Modern Method of Fortifying a Position

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"Whatever arguments may be drawn from particular examples, superficially viewed, a thorough examination of the subject will evince that the art of war is both comprehensive and complicated; that it demands much previous study, and that the possession of it in its most approved and perfect state is always of great moment to the security of a nation."

WASHINGTON'S LAST ANNUAL MESSAGE.

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MODERN METHOD OF FORTIFYING A POSITION

General Considerations

1. In the following discusssion no attempt will be made to lay down rules or to establish typical forms of works that will be suitable to all circumstances. It should be remembered that the true essentials of a fortified position cannot be expressed on plans and maps. The disposition and the design of the defensive works should be decided on the actual ground to be defended, and only after a full consideration of the tactical circumstances. As the tactical considerations; that is, the conformation of the ground, the nature and direction of the expected attack, the strength of both combatants and the weapons employed, will vary greatly in different cases, it would be impossible, even if it were advisable, to lay down any system which would be applicable to all. Even the design of the individual works depends solely on the tactical considerations. Type designs are therefore useless, except as a general guide.

2. *Classes of Defensive Positions.* — Defensive positions may vary from the great extensive fortified position guarding some important city or strategic point liable to be assailed by a formidable force and therefore requiring an army for its defense, to a small fortified post holding a road, a pass or a bridge head, and occupied by a small detachment.

Again, the methods of defense vary according to the weapons that may be used by the expected at-

tacking force; and many of the measures that would be necessary against a force employing siege guns, howitzers and mortars would be unnecessary against a force with field guns alone, or without any artillery.

3. An *intrenched camp* or an all-around defensive position would consist at the present day of a series of fortified and strongly held positions surrounding the town or other object to be defended, and so situated in tactical relation to each other that it would be impossible for an attacker to penetrate to the interior of the defensive line without first capturing some of these positions.

4. The *distance of the defensive line from the nucleus* would in almost all cases be decided by the topography, but this line should be so selected as to prevent the enemy from locating any batteries within a range less than 10,000 yards from the nucleus, if aimed and observed fire is possible from the location.

5. Sometimes it will be sufficient to keep the enemy's position *out of sight* of the town, as unaimed and unobserved fire will seldom be effective, and it may happen that a conveniently intervening range of hills would effect this; it should, however, be remembered that observation of fire can be conducted with sufficient accuracy to hit a town or other large area from captive balloons, so the end would not be achieved if the town could be seen from balloons sent up from the besieger's positions, if the latter were within range.

6. *Second line.*—It will seldom be wise in the case of a large and important town to rely on a single line of fortified positions for its defense. Therefore, it is often desirable to keep the main defensive line at a considerable distance from the nucleus in order to leave room for a second line or

retired position, in case some of the works in the front line are captured.

The second line must not be commanded by the first, for in case a portion of the first line were captured, the attackers would be able to render the works of the second line untenable.

7. *Tactical Situation of the Works.*—There are three prime conditions to which every defensive position should conform:

1. It should admit of full scope for the effective use of the defender's weapons.

2. It should restrict as far as possible the effect of the attacker's weapons.

3. It should provide full facilities for tactical control and movement of the defender's forces.

If a hill or other commanding feature be occupied by some of the defender's troops in such a manner that they can sweep with the fire of their weapons the ground in front and on both flanks of it, then none of the attacker's troops can pass by that position within the limits of effective range of the weapons of the troops holding it. If the defenders hold two such positions situated at such a distance apart that the occupants can sweep with their fire the whole of the ground between them, then the enemy would be unable to pass between the two, or within effective range of their outer flanks.

A series of positions all around the town arranged in the above manner, so that the ground between every pair can be swept by rifle fire from the works, or artillery fire in rear, would make it impossible for the enemy to penetrate without capturing one or more of the fortified positions.

8. *A Defensive Line.*—The above principles apply equally to cases where the position is a straight line or an arc with secured flanks. It is imperative,

however, in such cases that the flanks cannot be turned.

9. The *intervals* between the supporting points would not necessarily be all the same. Where the ground in the intervals is absolutely open and flat it might extend up to 3000 to 3500 yards; where it is less favorable it might be necessary to make it only 2000 yards or even less. If the ground is very broken, so that there is much space concealed from view from either of the adjoining works, subsidiary works or trenches might be necessary in the intervals to cover the dead ground.

10. *All main roads* or other lines of approach by which an attacker's columns would probably advance should be covered by the fire of positions such as the above.

11. *Form of Supporting Points.*—It is now necessary to consider what will be the form of the supporting points above mentioned. Anything in the nature of a fort or redoubt must always form a more or less conspicuous target, and be certain of receiving a heavy and concentrated fire from the besieger's batteries. The interior of a redoubt will necessarily besome what crowded, and heavy explosive shells dropped into crowded restricted spaces are known to have a most destructive effect.

It is quite possible, on account of the greatly increased defensive power of the rifles of the present day, to space the defenders of a line of parapet at much greater distances apart than was rule in past times. A line of men with magazine rifles, four to six paces apart, behind good cover, can bring such a hail of bullets over the open ground in their front to a considerable distance from their own position, as to effect terrible loss on any troops endeavoring to advance on it. Such dispersion, moreover, is advantageous in that it reduces the risk of casualties

from the hostile fire, and in an immovable defensive position cannot be considered too great for effective supervision and control.

It seem probable, therefore, that each of the detached points that go to make up a great defensive position would consist merely of a locality or tract of ground rendered defensible by a skilful treatment of its natural features; that is to say, by the provision of simple trenches or parapets, in such a manner as to interfere as little as possible with the natural appearance of the ground.

12. The *conditions* that should be sought for in laying out or constructing these trenches or parapets should be, as in all other defensive works:

1. A good field of fire over all the ground over which the enemy could advance.

2. As great a measure of invisibility as it would be possible to obtain under the local conditions.

3. Good cover from rifle and ordinary artillery fire.

4. Good covered and concealed means of communication with all parts of the position.

13. *Artillery Positions.*—The guns of the defense would be placed in such situation as would afford the greatest scope for their fire, combined with as great a measure of invisibility as the circumstances will admit of, and also with the power of unobserved removal and bringing up. They need not necessarily be clear of the infantry portions of the fortified positions, for the conditions are very different from those which prevailed in the confined forts of the old type. In extended positions of the type above described, it would not be difficult to find for the guns sites so placed that they would not draw on the infantry trenches the hostile artillery fire. It might often be that the best sites would be on the flanks of the infantry, but it is not necessarily so,

and they might sometimes be placed so as to fire over them.

14. *Concealment of the Interior of the Defended Position.*—It is of great advantage if the main defensive line can have the ground steeply sloping away from it in its immediate rear. Not only would such a conformation make it easy to provide cover for local reserves and for the defender's encampments, but it would conceal from the enemy's view all that went on within the defender's lines. The latter condition is of infinite value and worth many sacrifices to obtain. At all events the general position taken up should, if possible, be one that admits of situations being found out of view of the enemy for the camping grounds of the defending troops; and also of the communications being concealed. If the latter cannot be achieved by natural means, it should by artifical.

15. *Command.*—It is generally considered very advantageous to place the defending works if possible on commanding heights. It is doubtful, however, whether beyond a certain point this is an advantage. Infantry fire with the low trajectory rifles of the present day is less effective from a height than from a low site. It is best to as near as possible graze the surface of the ground over which the attackers must advance. The same argument applies to the fire of low-trajectory, high-velocity guns; with these against troops in the open it is desirable to burst the shrapnel with as flat or grazing a trajectory as possible. For fire, either of guns or howitzers against works, an elevated position gives better searching effect, but at long range this does not make so much difference as is generally supposed. A high site for a defensive position has also certain positive disadvantages. Hardly any hillsides are at a uniform glacis-like slope all the way up. If they are convex in section, it is

impossible to avoid having a good deal of hillside and ground at the foot hidden from the defender's positions, and therefore the attackers can advance up it unseen and unharmed. If it is concave, then to be able to see and fire all down the slope, the defenders are obliged to expose themselves greatly to direct fire. Moreover, on an elevated position the attacker's artillery can safely keep up a heavy fire over the heads of their advancing infantry till the very last moment.

Elevated positions derive a certain amount of advantage from the fact that it is less easy to search out the works by the fire of the attacker's artillery. But well-concealed, narrow, trench-like works have in any case little to fear from this form of fire. A more positive advantage is found in the fact that elevated positions, such as those on ridges, lines of hills, etc., will nearly always give concealment from the enemy's view to the interior of the defended area. Similarly such positions permit of a range of view over the attacker's positions and enable the defenders to note his movements. Observation of artillery fire is also more accurately carried out from elevated positions.

For these last reasons, therefore, it is desirable for a defensive position to have a certain amount of command over the ground over which the enemy must advance. The actual height, however, need only be sufficient to give a good view over the ground in front, particularly to clear all obstacles to vision, such as crops, trees, undergrowth, etc., and also to obtain concealment for the interior of the defender's lines. With flat, open country it may be very little indeed. The slopes to the front should be as gentle and evenly sloping as possible.

16. *Good means of communication* between all parts of the general line of defense, and also from

the town or headquarters to all points on the line, are of vital importance.

17. *Location of Works in the Second Line.*—The same general principles apply to the selection of the sites for works or supporting points in the second or retired line. It should be possible to bring from it a concentrated and heavy fire on any part of the outer line which has been captured, and to confront the assailants with a fresh series of works which must be carried before they can reach the object of their efforts.

Tactical Organization of Infantry in Defense

18. *Division into Sections.*—A large fortress or defensive position would be far too extensive for all the troops to be directly supervised by one man. It would therefore be sub-divided for purposes of command into several sections, each under the command of an officer with a suitable staff.

Each section should be completely independent both tactically and as regards administration; subject, of course, to the general control of the fortress commander.

19. *Strength of the First Line, Supports and Reserves.*—Every fortified post in the front line of the section would be occupied by its own infantry garrison. In rear of the works, if possible close to them and never over 300 yards distant from them, and under good cover, will be the supports, whose strength would vary according the necessities of the case, but would generally be from $\frac{1}{2}$ to $\frac{2}{3}$ of that of the garrison of the post. Then in rear again and at a central position as regards the whole section would be the local or "section" reserve. Its strength would depend upon the defensive strength of the works

along the front of the section. If the latter were strong and the means of communication to them were good and not long, the number of troops in the works, including their immediate supports, could be kept low, and the number in reserve increased. The advantage of this would be, that it would relieve as large a number of troops as possible from an exhausting and demoralizing life in the advance works under constant shell fire. If, however, the nature of the ground made the outer defensive position a weak one, or if the reinforcements could not reach them without long delays, then a considerable number of troops must be kept well up to the front, and the reserve would be proportionately less.

The artillery belonging to the section would usually remain either in emplacements in the front line or under cover close in rear. There might, however, be some light pieces with the section reserve troops.

20. The *position of the section reserve* would form the headquarters of the section, and should be out of sight of the enemy. It should also be on or near a main radial road of communication, and from the camp a road or roads should lead to different parts of the front line. It should be connected by telephone with each of the fortified positions in the defensive line, with headquarters, and the main depots.

21. *General Reserve.*—In addition to the section reserves there should be in all cases a general reserve for the whole position. It should be encamped in a central location and should be of as mobile a nature as is practicable.

The disadvantage of the great extent of the position which has to be taken up for defense at the present day is largely neutralized if a considerable portion of the defenders are kept as a mobile reserve

force, as the fortified pivots may in such a case be few in number and far apart; they should, however, always be individually strong.

Tactical Employment of Artillery in Defense.

22. The disposition of the fortress artillery will be different from that of the infantry. It will not usually be desirable to keep any of the heavier guns or howitzers in the center of the defended area as a general reserve. As a general rule, it will be required to have all the heavy artillery in the front line from the very beginning of the siege, in order to crush the besieger's guns, and prevent him building batteries, so that only the shorter ranging pieces should be kept in rear. If, however, the defense is very weak in artillery the guns might have to be kept under cover so as to have them available for use in the later and more critical phases, particularly in the event of an assault.

23. *Mobility.*—All the guns should be movable and there should be a large number of alternate emplacements, and good and direct communications hidden from the enemy's view. Mobility, in fact, is the chief factor.

24. *Armament.*—Generally speaking, the armament of a first-class fortress would consist mainly of howitzers and mortars from 5-inch caliber upwards. It would also have a certain number of long range heavy guns, such as the 6-inch; also a proportion of less powerful pieces, which should be of the rapid fire class, the 4.7-inch and long 12-pounder being the most useful sizes. Long range direct-fire guns are required to keep the attackers at a distance and to act upon them if they attempt to come out into the open; howitzers and mortars are required to search

out their trenches, drop heavy shells into their gun emplacements, break down overhead cover, and search hollow ground, reverse slopes of hills, ravines, and other places where they might find cover. Howitzers and mortars are ineffective at ranges under 1,000 yards, so that for this stage of the attack, guns only can be relied on. Shrapnel fire from guns is also required against attackers in the open.

The proportion of the guns to the howitzers and mortars will depend to a certain extent on the topography. If the ground in front is broken, affording abundant cover, and precluding long range fire, then howitzers and mortars should predominate. Where the foreground is open for a long distance, or the defensive position very commanding, the proportion of guns might be greater.

25. The *location of the emplacements* for the heavy artillery will depend mainly upon the duty that each piece has to do. Generally this duty is to operate against an enemy who is attacking the main supporting points. By this is meant that the defense of these points, rather than that of the intervals between them, is the object chiefly to be aimed at, for an attack through the intervals need not, as a rule, be feared. At the same time means of bringing a cross fire over the intervals are not to be neglected. Certain also of the pieces, generally howitzers and mortars, will have specified duties to perform, such as to enfilade reverse slopes of hills, hollow ground or ravines, which are screened from frontal fire; and in general, the artillery positions will be so placed as to bring a heavy fire over all the ground to be traversed by the assailants.

26. The *dispersion of the guns* in an artillery position has several advantages. It renders it difficult for the attackers to concentrate their fire; it brings a converging fire from a wide arc to bear on

the object specified for attack; it permits of far greater latitude in the selection of sites for emplacements and in taking advantage of the ground to obtain concealment, and it very considerably does away with the demoralizing effect produced by a heavy shell fire in a comparatively small area. The guns should therefore be dispersed, but their fire must be capable of concentration by complete telephonic communications between the guns, observing stations and commanders.

27. *Position with Reference to the Infantry.*—If the existence of high ground in rear admits of it, the defending artillery may fire over their own infantry positions, or the artillery itself may be in two tiers, the direct firing guns being in advance, and the howitzers, firing over them from retired positions. It may be necessary for some of the guns—for instance, those entrusted with the duty of enfilading hidden ground in front of the main position—to be placed well to the flanks of the infantry positions; that is to say, practically in the intervals between the supporting points. In all such cases they require to be defended by infantry, for whom intrenched positions should be provided near them.

It is not necessary that any of the guns may be able to defend their own fronts by their own fire, as this duty can be more conveniently and effectively carried out by infantry.

28. *Location of Guns.*—A somewhat commanding position is an advantage for guns particularly for purposes of observation. If the sites are on a hill they are, for purposes of concealment, best placed a little way down from the crest; at all events not on the sky line, provided means of access are obtainable from the rear. It may sometimes, however, be better to put them in positions somewhat drawn back from the crest of the hill. Here they will be less

easy to hit, and the guns can be more easily withdrawn, or brought up. It is possible that from such a position, a good deal of ground at the foot of the hill could not be seen, but this could generally be dealt with by pieces from another part of the position.

29. *Location of Howitzers.*—Howitzers, which can fire over an intervening obstacle, provided its height is not such as to intercept the projectile in its flight, and whose fire can be controlled from observing stations can, and would usually be placed in retired situations on the reverse slope of hills, etc. Here they would be entirely unseen, and could hardly be hit. Good sites for observing stations would in such a case be of the first necessity, and these must obviously be as inconspicuous as possible.

30. *Indirect Fire for Guns.*—The heavy direct firing guns could also be fired in the same manner, if it were considered desirable to put them in retired positions; but with low trajectory weapons such positions would be less easy to find, and such an arrangement would be almost certain to result in a considerable portion of the ground at medium and short ranges being screened from the guns; moreover it is undesirable to rely entirely on observing stations which may be wrecked, so it is better that nearly all the direct firing guns should be capable of being laid direct on their objects.

31. *Rapid Fire Guns.*—In addition to the heavier types of guns, it is very desirable to have for use in the later stages of the siege a number of light guns of the rapid fire class, such as 6-pounder and 3-pounder rapid fire and the 1-pounder automatic or pom-pom. Guns of this class are of course useless against earthworks, but they fulfill most useful functions during the later stages of a siege. For instance, in the event of an assault they will assist in bringing an overwhelming fire to bear, and at any time should

the besieger offer, even for a few moments, a target in the open, their rapidity of working will permit of the opportunity being availed of.

For such guns there should be a number of alternate and well-concealed positions; the principle of their employment should be surprise, combination, and the taking advantage of every opportunity.

32. *Field Guns.*—A number of 3″ field guns could also be most usefully employed in the defense of a fortress. They need not be assigned to any particular positions, but might be kept with the reserve troops, and pushed up into any part of the front line when they are required.

33. *Machine guns* will fulfill a most useful purpose in a fortified position. They can be kept concealed when not in use, and even when in the act of firing, afford so small a target as to be hardly visible. A few such weapons in an intrenched position permit of the greater part of the garrison being kept well under cover; for in the event of an assault they enable a heavy fire to be developed by their attendants. In the defense of a flank, in a position where a line of infantry would be visible and liable to enfilade fire, a single machine gun judiciously posted behind a bush or rock or in a small pit could entirely escape observation. To cover particular points such as a a bridge or ford, they are also most valuable. Every fortress, therefore, should be equipped with a good number of these useful weapons. Each infantry work should have some assigned to it, and there should also be a number in reserve.

Design of Infantry Works

34. It is undesirable to indicate more than the general principles of the design of the works. In order to make these clear it is necessary to give some

of the designs, with the understanding that they are not at all rigid, and should be modified to suit the ground.

35. There are *four general objects* to be aimed at in preparing a given area for defense:

1. It should have the utmost development of fire to the front, and to a somewhat less degree to the flanks.

2. The works should be so arranged that they will offer as shallow a target to the enemy as possible.

3. They should be made inconspicuous and difficult to distinguish.

4. They should afford rapid and covered communication from each work or part of the defensive line to the rear, so that supports may be brought up with the utmost rapidity.

36. *General Character of the Supporting Points.* Along certain parts of the defensible ground, where a good field of fire in the required direction can be obtained, will be constructed lines of infantry parapet with cover in rear, connected by covered ways, perhaps with each other and certainly with the rear. On suitable positions for artillery fire will be constructed the emplacements for the guns, also with communications to the rear. The selection of both these infantry and gun positions will be governed by the four main principles stated above.

To permit of full scope for the defender's rifle fire, all that is needed is a simple parapet to fire over. In trace this should follow the contour of the ground, and should therefore seldom be straight, and never on any geometrical plan.

37. *Redouts* have not lost all their importance and are still needed to afford points of support to a defensive line; even though the reduction in depth of closed works imposed by the searching power of artillery reduces the volume of flank fire and dimin-

ishes the value of such works in an extensive fortified line in flat country. The employment of machine guns, moreover, enables small works with short flanks to deliver a volume of fire which makes the size of works and their garrisons a matter of minor importance.

They cannot generally be used in situations exposed to artillery fire unless they can be so arranged that they cannot be recognized as redouts from the enemy's artillery positions. A favorable site is one which commands the ground around it to effective rifle range and is not visible from artillery ranges.

In preparing a defensive position, if sites meeting the foregoing conditions can be found on which redouts can be built to flank the adjacent trenches, they should by all means be built. Redouts in good position *in rear of a line* form valuable supporting points.

The Fort Riley redout (fig. 1), and the Russian and Japanese redouts (figs. 2 and 3), are excellent types of a modern redout. They all have very flat profiles and are very shallow from front to rear; affording good cover, small artillery target, and strong frontal fire for infantry.

38. *Precedence of Infantry.* — If there is any question as to whether guns or infantry shall occupy any particular site, the way to settle it is to consider, not which arm is most suited for, but which form of fire it is important to have at that particular point. Generally it will be found that infantry fire is the more essential for it must always be remembered that rifle fire forms the bedrock of all defense, and that artillery is but an accessory—a highly important one, but still never more than an accessory. It will generally also be found possible to find another site for guns from which the same, or nearly the same effect can be produced, as from the point in question,

while it may sometimes be dangerous to leave it without infantry defense.

39. *Profiles.* — Low, flat parapets lend themselves better to concealment, while deep narrow trenches furnish the best cover. Whether one form of profile is better than another will depend upon circumstances. For purely defensive purposes the deep and narrow trench is undoubtedly the best, but where offensive movements are contemplated a more open type is preferable, not only because it affords good lateral communications and an easier exit, but because its more open construction is better suited to maintaining a proper temper in troops who are to assume the offensive.

The *height of the interior crest* above the natural ground will be so fixed as to see over as much as possible of the ground in front. For purposes of concealment, which is generally all important, it is necessary to keep the crest as low as possible, so that it will not be possible to cover all the ground in front.

The *interior slope* of the parapet should be revetted vertical or as nearly so as possible. At every two or three yards interval in the parapet there should be recesses for ammunition. The banquette should be about 4½ feet below the interior crest and an elbow rest should be provided. The banquette should be from 2 to 3 feet wide and 2½ feet below it should be a pathway 4 to 6 feet wide for lateral communication. Where lateral communication is not desired this should be made narrower.

The *superior and exterior slopes* should be as flat as possible, in order that shells striking them will glance off and pass over the trench.

Type forms of profiles which fulfill the above requirements are shown in figs. 4, 5 and 6. The first two were used by the Japanese. The last is the tri-

angular profile, the disadvantage of which is the additional labor of construction.

40. Some form of *head cover* should be provided, otherwise the defenders would be absolutely prevented from manning the parapet for firing purposes, by a heavy fire of musketry and shrapnel. For different forms, see Engineer Field Manual, Part V, paragraph 13.

41. A *background* for the heads of the parapet defenders would usually be provided by the natural ground in rear, by placing the parapet somewhat forward of the crest of the hill. Where this cannot be done, it may be neccessary to provide it artificially.

In order that high explosive shells may not injure the defenders who are manning a parapet or sitting close behind it, it is necessary that there should be nothing in rear to catch the shell and explode it or act as a stop-butt, for in this case the back-blast or all-around effect would cause loss. The ideal arrangement would be to have the parapet in such a position that all shells just missing the crest would pass clear away into space. But this could very seldom be arranged, as it would usually entail tracing the parapet on the sky line when viewed from the enemy's position, so that the defender's heads would be conspicuously visible. It should however, always be arranged so that there is no steep rising ground or bank close behind the parapet.

For this reason most redouts or forts are regular shell traps because of the parados, designed to protect the defenders of the gorge of the redout from reverse fire.

42. *Arrangements for Fire to the Rear.*—In the present day regular closed redouts are not usually required, so protection to the defenders of the gorge

is unnecessary. If it is desired to provide a firing line facing towards the interior of the fortress, it should be at a distance off, and probably behind the reverse of the hill, or in some other place hidden from the front.

If a closed redout is constructed, its gorge trench should have a double parapet; the front one serving as a parados, should be kept low and used as a firing line to command the interior of the works, in case the enemy gets in over the front.

43. *Overhead cover* of some sort should always be provided unless the exigencies of time absolutely prevent it. It is not however, necessary that this shelter should be of a very massive or elaborate description. It is very doubtful whether it would ever be necessary to make the cover of a sufficient strength to resist bombardment. It is evident that if the shelter is made completely underground and the earth above it is made to exactly resemble the surrounding ground, it will be impossible to locate its position, or to drop successive shells upon it. The utmost it would have to fear would be a chance hit.

The shelter may be small in area; it is only required to accommodate the men in the firing line, for the supports should be in another shelter in rear. It should be as close to the parapet as possible, and there should be steps or ramps for rapid access to the parapets, so that the latter can be manned at the shortest possible notice. If time and materials do not admit of covered-in shelters being provided, a deep, narrow trench will give fair security. If the earth admits, it may be recessed on the side next the enemy, as in the Boer trench (fig. 7).

The *thickness* of overhead cover for splinter proofs should be from six to eight inches of earth on a support of brush or poles strong enough to hold it up. For bombproofs a minimum thickness of six

inches of timber and three feet of earth is necessary against field and siege guns, or twelve inches of timber and six feet of earth against howitzers and mortars of a heavy siege train.

In determining the *area* of overhead cover to be provided, allow six square feet per man for occupancy while on duty only, or twelve square feet per man for continuous occupancy, not of long duration. For long occupation eighteen to twenty square feet per man should be provided. For various forms of overhead cover, see figs. 1 and 3; or the Engineer Field Manual, Part V, figs. 34-43.

44. *Magazine accommodation* is not necessary. Rifle ammunition is best placed in recesses distributed all along the front, close to the parapet, and these would be replenished from an intermediate depot in rear of the works. Artillery ammunition will be stored near each gun emplacement.

45. The trenches and shelters should be in *short lengths*, particularly if oblique or enfilade fire is to be anticipated. This will facilitate their adaptation to the ground. Lateral communication need not be sacrificed by this, as the trench may continue round a piece of natural ground left as a traverse, (fig. 8). If possible, the length of any distinct independent piece of parapet should be such as to be suitable to be garrisoned by a distinct unit, such as a company, platoon, section or squad.

46. In *locating a line of trench* it is important:

1. To avoid a sky line.
2. To occupy the military crest or line in advance of it.
3. To preserve communication under cover with the rear.

The selection of the exact position of infantry parapets, how far forward or backward, is a matter of considerable importance. If the defensive position

is on a hill it will generally be difficult, if not impossible, to find any spot at or near the top where all the ground in front, both near and far may be seen, except in a position greatly exposed to view and fire. Often the best situation will be at the bottom of the hill slopes, at or near its junction with the plain in front; from these a grazing fire can be brought over the plain, and trenches in such a position can probably be well concealed. Or it may be advantageous to give two lines of trench, one low down the hill, as above, and another firing over it at the distant ground from the top of the hill. The latter may, if the top of the hill is wide enough, be drawn well back from the actual front crest of the hill, and this will generally assist invisibility, (fig. 9). This retired position would have a further advantage in that its supports could be kept close up in rear on the reverse slope of the hill. If there is timber on the top of the hill, the line should be located near its front edge.

It will seldom happen that the entire field of fire to the limit of effective range can be completely swept from any position that can be selected. A position should be sought which reduces the dead spaces to a minimum in number and extent; and, if possible, advanced or auxiliary trenches should be located to sweep them. If the ground is open to 1000 yards or more, the long or mid range is more important than the short range, for an effective fire on the enemy while he is advancing from 1200 to 200 yards range will almost certainly put him out; or, if by any chance, he arrives at 200 yards in condition to keep on, little can be attained by holding him under fire from 200 yards in, and a retirement is in order. In both cases, the advantages of dead space in the close foreground is more apparent than real, and the main trenches should not sacrifice command of more distant ground within effective range, in order to

sweep the foreground. Such dead ground must be commanded at night or in thick weather by trenches detached or in flanking relation.

On the contrary, if an enemy can approach under cover to mid range or less, there will scarcely be time to stop him by fire alone, and obstacles are desirable at close range, which must be commanded by fire. The trenches, in such cases must be advanced to cover the close foreground, and if necessary, another line in a different position established to sweep the more distant ground.

47. *Communication with the Rear.*—There is one considerable difficulty attending the location of lines of parapet in a forward position low down a hillside, and that is in the provision of concealed means of access to them and of shelter for the supports. Where the works are hastily thrown up in anticipation of an early attack, it will be hardly possible to provide for these at all, and the use of works in such positions should in such circumstances be avoided as far as possible. If the ridge is intersected by ravines or covered with growth through which men could move under cover, the trenches at the foot of the slope can be easily reinforced and should be constructed.

Where such works are absolutely necessary, and also in cases of other advanced isolated works where covered approaches cannot be constructed, the defenders, who must be in more than the usual strength, must take their posts under cover of darkness, and must take with them food, water, and ammunition for the whole day; for it will be impossible to reinforce them under fire or to relieve them except at night.

Where, however, the works are constructed some time before an attack is expected, oblique approach trenches can often be provided, and this should be

done wherever possible, but the configuration of the ground may sometimes forbid it. Fig. 10 shows a section of communicating trench; if the enemy's fire is all from one side but one bank is needed.

48. *Cover for Supports.*—The provision of suitable cover for the supports is a most important matter. The best place is on the reverse slope of a steep hill. When good natural cover does not exist, it may be necessary to provide artificial splinter-proof shelters, kept low and well concealed, or even in extreme cases to provide bombproofs, but the latter would only be necessary where the site was most exposed and unsuitable for defense.

49. The *drainage* of the defensive works is of great importance and should be provided for, as otherwise the trenches and works may be so flooded by storms as to become untenable. The drainage problem is difficult in deep trenches; pumping may have to be resorted to, or seepage pits dug. All surface drainage into trenches should be cut off.

50. *Telephonic communication* should if possible be provided between the positions of the supports and each of the principal infantry trenches or groups of trenches, and also to the post of the section commander in rear.

51. *Obstacles.*—With an open field of fire, entrenched troops with magazine rifles and plenty of ammunition do not require the aid of obstacles to enable them to stop the most determined attack. Still, they would always add considerably to the strength of a position, and there may be places where obstacle are required; namely, where the work is retired behind the military crest of a hill so that the field of fire is short, or to delay troops at certain points where a heavy fire cannot be brought to bear on them, such as at the passage of a bridge or ford, in a defile, etc.

Obstacles are designed to protect the works from

surprise and to reduce the momentum of attack by breaking up the enemy's formation, and holding him under the accurate fire of the defense. They should be invisible from the direction of approach, should be difficult to destroy, and should afford no screen or cover to the enemy.

They may be in front of or on the line of defense. In the former case, they should be 50 to 100 yards in front of the firing crest. If on the line, they are in the ditch, if there is one, or are employed to close intervals, and are flanked or enfiladed by adjacent works.

The high wire entanglement is the most generally useful of all obstacles, because of its effectiveness, the rapidity of construction, the difficulty of removal, the comparatively slight injury from artillery fire, and its independence of local material supplies. In wooded country abatis would generally be used.

52. *Clearing the foreground* in front of the infantry parapet is important, but of course it will generally be impossible to get rid of all the cover within effective range of modern rifles. As much as possible, should however, be done, beginning near the works and proceeding outwards. If possible the clearance should extend to at least 800 yards from the parapet. The demolition of every house or village in front of the defender's works is not so important nowadays as it used to be; the attackers will not be able to use the buildings as positions for their infantry, as a few rounds of high explosive shell would bring them down in ruins on their occupants. They should, however, be removed if concealment could be obtained in rear of them for the attacker's columns.

53. *Houses or villages* which exist within a defensive line will seldom be of any use from a defensive point of view. If occupied they would offer

most easy targets for concentrated artillery fire, and the destructive effect on buildings of modern high explosive shell is so great that they would bring ruin on any troops within them. It would generally be safe to ignore them altogether, as the reasons which make them unsuitable for the defenders to occupy, would also make them objects of little temptation to an attacker, who would similarly be unable to hold them under the defender's fire. If it were really necessary to deny to the attackers the ground occupied by buildings, it would be best to put the defenders in trenches outside, well clear of splinters or fragments of stone, but in a position to bring fire over the approaches to the buildings. In places, however, where artillery could not be brought to bear, a group of strong buildings could be easily made into a strong defensive position. Isolated walls or walled enclosures without roofs, if thick enough to resist rifle fire and shrapnel bullets, are useful, for they cannot be damaged except by a direct shell hit, and even then only a short length will be blown down. They afford, however, a good target.

54. *Woods* are not generally very useful under modern conditions. If it is known that the front edge is held, so good a target is afforded that a very heavy fire can be concentrated on it. The interior of a wood certainly gives concealment, but great labor is involved in preparing a defensive position there and forming a field of fire, obstacles, and communications. Such a position gives no fire outside the wood to the front, unless the wood is on a steep slope; in which case a line might be located in the wood and have a good field of fire to the front. If a wood is in front of the defensive line, its rear edge should be entangled and positions taken up from which a fire can be brought to bear on troops issuing

from it. Generally speaking, a wood in a defensive position is a source of weakness, and works should be arranged if possible to bring a heavy fire over the ground in front of them so as to prevent the enemy from getting into them. It may sometimes be possible to have the front line of the woods, or a position just outside the front edge, prepared for defense, with the defending troops kept concealed in rear, and only brought up when an infantry attack develops, and the enemy's artillery fire must to a considerable extent cease. Communications will in such cases be necessary.

55. *Concealment* is most essential, and in order to secure it low commands are necessary, and also as a rule, some kind of a background. The ends of parapets or banks as seen from the front should be gently sloping and blended into the ground. Steep frontal slopes are also generally easily visible, so all should be gentle and irregular. The surface of all disturbed soil should be made to resemble the surrounding ground. The surplus earth may also be formed into dummy parapets elsewhere, to mislead the attackers.

When planning the methods to be employed for concealing a position, or locating the works so as to obtain invisibility, it is essential that the designer should go out to the positions that would be occupied by the enemy, and carefully examine the aspect of the defensive position from there, noting the appearance and color of the surrounding ground, the arrangement of the background, etc., and thus decide on the effects he should try to produce. More can be learned by this means than by any other.

56. *Advanced positions* in front of the main line of defense often are of considerable value in delaying the besieger's progress and prolonging the defense. They form good pivots for the outpost line;

they force the besiegers to deploy or to commence their siege works at a much greater distance from the place; they may even possibly necessitate a regular formal attack being undertaken against themselves, before the besieger can turn his attention to the main works. They cause, in fact delay, which is of priceless value in a siege.

They should be selected so as to necessarily force the besiegers to stay their advance till they are taken. They should be proof against assault over the open, and the communications to them from the main position should be secure and hidden, so that it is possible to reinforce them or withdraw their garrisons unseen. The positions should be commanded by the artillery and the infantry positions of the main line, so as to deny their use to the enemy after they have been vacated; and the works constructed on them should be of such a nature as to give no cover to the enemy.

It may occasionally happen that a point exists in front of the defensive line which would afford a very commanding position at short range for the enemy, and which therefore must be occupied and held at all costs. This case is different from that of an ordinary advanced work which it is intended to vacate ultimately. Such a post must be made as strong and secure as possible, and the defenders must be given to understand that they have to hold out to the last. If covered communications cannot be provided, reliefs, supplies, etc., must be carried up at night only.

57. *Second Line.*—The object of the second line is, in the event of one of the positions in the main line having been captured, to oppose a bar to the further advance of the besiegers. Also these retired works will form pivots for the action of the general reserve, in the event of any of the besieger's troops penetrating the front line by any means.

The works should, if possible, be arranged so as

to bring a heavy fire upon the rear of the works in the front line in the event of their being captured; also so that the attackers cannot make a dash between them upon the town or place defended. A continuous enceinte is totally unsuitable. Detached works or groups of works on tactical points are infinitely better, and it will often be found that one powerful group of works on a commanding but retired position will successfully dominate a large section of the defensive area. For their general disposition and design, the descriptions given in the case of the main works apply equally well, except that as a general rule they need not be so strong, and in many cases concealment will not be so necessary.

Artillery Positions

58. Low commands and inconspicuousness are to be sought for in the location of artillery emplacements, and they must be suitable for pieces on traveling mountings. The ordinary types adopted for siege batteries would be suitable for the fortress batteries.

59. *Form of Emplacement.*—No form of siege battery will give protection from howitzer or mortar shells; all that can be done is to surround the gun platforms with splinter-proof walls to keep out fragments of shells which burst outside the emplacement. See fig. 118, Engineer Field Manual, Part V.

If the battery is in so retired a position, or so well concealed by intervening high ground, woods, etc., that it cannot be seen from any part of the besieger's position, and observation of fire on it is impossible, then it is hardly necessary to have even splinter-proof walls, for a shell could only be dropped in the neighborhood of the emplacement by chance. If, on the other hand, the emplacement was any-

where visible, these walls would form too conspicuous a target.

Emplacements for direct fire guns, which would be in positions visible to the enemy, would have to be concealed by sinking them into the ground, and having a back-ground of trees or rising ground in rear. Invisibility for such pieces is a matter of supreme importance, provided, of course, that range and field of fire are not sacrificed.

Where the emplacements are liable to shrapnel fire, some form of cover for the detachments should be provided. This may, in the case of field defenses, consist of two deep pits close against the front parapet, one on each side of the gun, similar in principle to those in the ordinary type of field gun emplacement, but larger and deeper. Or overhead splinter-proof cover may be provided at the sides of the emplacements, or in the traverse, where such exists, between a pair of emplacements.

60. *Indirect Fire.* — The distance that guns using indirect fire can take position below the crest of a hill is shown approximately in the following table:

Ranges Yards	At 50 yds., Feet	75 yds., Feet	100 yds., Feet	200 yds., Feet	300 yds., Feet	500 yds. Feet
1000				10	13	16
1500			10	19	26	38
2000		11	15	29	41	66
2500	10	16	21	40	58	
3000	13	20	27	53	77	
3500	17	25	33	66		
4000	21	31	41			

61. *Expense magazines* for at least two days supply of ammunition are required in the neighborhood of each battery or group of emplacements. They should generally be on the flank of the battery, conveniently close, and connected by a trench to give covered approach. Recesses or benches for a

few rounds of ammunition should be given in each emplacement.

62. *Means of access* to the emplacements, to enable the pieces to be brought in or taken out, is very necessary.

63. Every battery or group of emplacements requires an *observing station*, which should be on commanding ground whence all objects to be aimed at can be seen. They need not be near the battery if telephonic communication is provided. They should be as inconspicuous as possible.

64. *Use of Balloons.*—In case there are many of the enemy's battery positions which cannot be seen from any of the sites available for observing stations, it may sometimes be possible to make use of captive balloons.

65. *Positions for Light Guns.*—It would not as a rule be necessary to provide any works for the light rapid-fire armament or for the field guns. The essence of the employment of pieces of this nature is surprise and mobility, so that there should be nothing that will mark the positions from which they will open fire. If any form of protection is required, field epaulments can be made when wanted.

Auxiliary Means of Defense

66. *Electric searchlights* will play a most useful part in defense operations of the future. Not only will they be a protection against night attacks, but also by their use, sapping or the execution of trench work by the enemy at night, at short and medium ranges, should be rendered impossible. They would be particularly useful in conjunction with light rapid fire guns or pom-poms, or with machine guns, as with such weapons a heavy fire could be immediately developed on the object illuminated by the beam. The

position of the beam in relation to the guns should be well to one side, for the best position for seeing illuminated objects is for the observer or gun-layer to have his line of sight more or less at right angles to the beam. It would be much better if the lights were not in fixed emplacements, as this would tie them to one spot; moreover, the emplacements would be conspicuous. and would be seen by day and wrecked. They should, therefore if possible, be on travelling mountings, so as to be used from any infantry parapet or from the open. It is very difficult to hit a seachlight at night, owing to the impossibility of telling the range or observing the fire. If in addition, its position is constantly varying it would be much more difficult to hit.

67. *Interior Communications.*—The most important features of a fortress, or great defensive position, are the interior communications, and these should be the first of the works commenced in preparing a place of defense. In laying out the communications, regard must be had to the probable tactical organization of the defending force. It is desirable to have a road or roads from the headquarters of each section to the different main supporting points in that section, also a road from the town or general headquarters—that is to say from the main supply and ordnance depots—to each sectional headquarters. In addition to these radical roads there must be a road all around the circumference of the position in the rear of the works, It is most necessary that the communications, particularly the circumferential ones, should be screened from the enemy's view.

68. *Telegraphic and Telephonic Communication* should be provided betweeen all parts of the position; that is, from the fortress headquarters to each sectional headquarters, and thence to each important

work or group of works in the front line, and also to the artillery commander's posts.

69. The *water supply* of a fortress is a most important matter. It is obviously necessary that the place should not be dependent for this essential requirement upon an outside source. If its supply is by means of a conduit or pipe from a distance it is extremely possible that the besiegers will find and sever it. It is most necessary, therefore, that for war time at all events it should be possible to obtain a sufficient supply for the garrison and the civil population from sources within the defended area; that is to say, from wells. A considerable economy can generally be effected by restricting the use of the pure water to drinking and cooking only, and there will usually be streams or rivers whence water for washing and cleaning can be obtained. If the only supply is from a river, it will be necessary to take steps to sterilize the water by boiling or otherwise, before it is issued to the troops for drinking.

Strength of Garrison

70. The correct method of estimating the *strength of the garrison* necessary for the defensive position is to begin with the infantry, taking each section of the defensive area separately. The garrison of the works can be calculated with fair accuracy by measuring the actual length of the lines of infantry parapet, and allow not less than two men for each yard. Of this number about one-fourth should usually be in the supports and one-half in the section reserve.

71. The *strength of the artillery* may be estimated at thirty men per medium and heavy gun (three reliefs of ten) and eighteen men per light rapid-fire gun. If available, some field artillery with the sec-

tion reserves will often be useful. The *engineers* should if possible be not less than one-twentieth of the strength of the infantry.

72. The *strength of the general reserve* would depend mainly on the facilities that are likely to be obtained for active measures. It is desirable to have it equal in strength to the total of the section garrisons; and, in any case if possible, not below half that strength. Mounted troops and field artillery would be usefully employed with this reserve if the defended area is a large one.

Defense of Small Isolated Posts Occupied by Detachments

73. The foregoing has dealt only with the case of an extensive fortified position, held by a very large force, and liable to attack by an army; a situation in fact, which would only be met with at points of very great strategical importance.

74. At *places where only a small force would be available* for the defense, certain modifications would be necessary. In such a case so extended a line could not be taken up, so it would be impossible to have the defensive line so far out as to keep the enemy beyond bombarding range of the town, and the supporting points would probably be closer together. The general principles and methods of defense would, however, be similar to those already described, subject to such modifications as the altered conditions would require.

75. The case would be different when the *position was quite a small one* to be held by a small isolated detachment, as might exist for the defense of a bridge, or a post on a line of communications, on which an attack in great force or a very prolonged

siege was not anticipated. In such a case a widely extended position made up of supporting points at intervals would be impossible. The smallness of the defending force would necessitate its remaining more or less concentrated.

76. In this case *concealment* of the general position would not be possible, so that deception must take its place. The trenches actually occupied must be so arranged as to afford concealment of the individual man, and dummy trenches, purposely made easily visible, may be arranged to draw the enemy's fire.

77. *Dummy trenches* should have head cover, not only to make them more conspicuous, but also to make it more difficult to discover whether they are occupied or not. They are better above and behind the occupied trenches, if the lay of the ground permits. The enemy will observe that fire comes from the direction of the dummies and will conclude that it comes from them. Fire directed on the dummies will pass over the heads of the defenders, a condition preferable to shots falling short, which would be the result of dummies in front of the occupied trenches.

78. Instead of providing a continuous redoubt or fort, it would be better to construct *simple trenches or parapets*, in such a manner as to interefere as little as possible with the natural appearance of the ground, in fact to rely on skillful treatment of the natural features of the position selected.

79. An isolated position of this nature would have to be prepared for *all-around attack*, so some of the trenches and emplacements would be required to face to the rear, and care would have to be taken to avoid the possibility of these receiving fire in reverse. Shelters for the reserves would be necessary in some central part of the position, and this should

be bombproof if possible, and in any case well concealed. Shelters for storage of supplies, ammunition, etc., would be required, and the important question of water supply must not be overlooked.

80. The position selected for defense *would not* in such a case necessarily *contain* within itself the *object to be defended.* It would hardly ever be possible to find a position that could be defended by a small force immediately round the object, if the latter were a bridge, railway station, or place of that nature; it would usually be sufficient if the position commanded the object and the approaches at short ranges. Sometimes it might be necessary to make the defenses in the form of two positions supporting each other, and both commanding the object.

81. *If the enemy is uncivilized or unprovided with artillery* it is evidently unnecessary to employ the elaborate methods necessary against civilized enemies. Protection against rifle bullets is easily obtained and neither concealment nor overhead cover are in such cases necessary. Blockhouses and villages or strong buildings make good defensible positions in these cases. For preparing these see Engineer Field Manual Part V, paragraphs 46, 61, 62, and 63.

For a fortified post in a savage country a *material obstacle* is generally essential; so if the work itself does not provide one in the form of a wall or stockade, a strong independent one in the shape of barbed wire entanglements or abatis should be provided. A clear field of fire is, of course, imperative, and flank defense should be provided, dead angles being inadmissible. Every fort of this nature should be self-contained; that is, should contain room for storage of supplies and ammunition, and should be possessed of its own water supply.

Calculation of Time Required to Execute Defensive Works

82. *The capacity of the average untrained man* for continuous digging does not much exceed 80 cu. ft. for easy soil; 60 cu. ft. for medium; and 40 cu. ft. for hard soil. He will do $\frac{3}{8}$ of this in the first hour, $\frac{5}{8}$ in the first two hours, and the other $\frac{3}{8}$ in the other two hours. In addition to the fact that he works but a little over half as fast in the second two hours, four hours work will leave him unfit for fighting or marching, while after two hours work he should be able to do either.

83. *Double Gangs.*—When men are plenty, tools are scarce, or time presses, a task may be completed in about $\frac{2}{3}$ of the ordinary time by detailing two men at each set of tools. The two gangs change off at frequent intervals and the men work as rapidly as possible.

84. Where *traction ditchers* are available, as in many cities and towns, they may often be advantageously used to construct infantry trenches. Some forms can dig a ditch 30 inches wide and 3 feet deep at the rate of one yard per minute.

85. The *Fort Riley* redout (fig. 1) for one battalion could be constructed by its garrison in 6 days of 10 hours. If plows and scrapers were used in addition to the men, it would require about 4 days.

86. The *Russian* redout (fig. 2) for one company could be constructed by its garrison in about 6 hours in ordinary soil.

87. The *Japanese* redout (fig .3) for one battalion could be constructed by its garrison in 2 days of 10 hours.

88. The profile shown in figure 4 has a trench area of about 40 sq. ft. and applying the rule in par. 82, could be constructed in soft soil in 8 hours; in medium, 10 hours; and in hard, 16 hours.

89. The profile shown in figure 5 has a trench area of about 28 sq. ft. and could be constructed in from 6 to 11 hours.

90. The *triangular profile*, fig. 6, has a parapet area of 58 sq. ft. The earth has to be thrown or carried so far that the rule in par. 82 does not apply. Ordinarily this form would only be used if scrapers and plows were available, and it were necessary to secure the command and yet avoid steep exterior slopes. With a scraper 15 to 20 ft. of parapet could be constructed per day.

91. The *Boer trench* has an area of about 22 sq. ft. and could be constructed in from 4 to 9 hours. If the earth had to be wasted at some distance, additional men or time would be required:

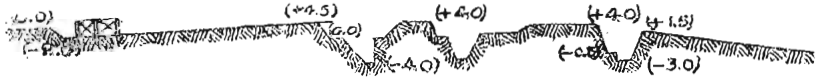
92. The *communicating trench* (fig. 10) has an area of 14 sq. ft. and could be constructed in from 3 to 6 hours. It would often be advisable to increase the bottom width to 6 ft. in which case 5 to 10 hours would be required to complete the trench.

J. A. WOODRUFF,
Captain, Corps of Engineers, U. S. A.,
Instructor.

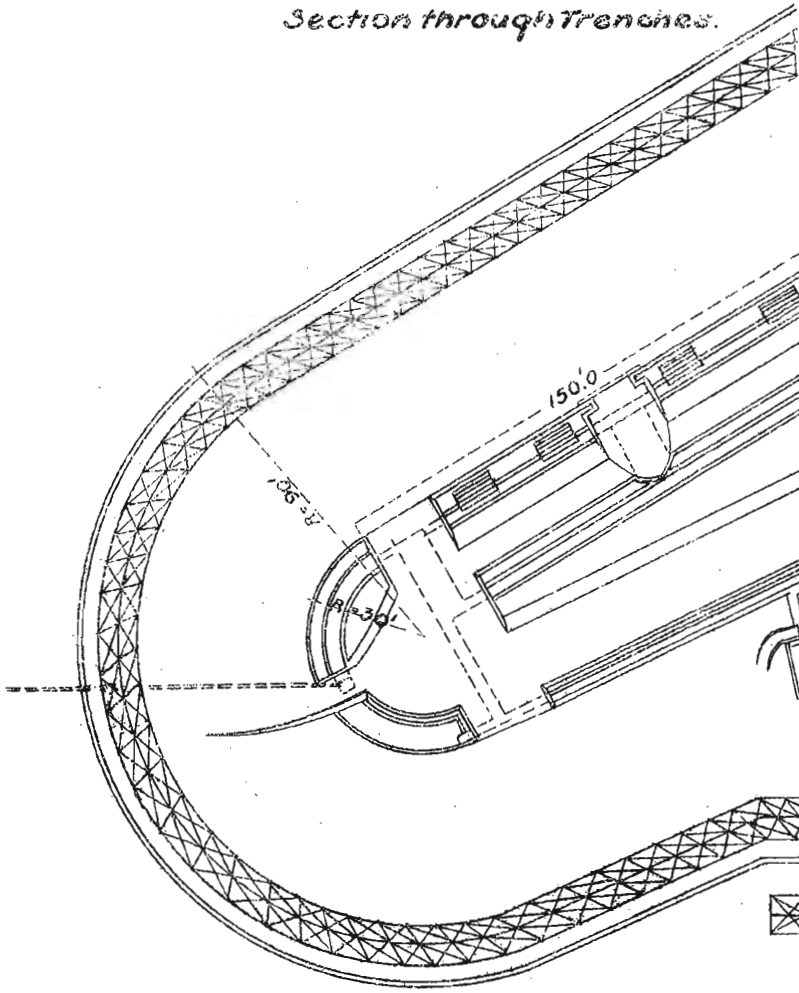
93. The following table gives the time required to execute different kinds of work in hours of one man:

Description of work	Figure in Engineer Field Manual, Part 5	Work done by one man in one hour	Remarks
Cutting brushwood, 6 years old		15 sq. yds.	Cutting only
Felling trees with axe, untrained men		No. 30	
4 in. diameter		10	
6 in. "		6	
9 in. "		3	2 men to each tree
12 in. "		2	
18 in. "		0.6	
30 in. "			
Abatis, small trees close at hand, 10 yds. wide	90	0.25 yd.	
Slashing, 10 yds wide	91	1 "	At edges of woods, etc.
Low wire entanglement, 10 yds. wide		1 "	
High wire entanglement, 10 yds. wide	101	0.3 "	
Military pits, 5 rows	104	0.5 "	
Walls, loopholes cut with chisels	109	No. 4	1 man to each
Walls, notches at top	108	No. 20	"
Gabions	64	No. 0.3	3 men to each
Fascines, 18 ft.	55	No. 0.2	5 men to each
Hurdles, 6 ft. by 2 ft. 9 in.	61	No. 0.2	3 men
Sand bag revetment	53	8.8 sq. ft.	5 men
Sod revetment	54	5 sq. ft.	
Continuous hurdle revetment		2 sq. yds	
Gabion revetment	65		Executed at same time as earthwork
Fascine revetment	59		
Overhead cover	34	4 sq. ft.	Not including earthwork
Siege gun emplacement	118	0.005	70 men 10 hrs.

Section through Covered Way.



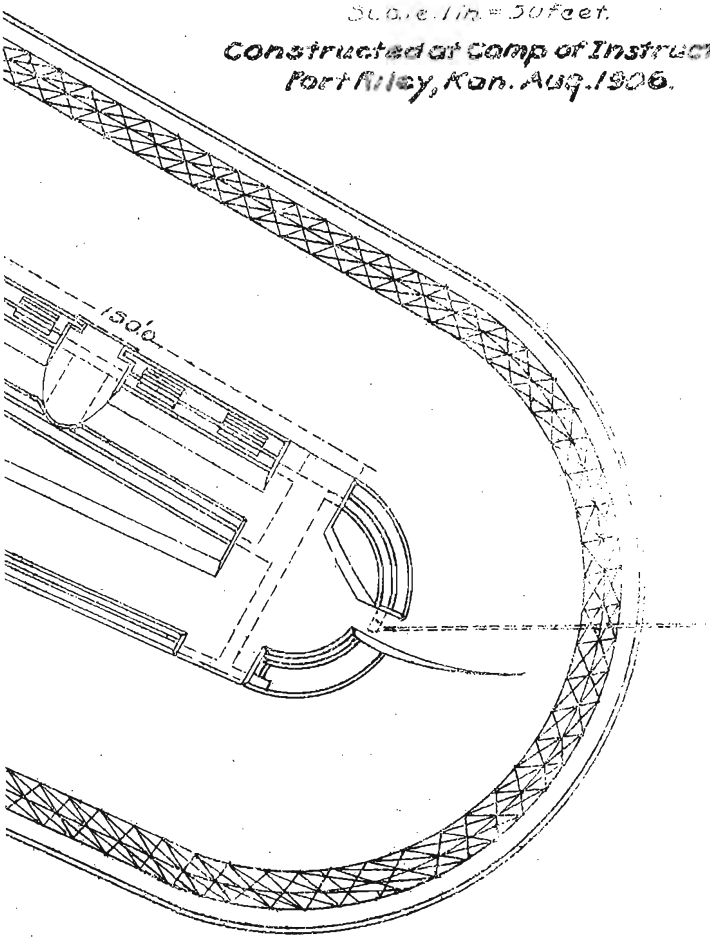
Section through Trenches.



FIELD WORK
for
One Battalion of Infantry
and
Four Machine Guns

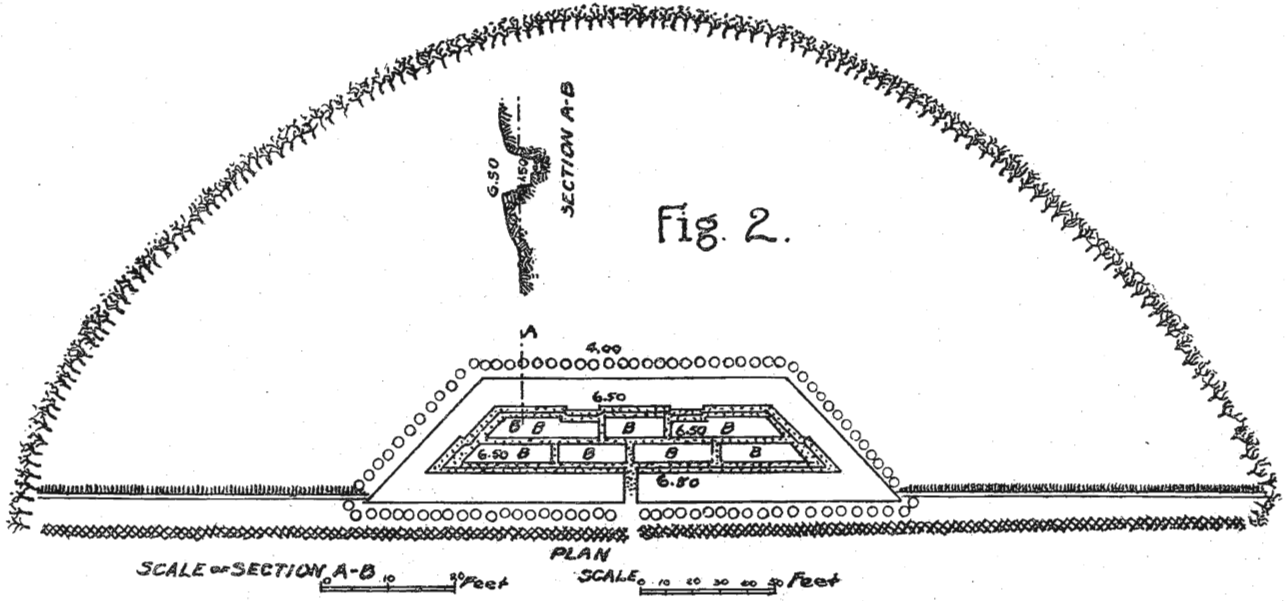
Scale 1 in. = 50 feet.

Constructed at Camp of Instruction
Fort Riley, Kan. Aug. 1906.



Little 5th Batt. Engrs.

RUSSIAN REDOUBT NEAR SHANLANTZU.



LITHO. 3rd BAT. R.E.

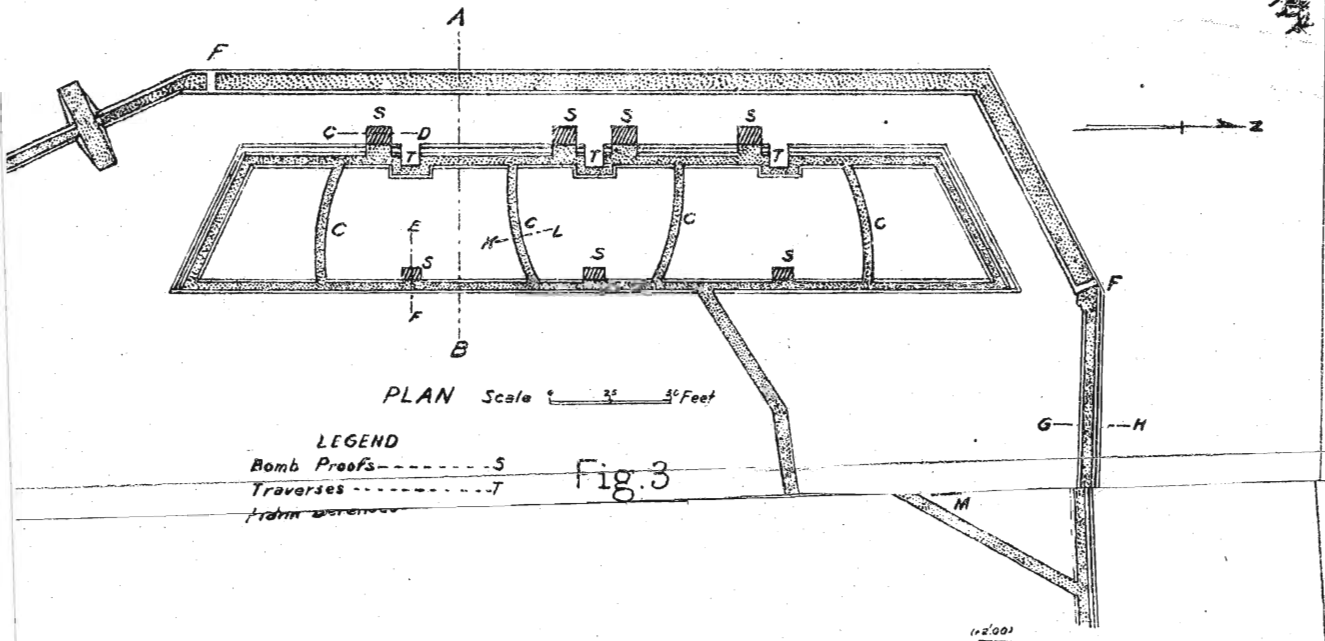
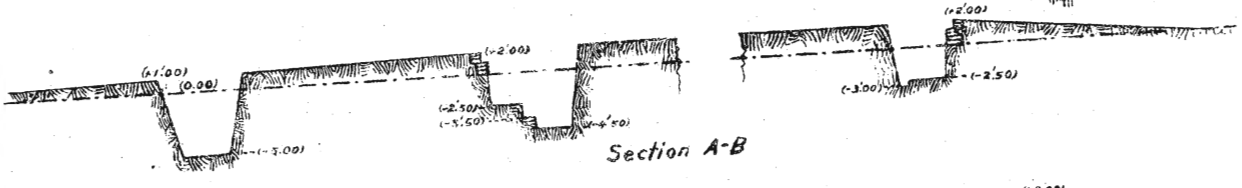
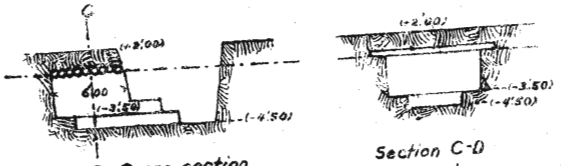


Fig. 3

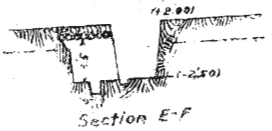


Section A-B

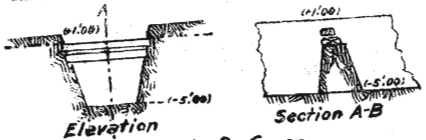


D Cross section
Bomb-proof in Front Parapet

Section C-D

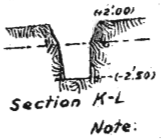


Section E-F

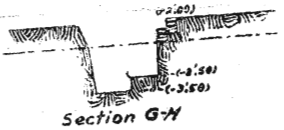


Elevation
Flank Defense

Section A-B



Section K-L



Section G-H

Note:
The dash and dot line represents the original ground surface.

Scale for Sections 0 5 10 Feet

JAPANESE FIELD REDOUBT NEAR KANGPIENHSIEN

LITHO. 3rd BAT. ENG.

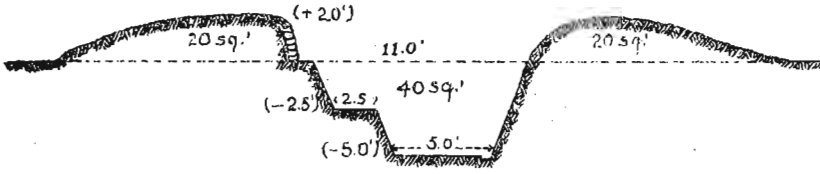
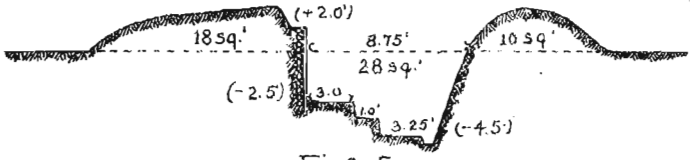


Fig. 4.



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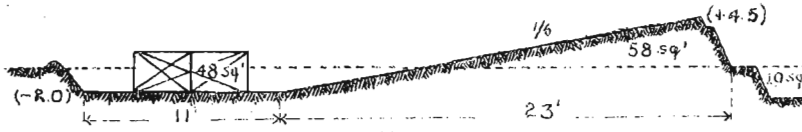


Fig. 6

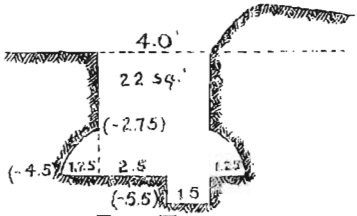


Fig. 7

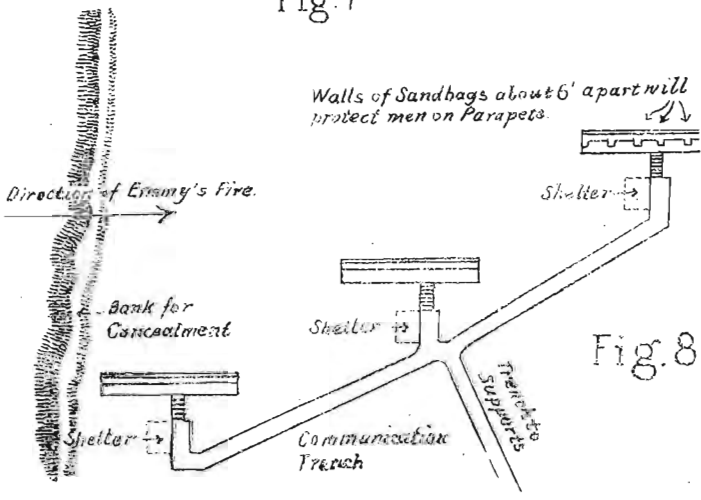
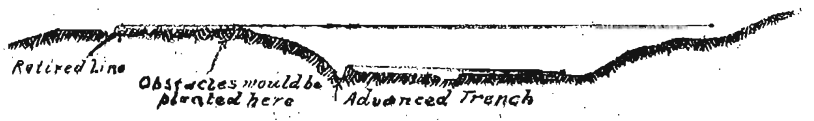


Fig. 8



Works retired and advanced

Fig 9.

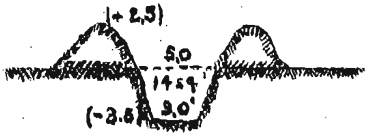


Fig 10

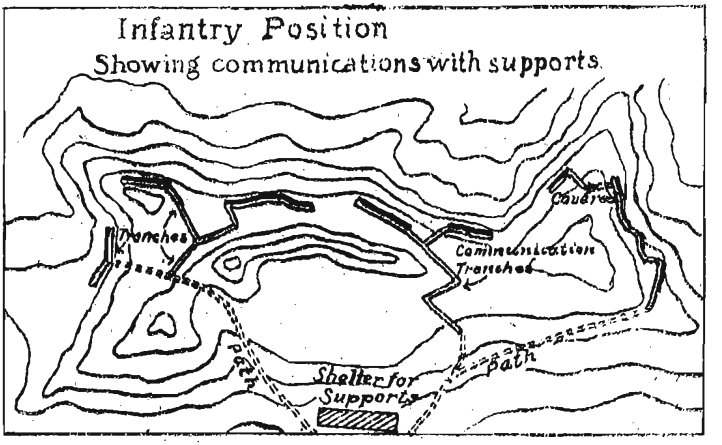
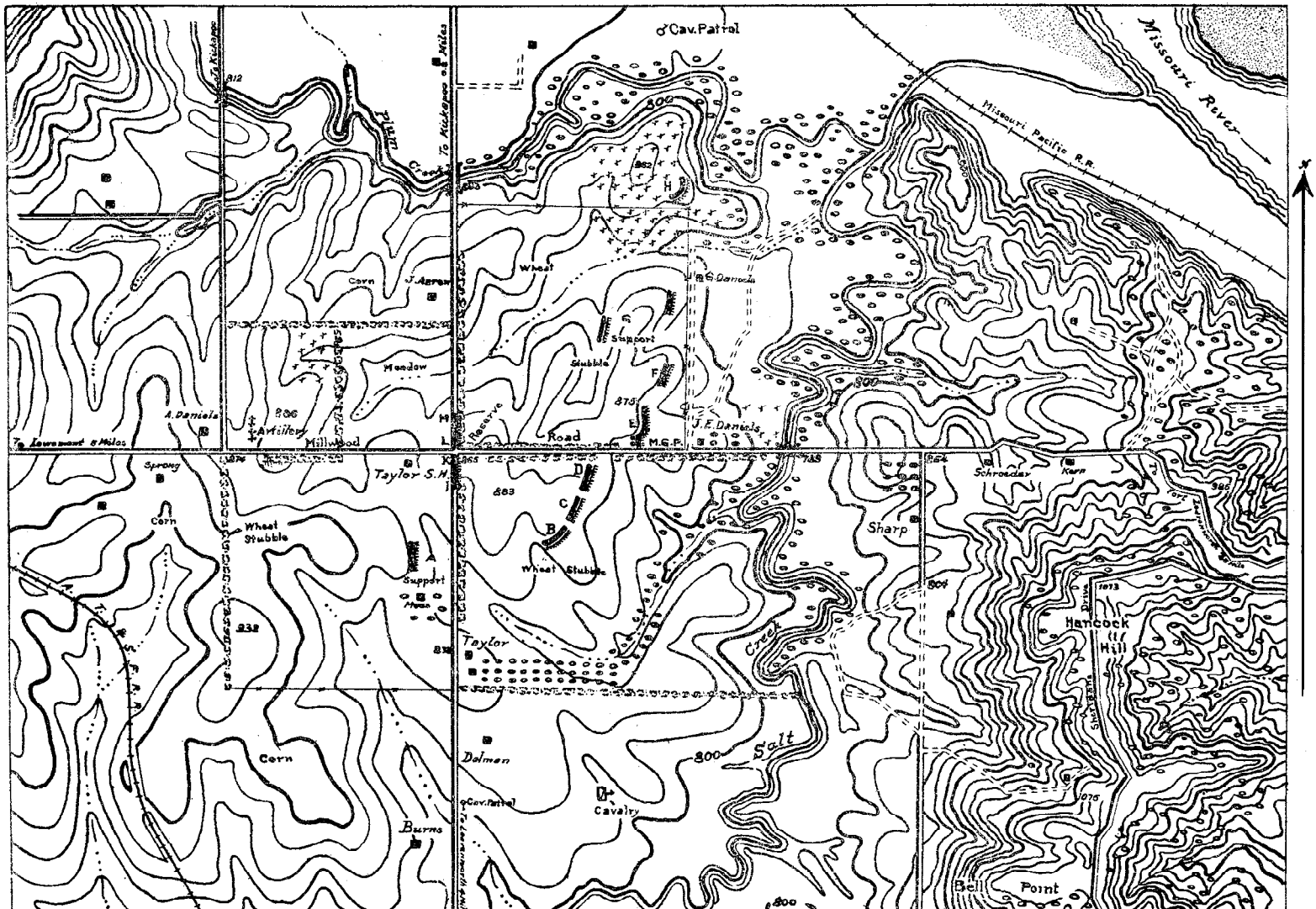


Fig 11

Field Problem No. 1



Scale: 3 **Inches** = 1 Mile.

V.I. 20 Feet.

500 0 500 1000 1500 2000 Yards

NOTICE

In the solution of the problems in "Field Problkms in -Fortification", references are made to paragraphs in the pamphlet "Modern Methods of Fortifying a Position? The original edition of the pamphlet "Modern Methods of Fortifying a Position" is exhausted and has been superseded by the book "Applied Principles of Field Fortification for Line Officers". This book contains these problems and solutions. The book can be obtained from the secretary; price 90 cents.

E. E. BOOTH,
*Captain, **7th Cavalry,***
Secretary.