden on, which might cause them to let go and fall off the ladder, bringing other men down with them. The fingers must not be put too far round the sides, for fear of being pinched between the ladder and the wall. In ascending, the rounds may be held, and men are invariably to get off the ladder *on the right-hand side.*

ladders do not lean over either way; the men then form up in file, on either side of ladder, as before.*

ORDER ARMS. The men order arms.

FORM ON BERM (OR FORM WITHIN WORKS). On the word *Berm*, the commanders, followed by their men in the same order as in descending, ascend the ladders, one step at a time, holding by the rounds, carrying their rifles by passing the right arm through the sling. When at the top they take hold of the right side of the ladder with the left hand, step off with the right foot first, and fix bayonets, without word of command. The men form to the left of the ladders as they get on the berm, the butt men closing to the left for a sufficient distance to admit the ladder detachment, the commanders dropping to the rear, and when the company is formed, at

ADVANCE. the word† *Advance*, they mount the exterior slope with their arms at the trail, the rear rank about three paces in rear of the front rank; on getting on to the superior slope they charge into the work. When there is no berm, each man finds his own way on to the superior slope as soon as possible, fixing his bayonet as he advances; as soon as there are enough men up they charge into the work; the commander in this case enters the work with his leading file.

Bringing the ladders back.

139. To bring the party back in order to repeat the exercise, the company is re-formed on the berm in line‡ and facing the work; the following words of command are then given:—

UNFIX BAYONETS. The men come back in the inverse order to

RIGHT TURN. that in which they advanced.‡

The men get on to the ladders and descend, spare men leading, followed by tip men,

FORM IN DITCH. centre, and butt men, commanders last; on reaching the bottom of the ditch they form up clear of their ladders, the spare men falling to the rear and having their backs against the escarp, and the others as close

* If, however, they are not to enter the work first, they get as close in to the escarp as possible, the butt men and others, if necessary, assisting to keep the ladders in their places; this is especially necessary when the defenders endeavour to overturn the ladders; the passage will then be clear for the storming party.

† With recruits, the bayonets (or swords) should be unfixed before the word *Advance* is given.

‡ The men should be cautioned to go down the exterior slope slowly for fear of falling into the ditch.

to them as possible, tip men leading; the commander on the left.

ON THE OUTWARD SHOULDER—SLING ARMS. The men should be reminded that their arms have to be slung on the contrary shoulder to that when advancing.

CROSS THE DITCH. The ladders are moved across the ditch in the same manner as before, the only difference being in the positions of the men, the tip men moving the butt across the ditch, and the butt men receiving the tip.

TURN OVER. The ladders are turned over in the same manner as before, the only difference being that the tip men keep the butts firmly on the ground, while the other men turn the ladders smartly over.

FORM ON GLACIS (OR COVERED WAY), &c. The men ascend the ladders, tip men first, commanders last; they get off the ladder as before directed, and fall in at the head of the ladder in file, facing from the work.

FORM CHAIN. The men turn inwards and grip hands as in lowering the ladders; the spare men pass the hand nearest the ladder round the side, and seize hold of the round in line with the shoulder, and the whole stretch out to the full extent of their arms, as in lowering the ladders.

DRAW UP LADDERS. The men move at a steady pace, increasing to a double, draw up the ladders, and drag them along the ground until the butts are about 20 yards from the edge of the ditch; the commanders will move at the butts of the ladders.

HALT. The men halt and fall back into position for carrying, tip men leading, spare men in rear.

Escalading in Quick Time.

140. When the men have been sufficiently practised by numbers, they will be put through the exercise in quick time by the following words of command:— Escalading in quick time.

ESCALADING IN QUICK TIME, LEFT TURN.—TAKE POST ON THE LADDERS, QUICK MARCH.—SLING ARMS.—SHOULDER LADDERS.—THE LADDER COMPANY WILL ADVANCE; BY THE CENTRE; QUICK MARCH.—HALT.—LOWER LADDERS.—FORM IN DITCH.—CROSS THE DITCH.—TURN OVER.—ORDER ARMS.—FORM ON BERM, &C.

The exercise will be repeated by signal, without words of command, from the instructor; the squad will next be practised

in two lines, the ladders of the first line being moved across the ditch, those of the second line being left standing against the counterscarp, as explained below for an escalading battalion.

Crossing second obstacle.

141. The men will also be practised once in drawing the ladders up the escarp, and passing them over the parapet into the work, as might have to be done if there were a second obstacle to cross; in this case the men should be cautioned to keep their arms slung; the words of command will be:—

FORM ON BERM.
DETACHMENTS.
RIGHT WHEEL.
QUICK MARCH.

The detachments wheel to the right, in doing which, some of them have to get on to the exterior slope.

HALT.
FRONT RANK,
ABOUT TURN.
FORM CHAIN.

The men form chain as before directed, with the exception of the rear file of spare men, who move to the top of the escarp wall.

DRAW UP LADDERS.

The file of spare men lift the ladders up, round by round, the other men move steadily up the exterior slope, drawing the ladders with them. When the ladders get clear of the parapet they are shouldered, the ladder men being in reverse order and facing the tips. On arriving at the next obstacle the ladders are to be lowered tip downwards.

Escalading Battalion.

Forming ladder battalion.

142. A battalion of eight companies will be told off as follows for escalading drill at a work with one escarp and one counterscarp to be crossed:—

Two companies as covering party.
Two companies as stormers, carrying 1st line of ladders.
Two companies as supports, carrying 2nd line of ladders.
Two companies as reserves.

This will be found a convenient arrangement for drill, but in actual warfare few cases could occur in which it would not be necessary to add to the supports the remaining two companies of the battalion, and probably the rest of the brigade. These would all follow the party which carries the second line of ladders at once into the work. The reserves would be another battalion, brigade or division.

143. The ladders having been laid out in two lines,* as mentioned above, the battalion will be formed up near them in quarter column with a front of two companies. The companies intended

* The distance between ladders to be such that the space occupied by the ladders is about equal to that occupied by the front of the storming party, *less* one section.

to carry ladders loosen the slings of their rifles, the officers twist their sword knots round their wrists; there should be a subaltern or serjeant with each ladder, and if there are not sufficient for this, corporals must be fallen out to make up the number.

It is always advisable to have officers and non-commissioned officers with their own companies, and on no occasion is this so important as with ladder parties. The captain superintends the whole of the ladders of his company, and remains in rear, but when the ladders are placed he leads down.

TELL OFF THE BATTALION. At this order the *captain* of each company tells off the number of his company as in par. 9, sec. 2, Part III, *Infantry Drill*, 1893.

The battalion commander will proceed:—

NOS. 1 AND 2, COVERING PARTY; NOS. 3 AND 4, STORMERS; NOS. 5 AND 6, SUPPORT; NOS. 7 AND 8, RESERVE.

NUMBER BY FOURS (FIVES, SIXES, &C.) FROM THE RIGHT OF LADDER COMPANIES. The *ladder companies* are numbered from the right in *detachments* of 4, 5, 6, &c., files, according to the number of men required for each ladder. Forming detachment.

FORM LADDER DETACHMENTS. The companies break into column of *ladder detachments* to the right or left, on receiving the order from their *captains*.

POST COMMANDERS AND SIZE LADDER DETACHMENTS FROM RIGHT TO LEFT. The commanders are posted by the captains, the guides taking the flank detachments, the non-commissioned officers the intermediate detachments. Detachments are told off and proved by the captains, as already laid down.

TELL OFF THE LADDER DETACHMENTS.

ATTENTION.—TAKE POST ON THE LADDERS; QUICK MARCH.—FOR ESCALADING.—SLING ARMS.—SHOULDER LADDERS.

The battalion is then ready to advance to the escalade.

COVERING PARTY WILL ADVANCE. The covering party will take the lead and extend as usual. Advance of column.

THE STORMERS WILL ADVANCE BY THE CENTRE. The column will advance at a very steady pace without noise; the commanders on the inner flanks of detachments keeping the dressing and distance.

QUICK MARCH.

THE SUPPORTS WILL ADVANCE BY THE CENTRE.—QUICK MARCH.

STORMERS, HALT. LOWER LADDERS. FORM IN DITCH. CROSS DITCH. TURN OVER. ORDER ARMS. By the time that the stormers are moving across the ditch, the supports should have reached the counterscarp, when they will lower their ladders and form in ditch, but instead of moving the ladders across the ditch they will order arms and follow the stormers

FORM ON BERM. ADVANCE. SUPPORTS, HALT. LOWER LADDERS.—FORM IN DITCH.—ORDER ARMS.—FORM ON BERM.—ADVANCE.

up the first line of ladders according to the words given in the margin.

If there are three or four lines of ladders, the stormers, or stormers and supports, will draw their ladders up into the work, as explained in the drill for a company, and will carry their ladders to the next counterscarp or escarp, and repeat the operation.

Front of column.

144. As before remarked, although a column of assault should have as great a front as possible, it would seldom have one of more than two companies; a convenient number of ladders for such a column would be sixteen in each line, one for the front rank, and one for the rear rank of each section, in a double company. As each party neared the ditch it would receive the word *Left turn*, *Heads of sections*, *Right Wheel*, when the front and rear rank men of each section of the reserves file down the ladders with their arms at the short trail; the party being at company distance, would allow of a continuous stream of men passing into the work, without any crowding on the edge of the ditch previous to getting on to the ladders.

Accessories to Escalading.

Bamboos.

145. When bamboo, or other light but strong, poles are available, a slight saving of time in crossing the ditch may be effected by using them to supplement the ladders. The following method has been tried at Chatham and found satisfactory, saving about one minute in three to four:—The stormers are told off in detachments of the same strength as would be required for ladders, but carry one pole for every two men; the supports carry ladders. On reaching the escarp the poles are lowered into the ditch, the tip men steady them while the commanders and butt men slide down. The butt men then steady them while the tip men slide down. By the time they are in the ditch the supports should have lowered their ladders in intervals left between the poles. The stormers close on the ladders, carry them across the ditch and form on the berms, while the supports slide down the poles, and follow the stormers, leaving the poles for the main body.

Bamboos, being hollow, make a considerable noise when being placed, if not muffled. This may be done by wrapping sandbags or canvas round them.

Grapnels.

146. Grapnels may also be used in connection with escalading, or even by themselves, when it is required to effect an entry with a small body of men.

The grapnel has five prongs, weighs 3 lbs. 2 oz., and has a length of 60 feet of 2-inch rope spliced to it. Fig. 3, Pl. 17.

The grapnel is thrown by rapidly whirling it round with the right hand, the coil of rope being held in the other hand. A few jerks should be given to the rope to ascertain that the

grapnel has caught, before anyone ascends. The men go up hand over hand with their legs perpendicular to the wall, until they get near the top, when by getting their elbows on the top, they scramble up without raising the rope off the edge of the wall, which might cause the grapnel to draw. The men first up should secure the grapnels by standing on them, or making them fast, and assist the other men up. When several men have ascended, the others can walk up the wall, by holding on the rope which is pulled up by those on the berm.

Rope ladders may sometimes be taken with the grapnels, as those first up can draw them up and secure them for the use of the others.

Portable bridges, sacks stuffed with wool, &c., may sometimes be advantageously used for crossing small ditches. (See Part I. "Field Defences.")

SECTION X.—DEFENCE OF A FORTRESS.

Objects of defence.

147. The object of defending a fortress is to hold the place till the enemy is worn out, or until relieved, or until such a time that the value of the fortress ceases to exist. This implies that the main object is to gain time.

Defences must sooner or later succumb to a strong and well pushed attack, but the gaining of even a few days, due to the energy and example of a good commandant, may give time for the defeat of the rest of the attacking army.

148. Nearly all modern fortresses are provided with a previously considered scheme of defence, which deals with all points to be mentioned hereafter, and which would at once be put into action by the commandant.

Commandant or governor.

As soon as it is apparent that a fortress is likely to be attacked, a state of siege is proclaimed, the effect of which is to make the authority of the commandant of the fortress supreme in both civil and military matters. The commandant should have a thorough knowledge not only of the fortress itself, but of the surrounding country.

Council of defence.

He is generally assisted by a council of defence, consisting of the chief of his staff, the commanding officers of artillery and engineers, and usually some of the senior officers; the duties of this council are, however, purely consultative—the commandant must act on his own responsibility. Any effective defence has generally been due to a good commandant.

The defences would be divided into sections, each of which would be placed under the command of an individual officer. All officers should be thoroughly acquainted with that particular section of the defence to which they are posted, while the officers of Royal Engineers should in addition be fully conversant with the details of the construction of the place, and of what additional work it is proposed to carry out.

Garrison.

149. The nature of the defence adopted will necessarily depend a great deal on the strength and nature of the garrison. Where the defence is to be active, or where it is intended to threaten the enemy's communications, the garrison must be much more numerous than the security of the fortress itself requires.

Infantry.

For passive defence, from 1 to 2 men per yard of front of the main defensive line should be allowed. At Plevna in 1878, the Turks numbered less than 1 man per yard for the whole perimeter, and not more than 3 per yard were available on the front of $7\frac{1}{2}$ miles which was attacked; but they were good soldiers, especially when on the defensive. The garrison of Paris in September, 1870, numbered $3\frac{1}{2}$ men per yard of the perimeter, and later in the siege the total under arms was twice this number, but many of these were very indifferent troops.

Artillery.

Artillerymen may be reckoned at 30 men per piece for the "fixed" and ordinary "Armaments for general defence." (See below.) The numbers for the "Light Armament for general defence" (see below) would be in accordance with "Field Army Establishments."

Engineers.

Engineers should number at least 5 per cent. of the number of infantry required for passive defence.

Cavalry.

For the number of the cavalry, about one-twentieth of the infantry may be allowed.

Militia.

The garrison of fortresses will often consist to a large extent of militia and other less highly trained troops, but the larger the proportion of regular troops, the better will be the defence, and in any case there should be a sufficiency of them to form the backbone of sorties.

Armament.

150. The armament of a fortress is usually classed under two headings, the "fixed" armament and the "armament for general defence." The fixed armament includes all pieces which are permanently, or practically so, mounted in fixed positions, whether inside or outside the forts, and which there would be a difficulty in shifting rapidly from one position to another. There should be no necessity for shifting them out of the main artillery position of defence at all; and as they would require very carefully laid platforms, carefully selected observing stations, and carefully arranged communications, we may look upon them as fixtures almost as much as in the days when they were all inside the forts.

The "Armament for general defence" consists of guns, howitzers, Q.F. and machine guns on travelling carriages and, of these, such pieces as can be readily moved, and can carry their ammunition in limbers and wagons, are further classed as the "Light Armament for general defence." With these latter the weight behind the teams would not be more than 50 cwt.

Only those pieces which are covered by armoured defences will, as a rule, be mounted in times of peace; but when a siege is anticipated, all "fixed" pieces must be got into their fighting stations and arrangements made to replace those which may be

damaged. Those pieces which are not mounted in peace time, would usually be stored inside, or in the vicinity of, the forts.

It is, of course, impossible to lay down any definite rules as to the number of pieces of artillery required, which will depend on the size and importance of the place, and on the character of the terrain. In order to cope successfully with the attack, howitzers, capable of delivering a searching high-angle fire should form the greatest portion of the fortress armament, and there can hardly be too many of them, provided there is sufficient ammunition and men to work them.

As a rough estimate of armament, it may be assumed that one fixed piece would be required for every 40 yards of perimeter facing the field of attack. The "general defence" armament would vary in strength with that of the garrison, and the supply obtainable. It cannot well be too strong.

A reserve of 10 per cent. of guns and of mountings, and a liberal allowance of appliances for mounting and transporting guns, &c., should be provided.

During the close attack any commanding spots will be favourable places for the use of the field, quick-firing, and machine guns against the besieger's saps. It is important to endeavour to maintain the power of using the light armament in the flanks of the forts against early attempts to force the intervals between the forts, and to search the works of the close attack when directed, later on, on adjacent forts.

Much use may also be made of pieces shifted by railway from one place to another, the Light Armament firing, perhaps, from the railway trucks.

Ammunition.

151. The quantity of ammunition to be maintained is not laid down. The quantity to be provided in case of a regular siege would probably vary from 400 to 800 rounds per piece, according to the expected length of the siege and importance of the piece. With siege howitzers it is improbable that any shrapnel will, in the future, be used. Their projectile will be common shell, and perhaps 5 per cent. of case. With guns about 70 per cent. shrapnel, 20 per cent. common shell, and 10 per cent. case. There should also be an ample supply of small-arm ammunition.

Engineer stores.

152. Engineer material must be got into store, such as timber, brushwood, rails, wire, sandbags, intrenching and cutting tools, mining tools, gunpowder, guncotton, fuzes, exploders for firing mines, telegraphic and signalling apparatus, means for lighting up the ground in the neighbourhood, powerful telescopes for observatories, balloons, carrier pigeons, &c.

The engineer stores should not be kept at a central depôt, but distributed at once to the different sections, in accordance with the works it is proposed to carry out at each.

Provisions.

153. A fortress should be provisioned for at least six months, or better still for a year. The inhabitants must be

ordered to provide their own food, and those who do not, as well as all useless mouths, should be turned out. An ample supply of water is of the first importance, and arrangements should be made for rendering the supply secure; also forage for horses and cattle, straw for bedding, fuel and light, medical necessaries, and clothing. When an attack is threatened, all supplies in the neighbourhood are requisitioned and brought into the fortress.

Civil inhabitants.

154. The inhabitants who are willing to assist as labourers, artificers, firemen, special constables and nurses are enrolled for these purposes. Workshops are prepared for the manufacture and repair of war material, the publication of newspapers is put under control, and supervision kept on public meetings, also on the intercourse of the inhabitants with the garrison, especially if the former are hostile.

The inhabitants should prepare bomb-proof cover for themselves, and arrangements for the rapid extinction of fires should be made.

Particular attention must also be paid to sanitary arrangements.

Preparation of works.

155. All ground in front should be cleared of everything which could give cover to the enemy, or which would be of value to him, such as timber, &c., from houses, rails, &c.

Anything capable of giving cover against artillery fire within at least three-quarters of a mile from the most advanced line of defence, and against musketry fire within half-a-mile, should be removed. The distances of all prominent objects should be measured and posted up in the parts of the works from which they can be seen.

Bomb-proof cover.

156. Bomb-proof cover either in, or in the vicinity of, the forts is of all-importance. This, in order to resist modern shells, should be prepared in time of peace, but existing cover may be strengthened, or hollows formed in old quarries, chalk pits, &c. Splinter-proofs must be erected where time will not allow of better protection, and every attempt should be made to localize the effects of bursts of high-explosive shells by the introduction of splinter-proof traverses.

Artillery positions.

157. The positions for the different pieces of the fixed artillery armament having been decided on, the emplacements should be formed at once, platforms laid, and as many pieces as possible got into position. These emplacements if prepared in time of peace would probably have concrete platforms and sides, with strong anchorages, otherwise they would be very much of the same pattern as those used by the attack.

Observing and plotting stations would be as necessary for these batteries as for those of the attack.

Communications.

158. Communications too must be established in rear of the main line of defences, or improved where they already exist, so as to connect up the different batteries and forts with one another and with the depôts in rear. These communications, partly

ordinary roads and partly railroads, must be hidden from view of the attack, and must be both circular and radial.

Perfect communications by telegraph and telephone should be also established to connect the different sections of the defence with one another, and with the headquarters in rear.

If the ditches are wet, preparations should be made for keeping them free from ice, and arrangements made for forming inundations, also for flooding the ditches and removing the water at will, if possible. Streets opening towards the works, except those which it is decided to keep open, should be barricaded.

Obstacles.

159. Every obstacle that can be devised should be arranged to delay the advance of the enemy—especially to prevent the capture of the forts by storming. Deep ditches and glacis parapets should be specially taken in hand, and strewn with every imaginable impediment.

Advanced line.

160. If the strength and moral of the garrison will allow of it, it is advisable to intrench and take up a position in advance of the main defensive belt on which the forts themselves are sited, but sufficiently near to it to receive very considerable support from the fixed armament of the defence. All devices of field fortification would be here employed—shelter trenches, gun pits, obstacles, and villages and woods in a state of defence, would all form part of the scheme. The defenders can only hold on to the advanced position so long as it entailed no serious losses; but the time expended in the forcing back of this advanced line is all a gain to the defence, and, where it is possible, it is likely to be an important feature of future defence arrangements. The position should be carefully selected as the battle-field on which to force the enemy to fight, before he can complete the investment. If taken up at all, such a position should be from 2,000^{x} to 3,000^{x} in front of the main line of defence.

Counter-approaches.

161. Often it may be possible to form counter-approaches in front of the main line so as to harass the advance of the attack, and such action has been often a marked feature of active resistances—but the garrison may not be sufficiently powerful for this purpose. In any case as the attack gains ground, every point should be well disputed. Arrangements should be made for a step-by-step defence, so that the troops driven out of the advanced line may have other positions in rear which will give them cover, and from which if possible the interior of the advanced line may be swept.

Retired position.

162. A retired position, or line of retrenchment cutting off the forts that may be attacked, should also be considered so soon as the besieger has declared his line of action, so that further delay may be forced on the attack, even after the falling of one or more of the forts. This should be taken in hand some time before there seems a probability of assault on the

forts. Its flanks would usually rest on two of the forts which are on the flanks of the special front attacked. (See Pl. 18.)

Withdrawal of howitzers.

163. As the siege progresses it will probably be advisable to withdraw many of the howitzers to a retired position considerably in rear, where they will be in greater security, and from which they will be able to attack effectively the closer works of the attack, and even to assist in an attempt to recapture the forts if they fall into the possession of the enemy.

Enceinte.

164. Where an enceinte exists, it should be put into a state of defence. It may be of but little use for prolonged defence, but it secures the town from sudden raids, gives confidence, and renders it a refuge.

Keeping the forts in repair.

165. To prevent the capture of the forts is an all-important point, and therefore, all through the siege, efforts should be made to repair breaches that may be formed, and to keep the obstacles intact.

In works which give cover in the ditch, explosive missiles should be prepared to throw amongst the assaulting columns. These may be improvised out of glass or earthenware bottles, or may consist simply of packets of high explosives.

Finally, we may add that the first attention of the defenders should be given to completing and strengthening in every way the main defensive line or girdle of forts, and that the choice and strengthening of advanced or rear positions are only secondary matters, which it may never be possible to undertake.

Sorties.

166. A vigorous defence, properly conducted, will require constant sorties by the garrison, with a view to harassing the attack.

Sorties are of different kinds, and may vary from great sorties, in which every available man may be employed, to small raids undertaken by half or a section of a company.

Great sorties are undertaken to raise the siege, or to destroy the siege works and batteries. They are usually undertaken at the early portion of a siege, before the enemy has thoroughly established himself, and become acquainted with the ground, or whenever any critical stage of the siege has been arrived at. They usually take place at break of day. The troops assemble during the night close to the places of exit, and under the best cover obtainable. Demonstrations are made at different points, so as to deceive the enemy, and prevent his reinforcing his troops at the point of attack.

If the object of the sortie be to destroy the siege works of the enemy, the main attack is generally made on one flank, while a demonstration is made on the other flank, or at other points, to keep the guard of the trenches engaged and prevent them reinforcing the point attacked.

The real point of attack is generally, at the commencement of the sortie, well plied with artillery fire, though such action often, as in the case of the siege of Paris, warns the attacker of the direction of the sortie; the troops then force their

way to the trenches, and drive the enemy out of them, and, if possible, along their communications to their camp; in the meantime, guns and gun carriages are destroyed, tools removed, gabions, fascines, and wood work collected and burnt, and the parapets of batteries levelled, trenches filled in, &c. Even if this cannot be effected before the sortie is compelled to retire, much confusion and delay will probably be caused to the besiegers.

Small sorties.

167. Small sorties may be frequently made, their object being to reconnoitre, to drive away and harass the working parties, especially the sappers, to do any damage to the siege works that may be feasible, or to dislodge marksmen. They are usually carried out by night, and for a distinct object, such as the demolition of a certain work.

After para 167.

TABLE of Ordnance likely to be employe

NATURE.	Platform.	Weight of carriage or mounting.	Weight of platform.	Total weight, gun, carriage, and platform.	Maximum elevation.	Maximum depression.	Height of axis of trunnions from the ground, in firing position.	Projectiles.	Maximum rate of firing.	Weight of projectiles.	Bursting charges.
		Cwts.	Cwts.	Cwts.	Deg.	Deg.	Ft. in.			Tons.	Lbs.
B.L. GUNS.											
12-pr. of 7 cwt.	Nil	11½	Nil	18½	16	8	3 5½	Common ... Case ... ... Shrapnel ...	Rapid fire, one round in 7 to 10 seconds, ordinary fire, 15 to 20 seconds	½	0 ... ...
15-pr. of 7 cwt.	Nil	11½	Nil	18½	16	5	3 4	Do.		½	0
30-pr. of 20 cwt.	Nil	15	Nil	35	17	9	3 6	Do.	1 round in 30 secs.	1½	
6-inch of 5 tons ...	Special	10	tons.	300	15	5	5 6	Common ... Shrapnel ... Armour-piercing Case	200 rounds in 24 hours ...	5½	9
B.L. HOWITZERS.											
5-inch of 9 cwt.	Nil	7 11	Nil	7 20	45	5	3 9	H.E., common, Case	1 round in 30 secs.	2½	4
5·4-inch of 12¾ cwt.	Nil	7	Nil	7	45	5	3 7	Do.	Do.	2½	
6-inch of 25 cwt.	D.D., special	7 46	60*	7 131	70	Nil	4 5½	Do. ...	200 rounds in 24 hours ...	5½	13
6-inch of 30 cwt.	Do.	7 46	60*	7 136	70	Nil	4 5½	Do.	Do.	5½	13
8-inch of 70 cwt. ... {	Special experimental	7 90	7 120	280	70	Nil	6 0	Do.	Do.	12½	32
R.M.L. GUNS.											
6·3-inch of 70 cwt.	Special	52½	20	142½	12	5	8 5½	Common ... ... Shrapnel ... .. Palliser. Case.	... ... 200 rounds in 24 hours	0½	0 ...
40-pr. of 35 cwt.	Nil	43	Nil	78	35	5	6 3	Do., except Palliser	1 round in 30 secs.	2½	3
25-pr. of 18 cwt.	Nil	23½	Nil	41½	35	5	6 0	Do.	Do.	1½	2
R.M.L. HOWITZERS.											
6·3-inch of 18 cwt.	D.D.	31½	46½*	97½	70	Nil	3 6½	H.E., common Case	200 rounds in 24 hours ...	3½	9
6·6-inch of 26 cwt.	D.D.	31	46½*	115½	45	Nil	3 6½	Do.	Do.	4½	7
8-inch of 70 cwt.	D.D.	44	46½*	162½	35	5	4 5	Do.	Do.	8	26

* Includes of ground plate, trail plank, and w

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