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INSTRUCTION IN FIELD FORTIFICATION.

TRANSLATED, BY PERMISSION, FROM THE GERMAN OFFICIAL PUBLICATION BY

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PAPER II.

INSTRUCTION IN FIELD FORTIFICATION.

(Translated by permission from the German Official Publication by Capt. M. Nathan, R.E.).

Translator's Note.

The *Feld-Befestigungs-Vorschrift* was issued in 1893 with directions that the *Pioneers* were to be instructed in all the works described in it, and the *Infantry* in those which had previously been included in their training. It still forms the *Pioneer* regulations for field fortification, though it has been superseded in the *Infantry* since 1894 by the *Feld Pionier Vorschrift fur die Infanterie*, which deals in less detail with field fortification, but contains also instructions with regard to bridging construction, demolition of communications and encampments—all work which would be mainly undertaken by the infantry. It corresponds generally to our *Manual of Military Engineering*.

The *Feld-Befestigungs-Vorschrift* has no exact parallel among the English official handbooks. It is far less detailed than the *Instruction in Military Engineering*, Part I., which forms the basis of instruction at the S.M.E., Chatham. This would appear to be due in part to the difference in the training which it is possible to give the German pioneers, who serve only two years, and to the English Engineers, who serve three to eight, but more especially to the elastic spirit which pervades all German regulations. They clearly define general principles, leaving to well-educated officers the details of their application.

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INSTRUCTION IN FIELD FORTIFICATION.

I.—General Considerations.

Object and Application of Field Fortification.

1. Field defences have acquired additional importance from the effect of modern fire-arms.

Constructed at the proper time, and in the proper place, they render great—often indispensable—services. While increasing and maintaining the fighting power of the troops, they make it possible to offer a stout resistance even with comparatively weak forces, or else, by economizing men, they enable a sufficient force to be reserved for an effective counter-attack at decisive points.

Entrenchments may also find useful application in the attack in holding and strengthening parts of a position that have been captured.

2. The application of field fortification is determined by tactics. It is necessary that in every case it should serve the purpose of tactics, and not the other way round: tactics should not be influenced by them, as is the case when works are put in hand before their purpose is determined. Premature strengthening of a position is directly harmful, restricting freedom of action.

Selection of a Defensive Position.

3. Strategic conditions decide the selection of a position. Its general location will, therefore, in most instances be determined from the map before it is reconnoitred in detail.

4. In this reconnaissance too great importance must not be attributed to certain unfavourable conditions that may be met with in individual sections of the line. In an extended position weak points are unavoidable, and have to be met with by corresponding strength in the dispositions for defence.

5. The position selected should always be considered from the assailant's point of view, and, where possible, should be examined from the front.

6. In the case of a position which it has been decided to fortify, it must be settled whether a decisive engagement is to be accepted there, or only time to be gained.

7. Strong obstacles in front of a position will suggest to an enemy to turn it, and will often hinder the defender's counter-attacks.

They may, however, be of value either if the flanks are secure or if the object of gaining time is effected by forcing the attack to make a turning movement.

Strong obstacles in front are always an advantage in those cases where everything depends on holding a particular spot for a long time.

8. The extent of a position must be proportioned to the troops available for its defence.

Attempts at envelopment should be met by refusing or echeloning the flanks with correspondingly deep formations. Slight depth in a position entails difficulties in covering reserve troops and in moving them to the front, as may be necessary during the course of an engagement.

9. The main requirement is a clear field of fire. Flat, even slopes falling towards the enemy are favourable to the effect of infantry fire and an extended view to the action of artillery.

Concentration of fire on the probable directions of attack, and the possibility of combined action of infantry and artillery up to the decisive point, are of great value.

Woods and ground close to the position which cannot be seen into are a disadvantage, particularly on the flanks.

10. It is an advantage if the nature of the ground in front restricts the assailant in the deployment of his artillery.

11. Facility of supervision and communication inside a position are favourable to the tactical direction and movement of troops. Heavy roads or difficult obstacles in the rear of a position are a disadvantage.

Disposition of Field Defences.

12. Before the fortification of a position is put in hand, the proposed distribution of troops in it must be clearly settled.

13. The occupation of *advanced posts* (apart from that of outpost positions in certain cases) is not, as a rule, recommended, as it tends to the defeat of the advanced troops, and to hamper the fire from the main position. It is, therefore, better to concentrate all the defences in one line.

13. The time available for works of defence depends on the general position of affairs.

The first care must always be for the clearing of the field of fire. This is more important than the provision of cover. Next, works should be thrown up of such a nature that they will be *in a short time* available for defence. It is important to choose types which admit easily of being subsequently strengthened.

15. *All works should be concealed as much as possible from the view of the attacker, and should, therefore, be carefully made to resemble the surrounding features of the ground.*

Instead of placing works on the crests of hills, infantry lines will be more advantageously thrown forward on the slopes towards the enemy, and the artillery positions withdrawn behind the crests so that only the muzzles of the guns project over them.

Parapets and other earthworks must be kept as low as possible, and must present a generally uniform appearance not to be distinguished from that of the surrounding natural features.

It is also frequently advisable not to defend the easily distinguished boundaries of villages, farmhouses, woods, etc., but rather to entrench *in front* of these as far as this may be possible without sacrificing the field of fire. The villages, etc., will then principally serve as cover for reserves.

16. Where it can be done, infantry positions should be located far enough in front of the artillery to give the latter the utmost protection from the enemy's rifle fire, and for the infantry not to suffer in the action between the opposing artillery forces. The fire of the artillery, however, must not be hindered by the dispositions of the infantry in front of them.

17. Infantry defence works generally consist of shelter trenches and cover for supports and reserves.

As far as circumstances permit, in both cases light blindages against shrapnel fire and splinters should be arranged for in the first instance. Protection from direct shell fire is best afforded by the blindages being distributed and made difficult for an enemy to recognize.

Artificial obstacles in front can be specially useful where the enemy can find cover till close up to the position. The freedom of the defender's movements, however, must not be unduly impeded by the provision of obstacles.

18. Cover for infantry need not be throughout of uniform strength. In addition to the flanks, those places require particular attention against which the enemy can find good artillery positions, or where the ground allows him to approach close under cover.

19. The disposition of the defences must also be subordinated to the principle that the occupation of a position should not be carried out until the direction of attack is known. Therefore, the laying out of works will generally be confined in the first instance to certain selected groups (*e.g.*, for battalions, etc.).

Such groups of works well spaced make it possible to do at first with a comparatively weak occupation. As they are strengthened, they become suited under favourable circumstances to serve as *supporting points* in the later stages of the engagement, and can then be held even when the connecting lines between them have been temporarily forced.

20. Features of the ground which combine a good field of fire in front and on the flanks with sufficient cover for the troops temporarily in reserve are the most suitable for these supporting points. Villages, farms, and woods should, however, be used in certain cases.

The arrangements for strengthening the supporting points consist, in the first instance, of skilfully-planned shelter trenches (with flanks refused, wings echeloned, etc.) for the firing line, and then in numerous trenches for supports and reserves. The troops must be protected as much as possible from the effect of artillery fire by numerous blindages, and obstacles must be used where necessary to detain the enemy within the effective zone of fire. Arrangements for defence by sections are recommended in special cases.

Closed redoubts will only exceptionally find application in field positions.

21. In making dispositions for the *artillery*, in addition to an extended clear field of fire, attention should also be paid to placing the line of guns as far as possible at right angles to their principal direction of fire, to obtaining level platforms inside the batteries, to sufficiency of space, and to the possibility of sweeping the ground to within close range. Earth protection should always be provided when time and circumstances permit of it. Its subsequent strengthening, and the protection of the detachments by the construction of light blindages, should be provided for as in the case of infantry.

22. If *heavy* (siege) *batteries* are available, they will find their special use against the hostile artillery according to the nature of the guns, and also against reserves posted under cover, and for sweeping the main lines of approach, etc. In deciding on their location, the most probable positions for the enemy's artillery must be considered. Siege artillery may also be of use on the flanks in cases where its fire could compel the enemy to make a wider detour. Proximity of roads is of value to heavy batteries, especially in regard to their ammunition supply.

23. The improvement and completion of the system of communications—widening of narrow parts of roads, marking out roads to be

taken by columns, restoration of bridges, etc.—should be taken in hand early, especially in those cases where the position happens to be cut up by impassable features of ground, or where it has not been possible to avoid difficult roads and obstacles in rear of the position. The putting up of sign-posts, and, if requisite, of lamps at night, will facilitate the rapid bringing up of reinforcements.

In extended positions, the different sections should be connected by telegraph with the posts of the senior staff officers, and, if necessary, the system completed by visual signalling (observing stations, rockets, etc.).

24. In the attack of fortresses, as in field operations, the field defences should be developed from the same simple forms; the requirement that the original work should be easily and rapidly strengthened is, however, in this case of special importance.

Conditions favourable to surprise often exist in fortress warfare, on account of the constant close proximity of the enemy. The occupied lines should be capable of being held with weak forces for a long time—till the supports resting in rear are ready to take part in the fight.

Hence in fortress warfare there results a more extended use of obstacles, especially in those parts from which attack is not intended; also the necessity for more comprehensive measures of protection against artillery fire and weather. It may serve a useful purpose to defend the whole perimeter of the supporting points of the occupied position, in order thereby to increase to the utmost their power of resistance. Closed works, however, exposed to aimed artillery fire, are in this case also to be avoided. Special importance should be attributed to improving by every possible means the communication of intelligence and the road system.

25. Occasionally it will be necessary to secure the occupation of posts, such as *line of communication stations, bridges, tunnels*, etc., with the smallest force possible.

In such cases an attack by surprise is often possible; a regularly planned artillery attack rarely probable. Enclosed posts with high parapets and strong obstacles all round them can then be of value.

Employment of Troops on Field Works.—Entrenching Tools.—Carrying Out of Work.

26. As a rule, the troops which occupy a position execute the works for its defence.

27. The *infantry* must be able to carry out independently all works of defence of a simple nature.

The *pioneers* are specially trained in the execution of field defences. When working with other troops they are best employed where heavy works have to be carried out or difficult tasks are required. The construction of works falls entirely on them in those cases in which the troops told off to occupy them are not available for their erection. In such cases it is necessary that the senior pioneer officer should be made acquainted with the views of the officer commanding. Otherwise the pioneers afford the infantry such assistance and direction as may be necessary. The infantry parties when at work remain in their tactical units, and are also under the direction of their own officers.

The *field artillery* generally carry out their works without assistance. The *siege artillery* are given help, according to circumstances.

28. The *entrenching tools* of the infantry, pioneers, and division bridging trains equipments are available. Care must be taken that the tool waggons of these trains are on the spot when required. The artillery carry with them the necessary tools for the construction of their gun pits, etc.

The total number of tools carried by an infantry division corresponds approximately to half their numerical strength. Appendix I. contains details on this subject.

Where there is time, the entrenching tools of the troops will be supplemented by others collected on the spot; under certain circumstances, tools will also be obtained from special stocks and from engineer siege trains.

In front of fortresses the entrenching tool requirements will be met principally from the engineer siege train.

29. A spade for each man will suffice for throwing up cover in light soil; in medium or heavy soil, picks will also be necessary.

A practised workman can excavate in one hour, with a big shovel,* the following amounts :—

In light soil	... ...	35 to 42 cubic feet.
In medium soil	... ...	26 cubic feet.
In heavy soil	... ...	14 ,, ,,

With long hours of working the amounts of the hourly tasks must

* Length of large sized spade = 40 inches.
,, small ,, ,, = 20 ,,

be decreased. With four hours' work the average amount per hour can only be reckoned at—

In light soil	...	...	...	25 cubic feet.
In medium soil	...	...	...	16 „ „
In heavy soil	...	...	...	7 „ „

If infantry entrenching tools exclusively are used, the tasks will be diminished from $\frac{1}{3}$ to $\frac{1}{2}$.

In frozen ground, the surface must first be broken with heavy picks, jumpers, iron wedges, and heavy hammers.

Vide Appendix II. (page 43) for the necessary thickness of cover in field works.

II.—Execution of Field Works.

Preparation of the Foreground.

30. Buildings, etc., which afford cover should, as far as practical, be removed. The material obtained from such clearances will be used to fill up and make impassable any depressions, ditches, and hollow roads, as well as for the construction of obstacles or for screens.

Standing crops should be trodden down, mown, or even ridden through by cavalry.

Heaps of straw, wood, refuse, and stones should be spread out.

Hedges, trees, bushes, palings, thin walls, and light buildings should be levelled with axe, saw, pick, rammer, etc. Thick walls and substantial buildings can generally only be removed by blowing them up; it should, however, be borne in mind that the resulting *débris* will often give better cover than the standing buildings.

It is seldom possible to burn down cover, and this is only permissible when every disadvantageous effect of the fire is guarded against.

Objects which would facilitate observation and range-finding for the assailant, such as single or groups of trees, sign posts, etc., should also be removed.

31. Simultaneously with the clearing of the foreground, the distances to conspicuous lines or points of them should be measured by means of range-finders, pacing, or from the map. Where there are no such lines or points within effective fire range, the distances should be marked by sticking up branches or wisps of straw, marking trees, or piling up stones.

Shelter Trenches for Infantry in Firing Line and Supports.

32. One pace per rifle should be reckoned for shelter trenches. On this basis a company* requires, according to its strength, 130 to 165 yards. Intervals of a few paces may be conveniently left between the trenches of different companies.

33. The height of the rifle for troops kneeling is 3 feet, and standing, 4 feet 7 inches. *Fig.* 1 shows a trench for *kneeling*, and *Fig.* 2 for *standing* troops. Both give an upper parapet about 3 feet thick. If the nature of the soil makes this appear too slight, the trench should be widened or enlarged, in accordance with *Fig.* 3, into a *strengthened shelter trench*. This trench gives also covered communication in rear of the firing line.

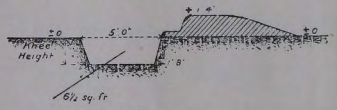

Fig. 1.

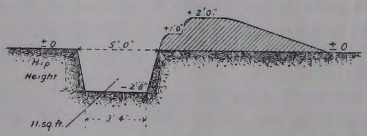

Fig. 2.

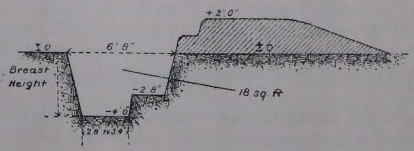

Fig. 3.

The figures all give only a general indication, and are not intended to furnish a definite pattern.

34. As a general principle, it should be borne in mind that, where

* This refers to a company of which the establishment is about 250 men.

time and circumstances permit, cover for troops standing, as shown in *Fig.* 2, should be provided.

Since parapets should be kept as low as possible, as far as is consistent with a proper view being obtained, a shelter trench, as shown in *Fig.* 4, may also be recommended. Its construction requires, however, considerably more time than that shown in *Fig.* 2.

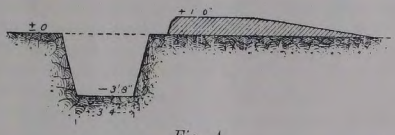

Fig. 4.

On the other hand, higher parapets may be necessary in order to obtain command.

The off-set, 12 inches wide, shown in the figures, serves to support the arm when aiming, and for keeping ammunition at hand.

Further, each man should arrange his cover so that he can load and fire comfortably, and so that the muzzle of his rifle is clear of the parapet when aiming.

35. The revetment of the interior slope should always be made as steep as possible.

Deep shelter trenches should have steps or ramps in the rear as may be required.

36. If an attack is possible while the work is in hand, an attempt will be made to complete at least a trench suitable for firing from the kneeling position. From the commencement of the work continuous parapets and trenches should be formed, and not detached pits. As soon as circumstances allow, the trench will be widened (*vide* para. 34).

37. The earth not required for the parapet, and which cannot be put into it without undue labour, will be thrown to the rear.

Parados are not to be formed, as they increase the splinter effect of bursting shells.

With rock or water close below the surface, the earth for the parapet must be taken from both sides of it.

38. In the case of shelter trenches to be occupied for a considerable time, a greater width of trench and height of cover may be given to

facilitate communications. *Figs.* 5 and 6 show shelter trenches which meet these requirements.

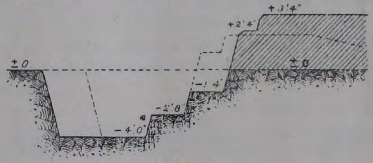

Fig. 5.

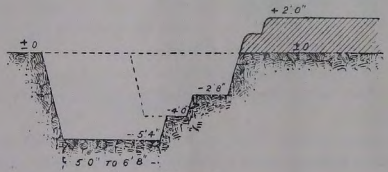

Fig. 6.

39. Trenches to give cover to supports, similar to those for the firing lines, will be thrown up in rear of the latter, protected as much as possible by the conformation of the ground. They do not require, however, the same defensive arrangements, but should give cover to the full height of a man.

The trenches for support should have easy ramps at the ends, and when not connected with the front line by covered ways, steps, etc., should be provided here and there to enable the troops to issue from them.

40. For the execution of shelter trenches, each company forms a working party equipped with the available picks and shovels. Other squads are told off for determining or marking ranges, for special works, reliefs, etc.

While the company is being told off, an officer, with a few men, lays down the line of the proposed trench, making certain at the same time that it will be possible to see into the ground in front from every part of it.

As soon as the men are ready for work, those carrying shovels are placed along the marked line, at arm's length from each other, and those carrying picks are distributed along it.

As soon as they are in position, each man carrying a shovel drives it into the earth immediately in front of his feet, and forms a furrow from the right till it meets those of the next man, to mark the front edge of the trench. In the same way the back edge is marked, and then the excavation commenced from the front limit.

The length of a shelter trench for a company is given approximately by the original distribution of the shovel men at arm's length from each other. The individual tasks resulting from it are according to the different natures of soil.

$\frac{1}{2}$ to $1\frac{1}{2}$ hours for the section shown in *Fig.* 1.

$\frac{3}{4}$ to 3 hours for the section shown in *Fig.* 2.

2 to $5\frac{1}{2}$ hours for the section shown in *Fig.* 3.

It is only advisable to relieve the men employed when the work lasts more than an hour.

41. Sods or earth clods obtained in excavation are to be used for the revetment of the inner slope of the parapet. The parapet should be repeatedly trodden on or beaten down in the course of formation.

Casks, bundles of brushwood, logs of woods, etc., may be stood or piled up as a revetment to obtain cover rapidly.

Sharp angles are to be avoided in all parts of the earthwork visible to the enemy. The parapets should be strewn with similar surface growth to the surrounding ground, so as not to be conspicuous against it.

Dummy works and screens may be used to make the discovery of the actual position more difficult.

42. When shelter trenches are exposed in certain parts to enfilade they can be protected from it by epaulments.

For this purpose, when the trench is originally executed, intervals 3 to 4 yards wide may be left at the required places, the trench carried round them, and epaulments thrown up where the ground has been left undisturbed (*vide* para. 58).

43. The ricochet effect of rifle shots which strike in front of the trenches may be lessened by loosening the ground immediately before them. But on no account should this be allowed to make the trenches more easily recognized.

44. Where the space is limited and the form of the ground suitable, it may, in *exceptional cases*, be permissible to lay out the shelter trenches in several tiers one behind the other.

45. If it is necessary to work under fire, the men of the firing line, provided with shovels, putting their rifles aside, throw up cover for

themselves in the first instance, and then pass on their shovels to others.

Overhead Cover in Shelter Trenches for Firing Line and Supports.

46. The infantry can only bring effective fire to bear on the hostile infantry when it has approached within effective range. During the preliminary artillery duel it will be exposed to constantly increasing losses as the attack asserts its superiority. It, therefore, becomes necessary to protect the infantry in the shooting line and supports as much as possible from the effects of this artillery fire by means of overhead cover.

Numerous light constructions are generally preferable to the erection of single bigger and stronger blindages, for they will give ample protection against shrapnel fire and splinters; by giving the necessary inclination to their roofs, they can be made secure against direct hits from field or other flat trajectory guns. Protection against the direct hits of high-angle fire guns is to be sought in a good distribution of the shelters, since, with the means available for field fortification, real security against such fire is unattainable.

47. It is an important point with all blindages that their position should not be recognizable from outside. The extent of parapet available for the firing line should, if possible, not be limited by them. They must also be so placed as to ensure the rapid deployment of the garrison into the firing line.

Erections of so simple a character that they can be put up in a short time, and by the infantry without assistance, are recommended.

48. For blindages, easily procurable building materials such as doors, gates, boards, planks, light baulks, poles, etc., should be used. As regards nature of construction, besides the instructions given in paras. 46 and 47 and the requirements of cover specified in Appendix II., the question of stability has also to be considered.

With regard to this, only the following general indications can be given, on account of the variety of the timber which may be available in different cases:—2-inch planks, with a light earth covering, may have an unsupported span of 3 to 6 feet, rafters 4 to 5 inches deep a span of 6 to 12 feet. Weaker rafters should be supported or laid with smaller intervals. Boards should be laid in two or three layers, and supported as may be necessary.

49. If the overhead cover is given a slope of about 12° (1 in 5), it is secure against direct hits from field and other flat trajectory guns up to a range of over 3,000 yards.

Boards or baulks are used to give a firm, even abutment for the ends of the planks or rafters. The ends of the rafters receive increased protection by means of baulks, fascines, or bundles of brushwood laid in front of them.

A thin layer of earth, and the use of brushwood, etc., is of advantage on all roofs, for the better closing of joints, and for strengthening the planks. It also serves to lessen the effect of striking splinters.

Steps and walls should be revetted as may be required (see Appendix III., page 44).

50. In completed shelter trenches a certain measure of overhead protection can be rapidly secured by the use of doors, gates, planks or boards, as shown in *Figs.* 7 and 8.

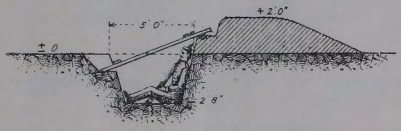

Fig. 7.

Fig. 8.

If these roofs can be quickly thrown off the extent of the firing line is not diminished by them.

51. By the simple arrangement shown in *Fig.* 9, in which planks

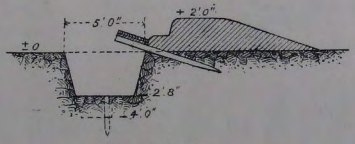

Fig. 9.

are laid on posts previously driven into the parapet, at least cover from shrapnel fire can be obtained. The planks are thrown off when the firing line is occupied.

Security against splinters also can be obtained by the additional work shown in *Fig.* 10, the front slope of the trench being cut

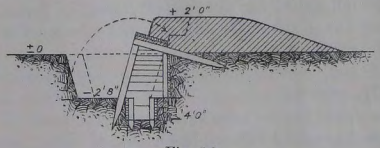

Fig. 10.

down and revetted, the trench widened, and the parapet strengthened to the rear.

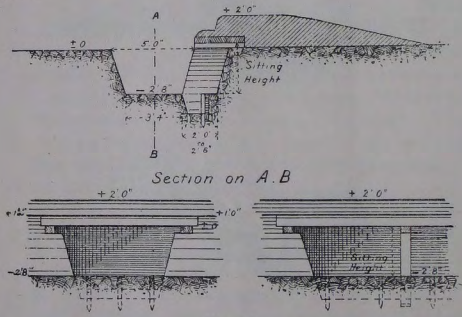

Fig. 11.

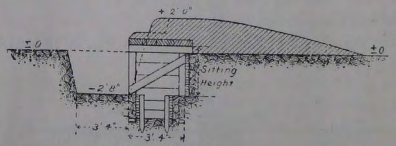

Fig. 12.

52. Other simple forms of overhead cover blindages, which are built into the parapet and cause no diminution in the length of the firing line, are shown in *Figs.* 11 and 12..

Fig. 11, for a row of men sitting, is intended for stiff soil. *Fig.*

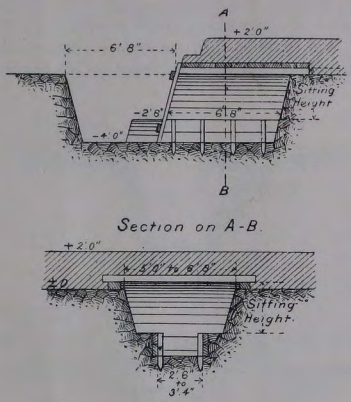

Fig. 13.

12 shows the necessary revetments where the soil is loose, and gives room for two ranks of men sitting.

The space for these blindages is most conveniently obtained by making the trenches in the first instance wider at the selected positions. If roofing timbers are available when the work is put in hand they may, if the soil is stiff, be laid in position before the trench is excavated, the earth being afterwards dug away from under them.

Blindages for single men can be formed from boxes, barrels, etc., let into the front slope of the trench.

53. In all blindages the opening to the rear may be closed with boards or planks, and in this manner protection can be given against chance splinters flying back.

54. The arrangement shown in *Fig.* 14 is also suited for building in under the parapet.

Any considerable extension of this space to the front is to be avoided.

55. Where a slight diminution in the length of the firing line is of less importance, or where it may be compensated by increasing

the total length of the shelter trench, the types shown in *Figs.* 14 15, and 16 are suitable.

Fig. 14 shows a blindage which would answer for the strengthened shelter trench, and accommodate one rank sitting and one standing. *Fig.* 15 gives a type for still wider trenches. This blindage furnishes

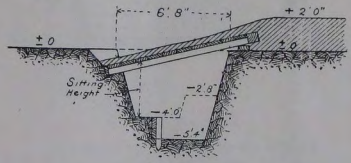

Fig. 14.

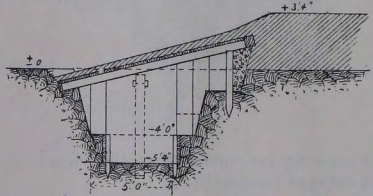

Fig. 15.

more comfortable accommodation, and allows, even when occupied, communication through it.

If it is a case for shelter more of the nature required in camp the type in *Fig.* 16 is suitable.

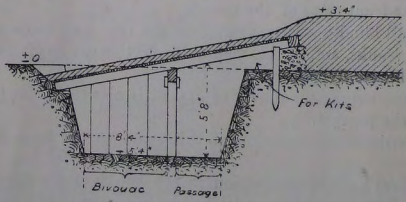

Fig. 16.

The entrances to the blindages of the types shown in *Figs.* 14 to 16 can be conveniently sheltered for the breadth of the passage by folding screens, and for the remaining breadth completely shut up.

56. To facilitate traffic along partially covered-in shelter trenches it is advisable, should time be available, to arrange for passages, as in *Fig.* 17.

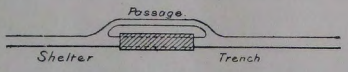

Fig. 17.

57. *Fig.* 18 shows a form of blindage suitable for widened shelter

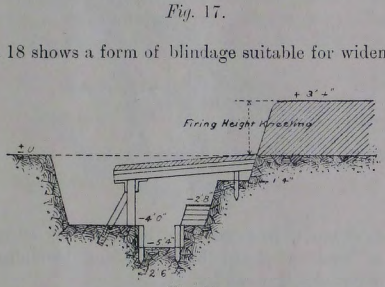

Fig. 18.

trenches, which does not decrease the length of the firing line, at any rate for men kneeling, while communication along the trenches still remains possible.

58. Blindages should not be placed in those parts of shelter trenches such as refused flanks, which are liable to enfilade. In such cases special trenches are formed parallel to the front line, and the blindages constructed there (*Fig.* 19).

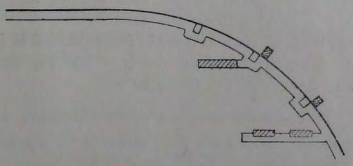

Fig. 19.

Smaller blindages may be placed immediately in rear of the traverses.

59. Sometimes earth banks, dams, steep inclines, etc., exist on the ground, behind which supporting troops or reserves can find a covered position. Blindages can be formed in such positions in accordance with *Fig.* 18, or more simply as in *Fig.* 20.

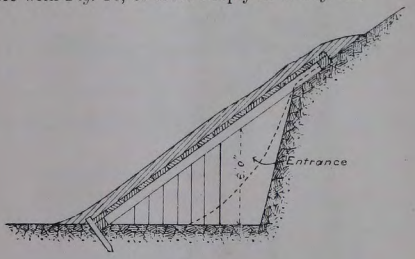

Fig. 20.

Such forms of lean-to roofs may also be effectively applied to the protection of reserves placed behind strong buildings in the lengthened occupation of localities.

60. In *siege operations* it may be advisable to strengthen the earthworks, and give greater solidity to timber constructions. With reference to this, see the second part of para. 46. Increased care in the construction of the blindages is further recommended, so as to give more comfortable accommodation and better protection from the weather to the troops occupying the trenches.

61. This is attained by fastening the timbers more firmly together with dogs, cross battens, etc., fixing the posts deeper into the ground or standing them on sills, tying and shoring well the timber walling, revetting the earth slopes with boards, and closing the joints in the roof planking more carefully.

62. The execution of such blindages is facilitated if it is possible to get prepared corrugated iron sheets. This is dealt with in further detail in Appendix IV. (page 49).

Other Arrangements in Shelter Trenches.

63. Where *shelter trenches are to be occupied for a considerable time* special attention must be paid to draining off the surface water. Deep-lying shelters must be protected against the water running in.

The provision of temporary wells should be taken into consideration.

It may be necessary to put up latrines some distance away from the shelter trenches, and connected with them by small covered ways.

Inside the several sections the requisite sign posts, lanterns, etc., should be put up.

Provision must be made for night firing.

It is important to be able to watch the ground in front of shelter trenches without being exposed, and in safety while they are under artillery fire, so that they may be secure against attacks by surprise. An observation post with look-out hole is shown in *Fig.* 21.

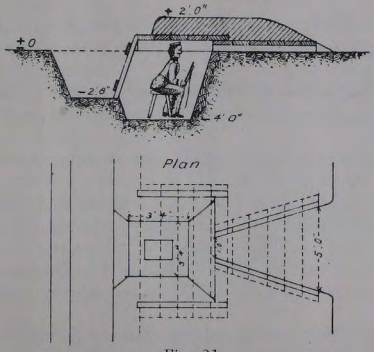

Fig. 21.

The watching may also be done with mirrors.

64. For the support of the infantry in shelter trenches against close attack, machine guns on moveable shielded mountings may be used in fortress warfare; there are special directions for building them into parapets.

Cover for Field Artillery.

65. As a general principle, protection for the men in the front line is to be aimed at, and cover for the guns, only when there is ample time. Where the conditions of the ground are not too unfavourable, cover for men can often be thrown up during the

attack, and under fire. This must not, however, be allowed to impair the fire effect of the battery.

The construction of complete gun pits will, on the other hand, as a rule, only be practicable in prepared defensive positions before fire is opened.

66. In arranging for cover, care must be taken that observation by the enemy's artillery should remain as difficult as possible. For this purpose, if there is sufficient time, masks, *e.g.*, mounds of earth, can be thrown up. It is further recommended that the single epaulments should be connected by a thin parapet of equal height, an unbroken line being less clearly visible. The free movement of the guns to the front must, however, not be hindered by this parapet.

Cover unskilfully provided sometimes furnishes the only indication by which the position may be recognized, and do them more harm than good.

67. A stronger form of gun epaulments, as well as the provision of connecting trenches between guns and batteries, may sometimes be necessary.

Where suitable, existing cuttings, shallow trenches, mounds, earth banks, etc., may serve as natural breastworks.

Measures should be taken for easily bringing forward the guns to participate, if required, in the defence against close attack.

68. The guns should generally be 20 paces from centre to centre; if necessary, this may be decreased to 10 paces; it is not necessary that the intervals should be the same on each side of a gun.

For fire direction it is desirable that there should be an interval of about 30 paces between batteries, but this distance should not be obtained by decreasing the intervals between guns.

69. The bottom of the gun pit should not be so sunk as to limit the field of fire.

In dry, sandy soil so much dust will be stirred up by firing that the advantage of smokeless powder will be lost. It is then, under certain circumstances, better to omit the construction of parapets immediately in front of the gun.

In soft ground it may be useful to lay a bedding of planks, etc., under the trail and wheels. If necessary, in this case also only the trenches for the guns detachments should be excavated, the gun being allowed to stand on the natural surface of the ground. A parapet may subsequently be formed from a trench in front.

70. The types given below are not to be considered as binding. The cover, however, should never take a form which might interfere with the efficient service of the gun.

71. The inner cutting lines of the two *trenches for the guns detachments* are marked at a distance of 6 feet 8 inches from the centre line of the gun emplacement; each trench occupies a square of 5 feet side on plan. The continuation of the front side of the square must pass midway between the axis of the gun and the rear of the gun wheel. Two or three men should be set to work at each trench. The trenches should first be excavated to a depth of 18 inches, and then to a depth of 3 feet, leaving a step to serve as a seat in the front slope, and one for getting out of the trench in rear.

The excavated earth is used to form a parapet in front and to the sides of the trenches, and should be trodden or beaten down. The ammunition (shell and cartridge boxes, etc.) should then be placed in recesses at the level of the seat, excavated in the natural ground (*Fig.* 22).

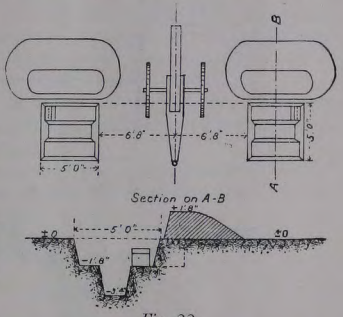

Fig. 22.

In average soil the trenches for the guns detachments can be excavated by them in about 25 minutes.

72. If the necessary time (about an hour for eight men in average soil) cannot be reckoned upon for the excavation of the complete gun pit shown in *Fig.* 23, the trenches for the men should always be first executed. If sufficient time is available, gun pit and trenches for guns detachments should be commenced simultaneously, and if additional men can be put to the work they might be used to excavate a front trench.

73. Arrangements as shown in *Fig.* 24 are recommended where gun emplacements are to be formed on the reverse slope of a hill.

Under certain circumstances, it is sufficient to make cuttings in the slope for the wheels, throwing the excavated earth behind the

wheels and trail. The cuttings for the wheels must be three or four times the breadth of the tyres.

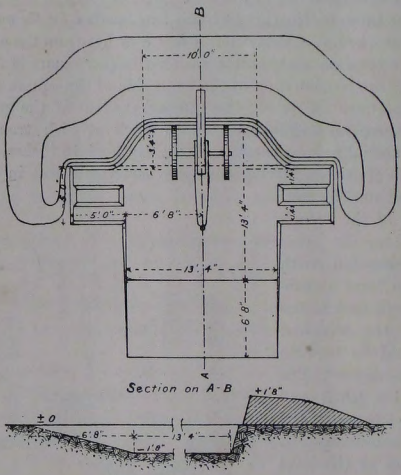

Fig. 23.

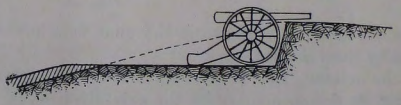

Fig. 24.

It will frequently be necessary to effect while in action repairs of damage done.

Cover for Siege Artillery.

74. The construction of cover for heavy batteries will be in accordance with the special instructions for siege artillery.

The preparation of a firm gun platform is the first requisite. Simultaneously with this the most necessary cover should be constructed, to be gradually strengthened as required.

75. All heavy batteries are to be arranged so as to be concealed as far as possible.

Curved fire batteries can be covered from the direct fire of guns, particularly of field artillery, by being placed behind heights, etc. Direct fire batteries will be sited similarly to well-covered batteries of the field artillery.

Adaptation of Existing Cover to Defence.

76. The existing features of the terrain often afford cover which may be adapted to defence. Such features include various—even slight—unevennesses of the ground, walls, hedges, woods, buildings, and enclosures.

77. It should, however, be borne in mind in arranging natural cover for defence that the enemy's attention will naturally be directed to those lines which are particularly conspicuous in the direction where he suspects the defender to be posted.

If the edge of a wood or village be occupied, the attacker is supplied with good points for finding and identifying the range with the help of the map (see para. 15).

78. *Ditches, trenches, hollow roads, banks* can be arranged for defence, according to their nature, by cutting out, deepening, providing banquettes, stairs, ramps, etc. (*Figs.* 25—27).

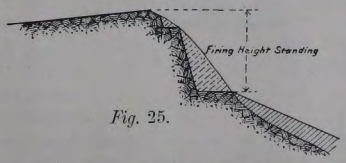

Fig. 25.

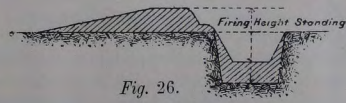

Fig. 26.

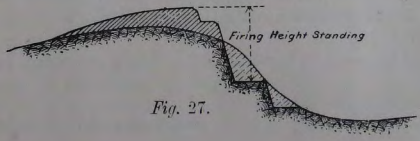

Fig. 27.

In the case of narrow banks, the side away from the enemy will be adapted for defence in the same way as the side of a ditch.

In the case of high or broad banks, where the foreground cannot be sufficiently seen from a position behind the bank, the cover had better be provided on the side towards the enemy, and connected by covered trenches with the reverse slope (*Fig.* 28).

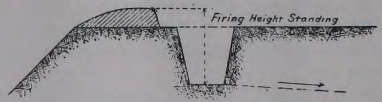

Fig. 28.

79. *Hedges*, if sufficiently thick and high, form good obstacles; they may also have value as screens.

They may be arranged for defence by throwing up a shelter trench in rear of them; any arrangement that can be seen from the front is to be avoided. This refers also to the clearing away for loopholes through a hedge, work which is most conveniently left to the men occupying it (*Fig.* 29).

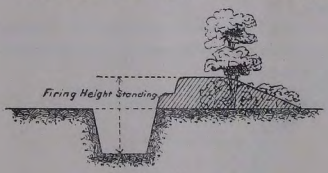

Fig. 29.

80. *Palings of boards* can be used similarly to hedges. As a rule, it is better to pull these down and use the wood for blindages.

Palings of lathes and wooden railings are only suitable for defensive purposes in rare instances, but may serve as obstacles.

Iron railings are good obstacles. Special provision must be made against splinters of shells in positions taken up behind such railings.

81. *Walls*, if of sufficient height, form good obstacles, and with a certain thickness (see Appendix II., page 43) give cover against rifle and field-gun fire.

Should the walls be higher or lower than is convenient for a man to fire over, they will be arranged for occupation in the manner shown in *Figs.* 30—33.

In order to diminish the effect of splinters of shells striking the

walls, the top of the wall should be covered with sods, etc., by which means a better rest for the rifle is also obtained.

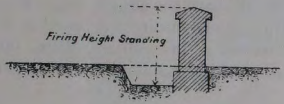

Fig. 30.

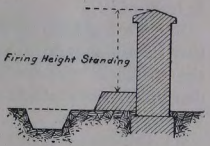

Fig. 31.

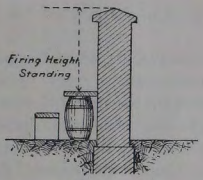

Fig. 32.

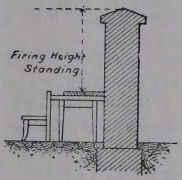

Fig 33.

In the case of high walls, loopholes can also be formed, it being borne in mind that openings narrow on the outer face, and at varying heights, will diminish the accuracy of hostile rifle fire.

If the wall is sufficiently high, it will be possible to arrange for several tiers of fire one over the other (*Figs.* 34 and 35).

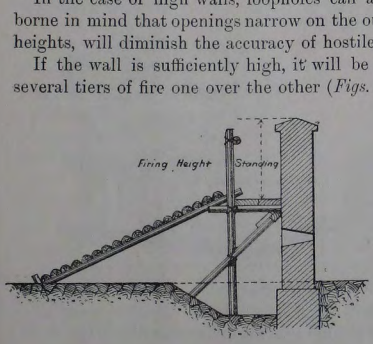

Fig. 34.

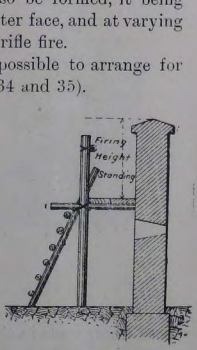

Fig. 35.

The scaffolding required for this purpose must be carefully put up, and requires much time and woodwork.

In walls less than 18 inches thick, it may be advisable to break down the upper part and strengthen the part left standing by earth in front of it.

82. *Woods* give cover from view, but have the disadvantage that they impede movement and communications in direct proportion to the thickness of trees and underwood. In preparing them for defence, the completion and indication of the communications should be first considered.

83. Only those troops which are well retired receive any protection in woods from fire ; it is not possible to do without shelter trenches and blindages in the front line. These will be much more effectively placed in front than on the edge of the wood (see paras. 15 and 77).

In the case of thin woods, it may, however, be advisable to withdraw the line of defence behind the outer edge.

84. If it is the case of defending considerable stretches of wood in the investment of a fortress or such like operations, the edge of the wood may be partially closed with abatis, and the throwing up of shelter trenches confined to the most important points. By this means troops are economized in the front line of defence.

85. *Fig.* 36 gives an example of a shelter trench on the *edge of a*

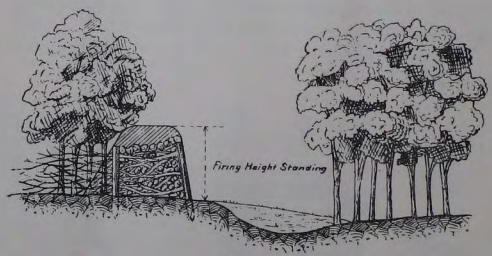

Fig. 36.

wood where roots in the ground make it difficult to dig. The timber cut down will be made use of in preparing the cover.

In other cases the arrangement shown in *Fig.* 37 may be convenient.

86. As a rule, *buildings* give no protection against field guns, and

only against rifle fire if they have comparatively thick outer walls.

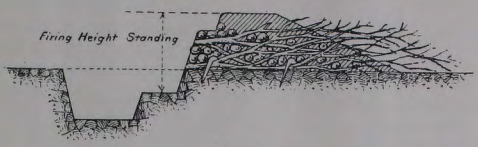

Fig. 37.

These conditions must be borne in mind when estimating their value in defended positions.

Houses roofed with thatch or shingles are unsuited for defence unless the roof is removed.

87. Measures for assuring effective fire delivery and cover to the occupying troops have to be considered in the first instance, and then the *precautions* against the enemy forcing his way in.

The window openings should be so arranged that the men may fire over the window sills.

Wooden shutters practically only serve to prevent a man getting in. If they are made use of, a loophole must be made above the window sill.

Entrances must be closed, and when not used should be barricaded. Loopholes will be made in doors and gates, which will be protected from rifle fire by earth in front of them (*Figs.* 38 and 39).

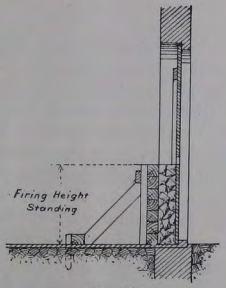

Fig. 38.

Cellar windows not occupied should be barricaded.

All easily inflammable objects should be removed from the building, and, if necessary, filled water butts placed in readiness.

If further time is available, openings may be made through partition walls, and other defensive arrangements completed as required.

88. In the case of *farmhouses*, *factories*, *railway stations*, etc., the first consideration is the preparation of a defensive enclosure. For the rest, the instructions given in para. 87 apply.

In the case of railway stations, rails held between sleepers fixed

in the ground and stayed offer a convenient method for closing gaps.

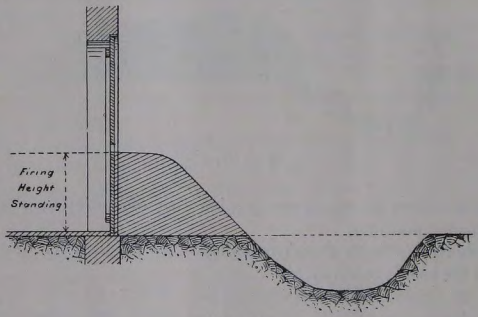

Fig. 39.

89. In organizing the defence of a *village*, its position and shape, as well as the nature of its surroundings, houses, and farm-buildings, have to be taken into consideration.

It is of advantage if the buildings are mainly of strong construction and comprehensively grouped, and if streets and open places are favourable to the employment of reserves. It is also desirable that there should be some principal buildings which would serve as central points for the inner defence, or that the construction of the village should be such as to admit of a defence by sections.

See paras. 15 and 77 with regard to the selection of the line of defence.

90. The village will be divided into sections, to be occupied by battalions and companies. These sections must be made to fit in with the dispositions for defence. It is recommended that their limits should not correspond with the main roads into the village.

91. As a general rule, each unit will fortify the section which it is to occupy. The troops of the front line have to look to their own communications and to the security of their supports. The dispositions inside the village, and the preparation of inner lines of defence, fall to the reserves, while the several central points of defence will be strengthened by the detachments told off to garrison them.

92. The dispositions for the defence of the edge of the village

will be in accordance with the instructions laid down in paras. 79—81, and 86—88. Gaps in the line will be closed with shelter trenches, obstacles, etc.

Barricades across roads may be formed with loaded vehicles locked together, or by piling up casks, etc.; they can be made so as to offer more resistance by taking up the paving stones, piling them up, and covering them with earth. It is generally advisable when blocking a road to form a bye-path for keeping open the traffic.

93. Suitable buildings in open places, or at street corners, will be fortified as *central points of the defence*, to prevent the enemy that have forced their way in from spreading out, and to facilitate the re-taking of the village.

The organization of *inner lines of defence* can only be undertaken where there are broad roads, brooks, etc., running through the village, parallel to the defended front, and with the buildings along them suitable for occupation. The dispositions for the defence will be similar to those for the outer edge, except that numerous passages must be left.

94. Where a weak force is exposed to attacks by surprise, or is required to offer a prolonged resistance, it may be advisable to defend the buildings inside, instead of the edge of the village. The defensive capabilities of the former must then be developed to the utmost, so that when completely surrounded it may still be possible to continue the fight.

95. The considerations that have been explained with regard to villages apply also to the defensive organization of *towns* as tactical points of support.

Redoubts.

96. Redoubts, being enclosed works, give a certain security to their garrison if they are protected from surprise by a continuous line of obstacles round them, and if the troops are sufficiently secured by blindages against artillery.

It is, however, difficult to avoid making redoubts so visible as to attract artillery fire, from the effects of which it is more difficult to protect the troops in a limited enclosed space than in long lines of shelter trench.

97. In extended positions, the necessary supporting points will, therefore, always best be provided by an arrangement of *shelter trenches in groups*, in combination with obstacles, etc. (see paras. 19 and 20).

The closed redoubt will only *in exceptional cases* find its place in

such a group, or even in independent positions. It is permissible in the defence of line of communication posts, bridge-heads, gaps between posts, etc. (para. 25).

98. Closed redoubts will be constructed only for infantry.

The strength of the garrison (as a rule, not less than one company), and hence the size of the redoubt, will depend on the importance of the point it is to occupy.

The required fire development and the form of the ground determine the plan of the work. By diminishing the depth, the advantage is gained that the work is less easily recognized as such.

Sharp angles are, as in shelter trenches, to be avoided, and the parapet should be kept as low as possible consistent with seeing from it the ground in front.

This condition, and that of allowing the troops to move conveniently about the work, will in most cases be secured by parapets somewhat as in *Figs.* 5 and 6.

For overhead cover, the considerations and types discussed in paras. 46—62 will apply, but it is particularly important in redoubts that none of the firing line should be sacrificed.

Fig. 40 shows *an example* of the arrangement and form of a redoubt for a company in accordance with the above instructions.

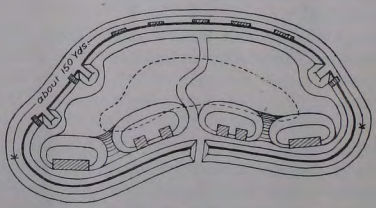

Fig. 40.

99. In *fortresses*, stronger types of redoubt may at times be required.

In them bigger dimensions for the parapet require, as a rule, an outer ditch, in which concealed obstacles may be placed.

The blindages can only be given sufficient power of resistance to furnish protection from shells of medium calibre at the expenditure

of considerable time in construction, and by the use of specially prepared materials.

Obstacles.

100. Obstacles are intended to protect the troops behind them from surprises, and to keep the enemy within the most effective fire area. They should not interfere with the defender's fire, and should be kept as much as possible hidden from the attack.

Visible obstacles often offer the most reliable indication of a defended position.

101. *Walls, hedges, railings*, etc., can be improved as obstacles by forming ditches in front of them, which will make them more difficult to climb over.

Underwood will be made more impassable if wire is drawn through it in irregular directions.

102. The effectiveness of *water obstacles* may be increased if an inflow exists or can be formed, and the outflow can be stopped.

The obstacle will be most satisfactory if a depth of 6 feet can be maintained over its entire area, or else in one continuous channel.

The dams must be sufficiently strong to resist the water pressure, and must be secured against softening and leaking. For this purpose, besides earth, stones, bundles of brushwood, refuse, sods, walls of baulks laid in front of posts driven into the ground, or trees, may be used. Piers of bridges or culverts may be used as supports.

The top of the dam must be about 18 inches above the anticipated level of the inundation; a breadth of from 3 to 6 feet at the top will generally suffice. The slopes should be kept as flat as possible.

One or more dams will be required according to the fall.

To prevent the incoming water from overtopping and washing away the dam, either weirs or sluices must be formed in them to take off the waste water; the edges of these overflows must be protected from being washed away.

103. Of *artificial obstacles*, abatis and wire entanglements will be most used in field fortification.

In order to keep them out of the zone of the artillery fire directed against the position, and at the same time to secure their being sufficiently watched, even at night, they will be placed about 150 feet in front of the line of defence.

It will only be possible to completely hide obstacles when the nature of the ground is particularly favourable. It will, therefore, often be necessary to throw up a slight screen in front of them.

104. To form *abatis*, felled trees or thick branches will be fastened together and to the ground. Tree and branch abatis are dealt with separately.

105. To form a *tree abatis*, felled trees are laid in several rows with the branches towards the enemy, so that the tops of the back rows cover the trunks of the ones in front. The obstacle is strengthened by binding trees and branches irregularly together with wire.

Tree abatis is employed to close the intervals between defences (*vide* para. 84), as well as to block hollow roads and other depressions.

106. *Branch abatis* is formed from trees and branches of about the thickness of an arm, best of spreading leaved wood; thin twigs are cleared away, and the branches are laid as shown in *Fig.* 41, in

Fig. 41.

several rows one behind the other, the thicker ends being pointed. In order that such an abatis may be overlooked from the defences in rear, it must be kept correspondingly low down.

The branches will be fastened together by laths, which will be held down by hooked or cross staples, and will also be bound together with wire.

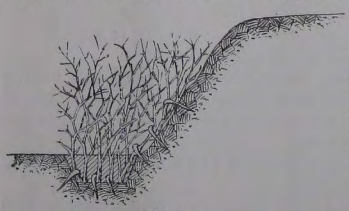

Fig. 42.

With steep slopes, for instance, in hollow roads, the abatis shown in *Fig.* 42 may be used.

107. *Wire entanglements* consist of posts between which wire is bound in different directions.

The posts, 4 feet 6 inches to 6 feet in length, and 2 to 4 inches thick, are driven firmly into the ground to such a depth as to project unequally, but on the average 3 feet. They should be at varying distances apart—about 6 feet in the mean

Cross nets are then stretched between the rows of posts. Each of them is formed of wire about 5mm. thick (No. 6 S.W.G.), passing crossways from the feet of one row of posts to the heads of the next (*vide Fig.* 43). Besides this, the posts in every row should be connected with each other at about two hand-breadths above the ground.

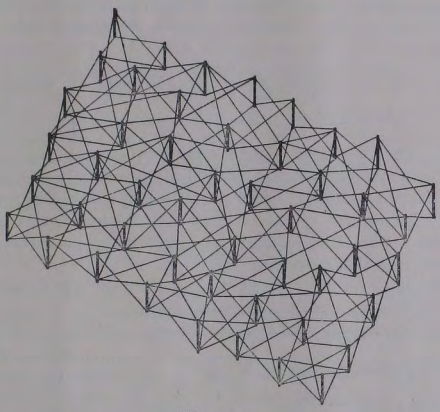

Fig. 43.

Between the thick wires, thin ones will be stretched in various directions at intervals of 18 to 30 inches.

The thick wires will be fixed to the posts with clips, which can be easily made from pieces of this sort of wire. The thin wires will be fastened to the posts as well as to the thick wires, where they cross them, by being twisted round.

The deeper the obstacle the more effective will it be; a depth of 10 yards is desirable.

Against the great efficiency of this sort of wire entanglement must be set the disadvantage that if uncovered it is easily recognized, even at long distances. If it cannot be concealed it should be kept lower.

If time and material run short, single wires stretched irregularly

12 to 18 inches above ground between strong posts will do good service.

108. *Other obstacles*, in addition to the above mentioned, may be provided according to the conditions found at the place where they are required.

109. Under certain circumstances, explosives, in the form of fougasses or land torpedoes, may be used as obstacles. The special Instructions for the Pioneers give details concerning them.

III.—Works of Infantry and Pioneers in the Attack.

General Remarks.

110. The works of the infantry and pioneers in the attack, especially of fortresses, will now be dealt with. Such works may also occur in a simpler form in the attack of a defended position.

111. The works of the infantry and pioneers before a fortress commence with those required for carrying out the investment and for the protection of the artillery.

Practically no other forms of field defences will occur in these operations besides those already dealt with.

112. The regular works of attack consist of infantry positions and approaches (*Fig.* 44). They are intended to render it possible, even under the most difficult conditions, for the infantry and pioneers to pour in effective fire and to push forward to the assault.

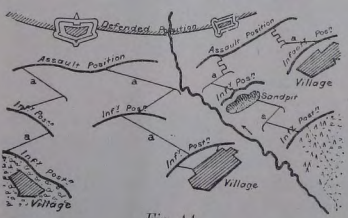

Fig 44.

Infantry positions and approaches are called "siege trenches."

113. The infantry positions are shelter trenches, which are pushed forward in the first instance as close as possible to the enemy's lines. This close approach is all the more necessary, as the execution of each new infantry position means a delay in the attack.

Value should be attached to secure communication to the rear, and to facilities for timely support.

There is no need for the infantry positions to form continuous

lines. The protection of the intervals may be left to the fire of the neighbouring lengths of trench, or to the action of reserves.

The assault is carried out, as a rule, from the last infantry position (storming position).

114. The *approaches* (*aa* in *Fig.* 44) serve to connect the infantry positions with each other and with the covered positions in rear. They must be secured by their direction against enfilade, and for this purpose are necessarily traced in zig-zags.

Each single line of a zig-zag is called a length. In certain places these lengths are prolonged to the rear (returns) to allow of special arrangements (for dressing stations, latrines, etc.).

115. Where approaches are necessary in such proximity to the work attacked that to trace them in zig-zags would unduly delay the advance, they will be traced directly towards the work attacked, cover being provided from the front and flanks by means of traverses (*traversed trenches*).

Types of Siege Trenches.

116. The simplest form of infantry position is a shelter trench for men standing, of the section shown in *Fig.* 2. It has to be adopted when the nights are short and the conditions of work unfavourable.

If possible, the strengthened section shown in *Fig.* 3 should, however, be completed in the first night.

On the following day the shelter trench should be widened as may be necessary in accordance with *Fig.* 5 or *Fig.* 6.

117. A still greater breadth of trench may be required in single parts of it, and especially in the storming position. Care should be taken in this position to arrange for the parapet being easily crossed by steps or ramps.

118. The approaches are to be constructed in accordance with *Fig.* 3, omitting the step and the offset for firing from. A breadth of about 3 feet is sufficient, in the first instance, for the bottom of the trench. It should afterwards be increased to 6 feet.

119. The nature of the soil and water in the ground may necessitate deviations from the types given.

If it is not possible to go deep enough down, the earth for the parapet must be obtained by increasing the width of the trenches.

Where the soil is rock, the siege trenches must necessarily be replaced by parapets of sandbags, etc.

Execution of Siege Trenches.

120. In *entrenching the outposts* it should always be taken into consideration that the shelter trenches thrown up for them should be capable of being subsequently used for the infantry position.

The siege trenches will, as a rule, not be constructed to the full extent intended at one time, but will be formed bit by bit by throwing up single lengths or by connecting or lengthening them.

121. As the men are not under cover when placed in position to excavate siege trenches, it is necessary that the work should be commenced as a surprise, and, therefore, generally at night.

In the *rare* cases where this procedure is not possible, gradual pushing to the front of the siege trenches by "sap" may be compulsory. Further details with regard to the execution of this work, which falls to the pioneers, are given in Appendix V. (page 53).

122. Before the troops are put to work, *the route to the trenches and the lines to be excavated must be clearly indicated* (for this purpose sign posts should be put up and the trenches marked with white tape secured to the ground).

Officers, who have been previously carefully instructed with regard to the ground and the works to be carried out, will also be told off to accompany the troops.

123. Attention should be paid in measuring and telling off work to preserving tactical units.

The necessary officers and pioneer squads will be allotted to assist the various detachments.

The troops will, however, remain, even in this case, under their own officers, who will be responsible for the execution of the allotted tasks.

124. The place and time of assembly and the strength of each detachment, together with the roads they are to follow, must be accurately determined.

It should be decided, in accordance with the circumstances, whether and where a special reserve working party is to be allotted.

Every man receives a shovel, and a proportion of them picks, from the entrenching tools, which will have been previously laid out. It may also be requisite to issue axes and saws, etc.

If necessary, instruction will then again be given with regard to the work to be carried out, and it is recommended that the men should be shown a length of trench already executed, and also how they will be placed for the work.

125. The troops should be marched to the ground and the work should be carried on without noise ; clattering of tools and rifles is specially to be avoided. Orders should, therefore, be given with reference to the manner of carrying them.

Orders and words of command are to be given in an undertone. Talking, smoking, or striking lights are forbidden.

Care should be taken that parts of the columns of march do not break off.

If detachments on the march or at work are lighted up from the fortress, the men will throw themselves on the ground and remain in their places without moving.

126. As a rule, the troops do not march directly from the place of assembly to where the work is to be carried out; the detachments go first to pre-determined halting places, as near as possible to the work.

A cross-country march is often advisable, as the detachments are liable to be lighted up and fired at on the roads.

At the halting place the guides are instructed, as far as may still be necessary, in the work allotted to their detachments, and then lead them to where work is to be carried out.

127. The working party is posted in a single rank, with 2 paces interval between the men, along the line to be excavated.

It depends on the darkness of the night, the nature of the ground, etc., how this deployment will be carried out, whether by the advance of companies or of the previously separated "zugs," or bit by bit by bringing up sections, or by posting single files.

As soon as the rifles, etc., have been laid down the work is commenced.

Any reserve of workmen remain provisionally in close order in rear of their detachments.

128. When the work is completed, if it is intended to proceed at once with enlarging the section of the trench, the tools will be laid down on the rear edge of it. As a rule, the troops will move off by companies. If it is still dark, they may move by the shortest route, otherwise by roads not seen into, or by the siege trenches.

The works should be clear of the working parties before the detachments told off to widening the trench come up.

Widening of Siege Trenches and Special Arrangements in them.

129. The siege trenches will be widened as required ; generally, immediately after they are constructed, the widening would begin at the positions of the advanced posts or outpost companies.

130. The construction of special arrangements, such as cartridge stores, blindages for outposts, telegraph stations, dressing places, etc., will go on simultaneously with the widening of the trenches (*vide* para. 63).

Wherever a further advance is not intended, obstacles may be laid in front of infantry positions.

131. In the defence of a fortress, trenches have often to be thrown up against the attack. Under certain circumstances, the defender will have to advance against the enemy with works of attack.

Removing and Surmounting Obstacles.

132. The removal of obstacles in the attack of fortresses or defended positions, where they cannot be destroyed by artillery fire, falls, as a rule, to the pioneers.

The nature of the obstacles has first to be ascertained in order that the necessary implements may be prepared.

133. As a rule, the removal of obstacles must be effected before the assault.

The pioneers endeavour, for this purpose, to approach the obstacles noiselessly in the dark, in small bodies or singly. It is best to commence clearing them away where gaps have been made by gun fire.

In the assault, the pioneers hurry on in front of the storming parties to further complete the removal of obstacles, or to clear away fresh obstructions.

If the removal of obstacles has, in an exceptional case, to be deferred till the time of assault, the pioneers will usually move forward with the firing line.

While the infantry, having reached the obstacles, lie down in readiness to overwhelm the defence by their fire, the pioneers carry out their work.

134. In *abatis* there are sometimes places which are less thick, and where, by cutting off single branches which are in the way, passages may be made.

Abatis of small trees and branches fastened together can be drawn apart with ropes when the fastenings have been loosened.

Wire entanglements are destroyed by cutting through the main wires with cutters or with an axe on an iron block, and afterwards knocking down or drawing out the posts.

Strong gates, thin walls, railings or such-like obstacles are opened up by knocking or tearing them down with special implements.

Inundations caused by watercourses are only to be removed by destroying or opening the dams. Sometimes this can be effected by means of artillery fire. An attempt should be made to render harmless fougasses and land torpedoes by cutting the leads, etc., where they have not already been destroyed by artillery fire.

135. Explosives offer a specially suitable means for destroying obstacles. The special Instructions for the Pioneers give the necessary directions on the subject.

136. The following hints will serve as a guide to surmounting obstacles. In some cases, for instance, where there are *pits*, *palings*, *harrows*, etc., places for passing over can be made by covering up with sacks, trusses of hay or straw, boards, etc.

Swamps can be crossed with the help of planks or bundles of brushwood.

Walls, railings, or other high obstacles can be got over with ladders, etc.

The special Instructions for the Pioneers give the necessary information with regard to getting over obstacles with specially prepared appliances.

137. Where time and other conditions permit of it, the troops told off to the assault will be practised in removing and surmounting obstacles, which will be specially prepared for the purpose.

APPENDIX I.

Entrenching Tool Equipment Carried with Troops.

Corps.	For Earth Work.				For Timber Work.			For Other Work.
	Spades.		Pick-axes.	Picks.	Axes.	Hat-chets.	Saws.	
	Large	Small						
Infantry or Rifle Battalion	—	400	—	40	—	20	—	
Cavalry Regiment	—	32	—	—	—	48	—	Tools and explosives for railway demolitions.
Field or Horse Artillery Battery—								
(*a*). With the Battery (6 guns and 4 ammunition waggons)	26	—	20*	—	4	20	—	* Field artillery carry heavy pickaxes.
(*b*). With the Ammunition Train	12	—	11*	—	7	12	—	
Total	38	—	31	—	11	32	—	
Pioneer Company—								
(*a*) Carried by Pioneers	88	—	44	—	45	18	—	60 dogs. 150 lashing ropes. 15 bags of nails.
(*b*). In Entrenching and Tool Waggon	60	—	30	—	20	—	12	Pincers and tools for various purposes. In the field miners' waggon also explosives and mining apparatus.
Total	148	—	74	—	65	18	12	
Pioneer Detachment of a Cavalry Division	13	—	6	—	8	3	—	200 lashing ropes. 50 dogs. 10 bags of nails. Explosives and mining apparatus.
Division Bridging Train—								
(*a*). In 3 Entrenching Tool Waggons	600	—	150	—	90	—	30	90 clamps.
(*b*). In Tool Waggon	—	—	—	—	3	1	3	Cordage. Tools of all descriptions for carpenters, locksmiths and blacksmiths.
Total	600	—	150	—	93	—	33	
Corps Bridging Train (in 2 Tool Waggons)	—	—	—	—	—	2	6	60 dogs. Tools of all descriptions for carpenters and joiners.

APPENDIX II.

Thickness of Cover for Field Works.

Against Rifle Fire.

Sand	2 feet 6 inches.
Ordinary soil	3 „
Built-up sods, turf or peat soil ...	6 „
Trodden snow	6 „
Corn sheaves	15 „
Fir and pine wood	3 „
Oak wood	2 „
Steel plates	$\frac{2}{3}$ inch.
Brick walls	1 foot 6 inches.

Boards 8 inches apart with small stones between them.

Against Artillery Fire.

Against *shrapnel* and *splinters* from

Field Artillery :—

Earth	16 inches to 3 feet
Wood in overhead cover	2 „

Siege Artillery :—

Earth	3 feet.
Wood in overhead cover	4 inches.

Against *direct impact* of single shells from

Field Artillery :—

Earth	3 feet to 6 feet.
Masonry	3 „
Snow, about	25 „

Siege Artillery (guns) :—

Earth	9 feet to 12 feet.

APPENDIX III.

Revetments.

1. When it is required to carry up a slope at an angle steeper than the natural slope of the ground, it must be revetted.

For this purpose sods, boards, and brushwood are used, as well as stones, casks, and building timber, and logs of wood.

In infantry parapets the interior slope should only be revetted up to the off-set on which the arm rests in firing.

As a rule, the revetment is carried up at the same time as the parapet is formed.

2. In *sod revetments*, the sods—about 12 inches in length and breadth—are to be laid in layers, breaking joint, and the earth packed behind them.

It is advisable to have single longer sods running at intervals further into the parapet.

In place of sods, firm clods of earth or stones may be used, or bags filled with earth.

3. *Boards* or *planks* behind stakes are a very suitable material for revetment, especially of steps.

The stakes are driven in at the foot of the slope at its proposed inclination. Their distance apart—3 to 6 feet—depends on the thickness of the boards or planks. These are laid against the stakes on the side of the parapet, and the earth filled in behind them.

With high slopes, or when the stakes cannot be given the necessary firmness by driving deep into the ground, the revetment must be anchored. Wire, withes, or lashings are fastened round the top of every second stake, and attached at the other end to posts or to poles buried in the parapet (*Fig.* 1).

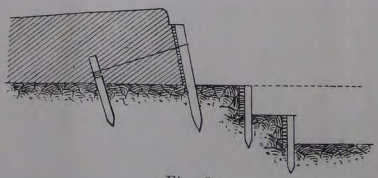

Fig. 1.

In wall revetments of a stronger sort, or when they are intended to serve as a support for overhead cover, it is convenient to connect the tops of the stakes by means of a longitudinal timber or bearer fastened on with nails or dogs (*Fig.* 2).

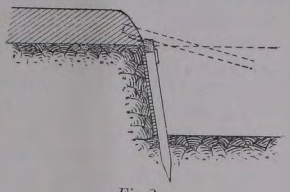

Fig 2.

4. *Brushwood packing* is the simplest form in which brushwood can be used for revetments. As in the case of board revetments, stakes are planted at intervals along the line of the slope, and brushwood packed so closely behind that the earth cannot fall through.

In this case, in order to anchor down the revetment, it is recommended that a lath or pole be fastened to the top of the posts, and that this be held into the parapet by anchors at intervals of 4 feet 6 inches to 6 feet (*Fig.* 3).

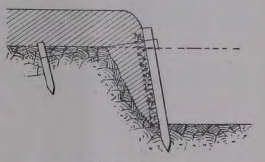

Fig. 3.

5. For *continuous hurdling* the stakes are driven in along the line of the slope at intervals of 12 to 20 inches, and connected together with a lath at their heads. The brushwood is passed alternately in front and behind the posts and frequently pushed down.

When about two-thirds of the slope has been completed, the anchorage, if one is wanted, will be formed, and the hurdlework then continued.

Preparation and Use of Fascines and Hurdles for Revetments, etc.

6. For the sake of handiness, *fascines* are usually made not more than 12 feet long and 10 inches thick. The brushwood, formed into a sausage shape, is held together by bands 12 to 20 inches apart.

Hurdles also, for the sake of handiness, are not made over 6 feet long and 3 feet high. These dimensions correspond best to the purposes for which hurdles are mostly used. The stakes, about 2 inches thick, on which the hurdle is formed, should be approximately 10 inches apart.

7. In *cutting brushwood* the material should be at once sorted on

the spot into the following natures, and, if it is to be made up elsewhere, these should be laid out in bundles that can conveniently be carried:—

Binding withes should be rods about 6 feet long, $\frac{1}{3}$ to $\frac{2}{3}$ inch thick at the ends, long and flexible.

Hurdle and *hurdling* material should be straight rods, not more than $\frac{2}{3}$ inch thick at the ends, as free as possible from twigs.

Fascine material, for which any straight twigged brushwood up to $1\frac{1}{2}$ inches thickness at the big end can be used.

Stakes will be made out of the strongest and straightest sticks to be found in the brushwood, or out of any round or split wood.

8. The *binding withes* should be trimmed to within 2 feet from the small end, and somewhat pointed at the thick end.

If they are not sufficiently flexible, they should be twisted, the small end being kept fixed by standing upon it or holding it firmly between two stakes.

9. Twisted withes may be used for *anchoring* as a substitute for wire, rope, or yarn. For this purpose two stakes are driven into the ground about 3 feet apart, and between the withes are turned and bound about themselves while being continuously twisted (*Fig.* 4).

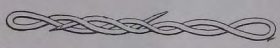

Fig. 4.

10. *Fascines* are prepared by squads of five or six men on stands constructed as shown in *Fig.* 5.

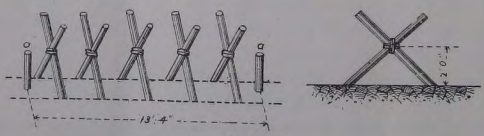

Fig. 5.

For tools, in addition to beaters, hatchets, pruning knives, saws, etc., a chain or rope choker is required; it should be $4\frac{1}{2}$ times as long as the section of the fascine, and should be provided with two sticks at the ends.

The brushwood is so laid that the thin rods come on the outside

and the thick and crooked ones in the middle. Branch twigs should be trimmed and squeezed in. The rods should cross each other, thin and thick parts should come at alternate ends of the fascine, and the brushwood should extend over the end post of the stand (*Fig.* 5).

The choker is first laid just outside the first trestle round the brushwood, which is squeezed with it till it is of the proposed size of the fascine.

The binding is done with wire, or, if there is none available, with withes.

In binding with withes, the thick end is passed through the brushwood from above at the place where it is to be bound, and drawn through so that the thin end projects about 6 inches. The fascine is then squeezed tight, and the withe bound round and fastened off (*Fig.* 6).

Fig. 6.

In binding with wire, which should be about $\frac{1}{8}$ inch thick, the bands should be made about 4 inches longer than the proposed girth of the fascine. One end is formed into an eye, through which the other end is passed and then twisted round. Pincers are required for this purpose.

11. Hurdles are made, as a rule, by squads of three men; the tools required are beaters, hatchets, pruning knives, etc.

The stakes are driven into the ground and fastened together as shown in *Fig* 7.

Fig. 8 shows the commencement of the weaving, which is always done with *single* rods.

The beginnings and ends of all the rods come on the same side of the hurdle, but not so as to lie against the end stake; where one rod ends another one is commenced.

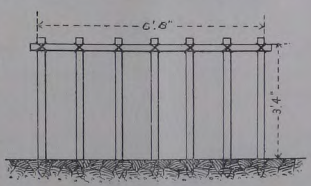

Fig. 7.

Fig. 8.

For binding round the end posts the rods must be slightly twisted. When the hurdlework has reached the required height, it is secured to all the posts with wire bands, two holes being bored at the top and bottom of every alternate post—one close to the end of the hurdlework, and the other 12 inches from it—the wires drawn through these holes (*Fig* 9).

If wire is not available, the hurdle should be bound with withes above and below *between* the posts (*Fig.* 10).

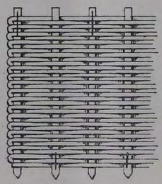

Fig. 9.

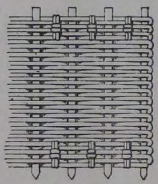

Fig. 10.

12. *Fascines* are principally used for revetting steps in accordance with *Figs.* 11 or 12.

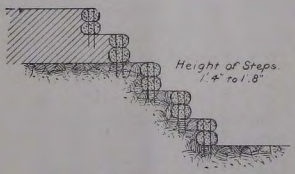

Fig. 11.

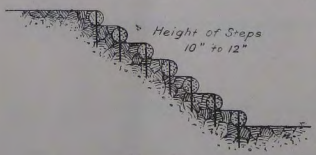

Fig. 12.

They may further be applied to the following purposes :—

Facilitating traffic along the bottom of wet trenches, improving roads in swampy places, making passages across marshy ground, covering over joints, and protecting the heads of bearing timbers in blindages.

13. *Hurdles* are placed close to one another along the slope, to be revetted with the ends of the stakes driven into the earth, and further anchored as may be necessary, or held down by

long crutch sticks (*Fig.* 13). Hurdles may also be employed for the purposes already detailed at the end of para. 12.

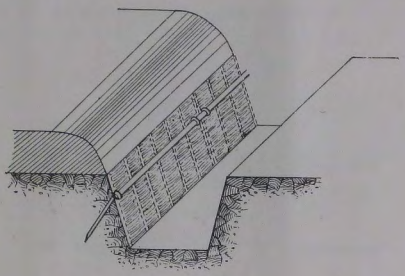

Fig. 13.

APPENDIX IV.

Prepared Blindages of Bent Corrugated Iron.

1. By using a greater or less number of 3-foot widths of corrugated iron, blindages can be constructed of any required length, except in so far that their use is naturally limited by their weakness against single hits from high-angle fire guns, and by the requirements of light and air.

For short blindages it is advisable that they should be at right angles to the direction of the parapet; for long ones, that they should be parallel to it.

Figs. 1, 2, and 3 illustrate a blindage of the first sort.

A wooden wall with timber struts is erected at the back as a revetment to the earth slope, and as a protection against displacement.

The struts also serve to carry the folding doors of the entrances.

A blindage provided with seats will accommodate eight men to the yard run in sitting position.

The earth covering, 2 feet thick, shown in the type, gives protection against single direct hits from field guns.

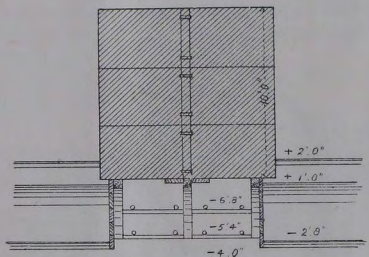

Fig. 1.

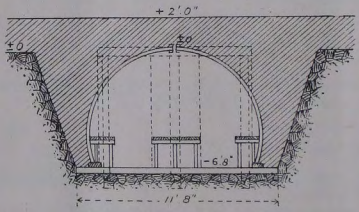

Fig. 2.

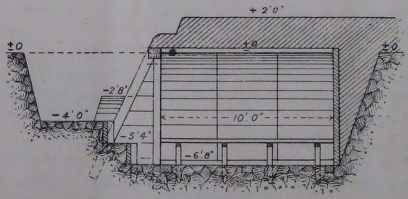

Fig. 3.

The corrugated sheet of iron will carry, if necessary, an earth covering of 12 feet thick.

When long blindages of this sort are erected in the direction of the trench, it is recommended that for half of their width they should be built into the parapet, and that the entrance opening, where it comes against the steeply revetted slope, should be closed by a firm plank wall, the remainder by a folding door (*Fig.* 4).

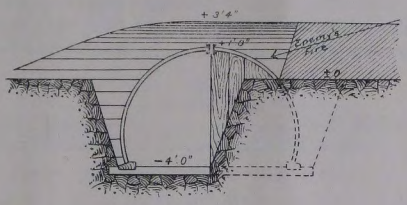

Fig. 4.

2. A *unit* of corrugated-iron blindage consists of two sheets of zinc covered corrugated iron bent to a circular arc.

At one end of the sheet is fastened an angle-iron foot bar, and at the other a channel-iron top bar.

In order that a unit may be quickly put together, a conical tongue is provided in the top bar of each sheet, which fits into a corresponding slot of the opposite top bar.

In each sheet one of the side corrugations is slightly opened out, and the other so far compressed that the side corrugations of two adjoining units will fit into each other exactly (*Fig.* 5).

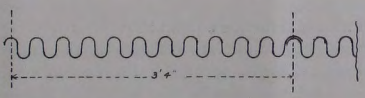

Fig. 5.

In one half of the sheets to be used the wide corrugation must be to the right, and in the other to the left.

The wide corrugation of each sheet is indicated by a red paint mark on the outer side.

The weight of a sheet is 215lb.

In order to hold the sheets firmly at the top, *clips* are provided, one to each sheet. Openings to correspond to the clips are formed in the upper flange of the channel irons (*Fig.* 6).

Fig. 6.

The corrugated-iron units stand on a frame, which is generally only made when required. The dimensions of the cross sills, of which one must be provided to every two units, are shown in *Fig.* 7.

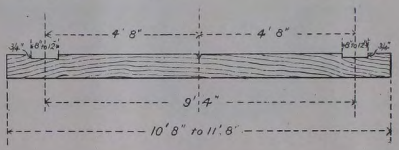

Fig. 7.

Fig. 8 shows the chamfering for the foot supports to rest on and the scantling of the longitudinal sills. The angle irons are secured by 4-inch nails, of which five are required for each side of a unit.

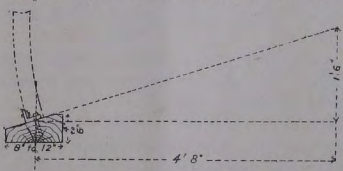

Fig. 8.

3. The following points must be borne in mind in the *erection of the blindages* :—

The sill framing must be laid level.

The two sheets of a unit are placed with the angle irons on the chamfered edge of the longitudinal sills, and so arranged that the head supports come together. One man then makes fast the two clips, while two men nail the angle irons to the longitudinal sills.

In putting up the first unit the bigger side corrugation, marked with red, is turned away from the direction in which the construction is to proceed, so that the bigger side corrugations of the subsequent sheets may be laid over the narrower end corrugations of those already erected.

If the side corrugations have been damaged, they should be bent

or hammered out previous to erection, in order to avoid delay and noise.

4. A squad of 1 non-commissioned officer and 12 men is sufficient for the construction of the smaller blindages. It will be convenient to increase the squad to 2 non-commissioned officers and 20 men for long ones.

A few hammers, besides other tools, will be required by the erecting party for laying the previously prepared sill frames, and putting u the corrugated-iron sheets.

APPENDIX V

Execution of Siege Trenches by Sapping.

1. By *sapping* is meant the gradual advance of a siege trench under cover.

The cover to the front is called *head cover*, the parapet thrown up to the side, *side cover*.

According to whether the side cover is thrown up on one or both sides, the sap is distinguished as *single* or *double*.

2. The slow procedure of sapping is confined to such cases where uncovered work is impossible.

Even in such cases it is the duty of officers on the spot to take advantage of every opportunity for hastening the work by carrying out bits of it by ordinary trenchwork.

3. *Single sap* has a head and a widened section. *Figs.* 1 and 2 give an indication of the dimensions under ordinary conditions.

The relation between the depth of the trench and the height of the parapet is derived from considerations of cover.

The width of the head section is made as small as possible to hasten the work ; for the same reason the head cover may be replaced by a projecting side cover, as shown in dotted lines in *Fig.* 1.

4. Under ordinary conditions one non-commissioned officer and eight pioneers are required for single sap, four men working and four men being in relief.

5. The tools required by a squad consist of one pick and one shovel, both with short helves, for the man in front, and three

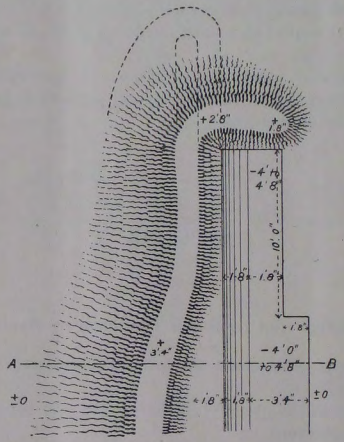

Fig. 1.

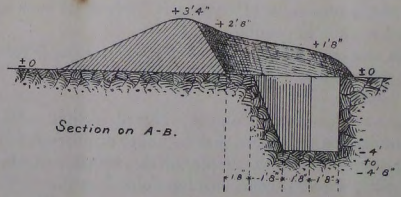

Fig. 2.

shovels and one pick with long helves for the others, as well as reserve tools.

6. In *carrying out single sap*, two men work at the head task and two men at the widening. Of the former, one man drives forward the head while the other throws up the side and head cover with the

loosened earth. The other two men complete the side cover and clear the berm between the edge of the trench and the parapet.

It may be assumed that in ordinary soil the sap, as shown in *Fig.* 1, will advance at the rate of a yard an hour.

The further widening of the siege trench is carried out as required by infantry parties.

7. To *carry out the double sap* two squads of four to eight pioneers are combined under one non-commissioned officer.

The two squads work together at one head and widening task (*Fig.* 3).

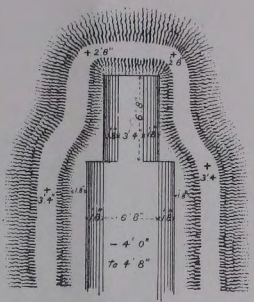

Fig. 3.

8. *Fig.* 4 gives an example of changing direction with double sap.

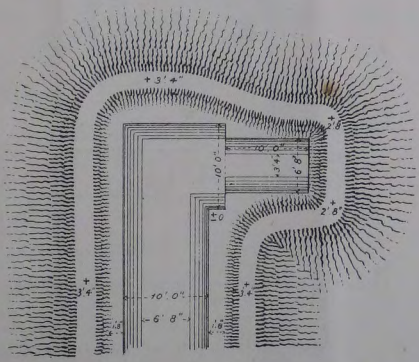

Fig. 4.

9. If it becomes absolutely necessary to make traverses, the

ground plan arrangement shown in *Fig.* 5 will result (*vide* para. 115).

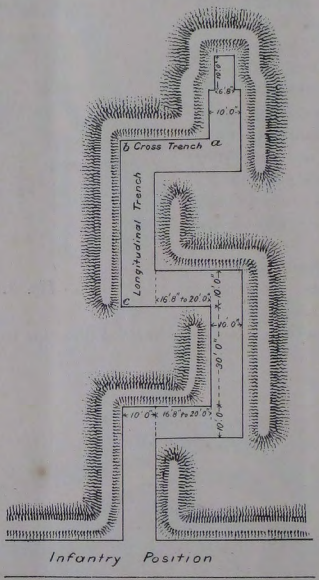

Fig. 5.

10. The traversed trenches are formed by frequently changing direction with double sap.

The cross trenches, which only receive fire from one side may, in order to hasten the work, be first made by single sap. The necessary widening may be done later.

11. In *executing traversed trenches* by ordinary trenchwork it is convenient to place two rows of diggers to the longitudinal and one to the cross trenches.

Fig. 6 gives an instance of how the men should be placed to carry out a short length by double sap.

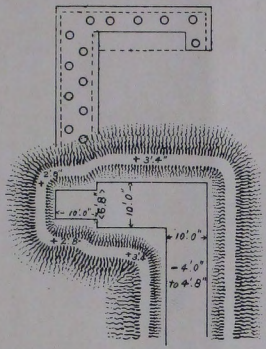

Fig. 6.

The cover of the abandoned head should be left until the newly-begun trench itself furnishes cover.