INTRODUCTION

The following pages are published with the idea of giving the Army an idea of how to conduct exercises in Field Fortification of very great value, especially to line officers.

The fortification with which this course particularly deals is not the strong defensive position prepared for a large force, nor is it the line of hasty entrenchments thrown up to enable a battle line to hold positions gained. It deals generally with a position prepared with the object of making it possible for a force, to which a particular duty has been assigned, to perform this duty for a limited time when opposed by a superior force. Of course the object of fortification in general is to enable a force to hold its own against superior numbers, but in many cases the element of time is not definite. The object may be to hold a large force of the enemy and compel him to resort to the slow moving operations of a regular siege, time being thus gained for the mobilization of another army or for certain other military or political conditions to eventuate.

Most of the problems, however, deal with situations in which the object of gaining time is not remote but quite definite, and of which the amount of time necessary to gain, can be pretty accurately determined. The time for preparation is also frequently limited by the conditions of the problem.

For example, we may take the case where a division desiring to advance and cross a river, orders a detachment to proceed at once to a certain bridge and hold it until the division, which will arrive sixteen

hours afterwards, can reach it. On arriving at the bridge the commander of the detachment learns that a raiding brigade of the enemy, having learned of the contemplated movement, is marching to recross to its own side of the river and hold the bridge against his own main body, and will arrive four hours before the division can come up. He then has a perfectly definite problem of holding a force three times his size for four hours and has twelve hours to make any preparations he may desire.

The problem, of course, admits of many solutions. The ground may be well suited for delaying action. It may be that a particularly fine site for fortification exists. Probably in many cases a combination of methods would be used, but it is more than probable that at some stage of the action the commander will avail himself of the assistance of fortifications. As this course deals definitely with fortifications we eliminate many of the possibilties by saying that "the commander determines to take up a defensive position at such a place and fortify it." We then have a perfectly definite problem but one which will have many elements for consideration. It is not a mere mechanical placing of trenches, for we have the tactical problem. The trenches will unquestionably be of the maximum advantage, if the tactics are sound, and may otherwise be worse that useless. In our particular problem if we had to defend our force against three times its number for four hours it might be a very small matter; it might not and probably would not be difficult to hold a good position for an approaching battle against such odds for that time. But the enemy does not want our position and only secondarily our force, His whole object is to cross his force and to prevent the crossing of our approaching column.

The solution of the problem involves a study of all the ground in the vicinity, so that the position

shall be as strong as possible naturally. It is rarely the case that all avenues of approach can be blocked by an intrenched force. In extent the trenches must be made to fit the force and not the force the trenches. Unless the position is one of very great natural strength no amount of fortification will enable it to be held indefinitely against three times its strength of men, but skilfully placed trenches and obstacles may easily more than overcome this difference for a limited time. Greater extension of line is allowable than with an unfortified defense, but this may be easily overdone. Such extension should be gained by increasing the intervals between units rather than by extension of the units. Trenches may be arranged beyond the real flanks of the main line for temporary occupancy, the abandonment of which at a certain stage of the action would not in any way compromise the main defense. Other trenches may be so lightly held as to amount to dummy trenches. Secondary positions should if possible be prepared. The main position should be so prepared that the enemy cannot gain his object without attacking and the defenders should, by the best combination of the natural and prepared strong points and obstacles, endeavor to limit the possible lines of attack and by the arrangement of communications, to provide as far as possible for that ideal condition of meeting attack with the maximum strength. Again great additional strength is given to a defense for gaining time if it is so skilfully arranged that it is difficult for the enemy to ascertain the number of its defenders or its weak points.

The value of fortification when such concealment can be made is very great indeed. It not only improves the morale of the defending troops by lessening their casualties, but makes it very hard for the attacking force to quickly determine the most favorable plan for attack.

No better illustration of the added strength given by fortification, particularly in gaining time, when the arrangement is such as to leave in doubt the strength and disposions of the defenders, can be cited than the attack on the line in front of Santiago. The position was not of greater natural strength than may be frequently found. It was held by what amounted to little more than a thin intrenched skirmish line with only a couple of comparatively strong points. Every principle of tactics was violated. It is almost certain that the line could have been pierced early in the morning by a charge such as was made in the afternoon. But the actual result was that the intrenched force held off for hours, from fifteen to twenty times its strength, and inflicted on its opponents a loss in killed and wounded of over twice its own strength.

In addition to the many points noted which must be considered in taking up a position we will often, as in the illustration given, have to determine not what is the best method of intrenching the position but the best that can be done in the available time.

It will be seen that this kind of fortification will generally fall to the line officer. The problems will have to be solved in action by detached forces on special service as illustrated above, by isolated detachments guarding important points on the line of communications, by advance guards, rear guards and outposts. The problems differ much according to the specific duty of the force, limitations are imposed by special conditions, but the general conditions are the same. How important it is then for the line officer to understand thoroughly the guiding principles of taking up a defensive position and of being able to quickly determine what are the really strong points of the defense of any particular position and the

amount of preparation that is possible in a given time.

Having been much impressed for several years with the importance of such study I was able last year to assign time for it in the course. The working out of the details were intrusted to Captain James A. Woodruff, Corps of Engineers. His handling of the subject impressed everyone as being so excellent, in the selection of suitable problems, the mechanism of their handling by a class and the preparation of a pamphlet "The Modern Method of Fortifying a Position," based on the very latest authorized data on types of trenches, loopholes, obstacles, etc., with the time necessary for the construction, that it has seemed expedient to issue this pamphlet, giving a few sample problems and their solutions, in order that officers of the army may have the necessary information for taking up this most important study.

While in this pamphlet it has been necessary to indicate the solution on a map, it must be distinctly understood that such exercises, to attain their maximum value, must be on the ground.

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Field Problems in Fortification

Fortification is intimately connected with Tactics, so much so that it would hardly be too much to say that Fortification is itself but a special branch of Tactics and not a separate division of the Military Art. Though the purely technical parts of the subject are assigned to the Engineers, yet a knowledge of the correct tactical disposition and employment of defensive works is a necessity for every soldier.

The tactical aspect of Fortification lies in its adaptation to the natural features of the ground and to the nature of the weapons employed by either side; tactical considerations, based principally on the above, but also on the probable direction, nature, strength, and other conditions of the expected attack, will govern the general dispositions of the defensive measures, the strength of the garrison and the armanent required.

The Field Problems in Fortification are intended to take up the details of the phase of terrain exercises, such as are given in the Military Art Department, following the issuing of the order for taking up a defensive position.

The course in Field Problems in Fortification for the Staff Class consisted of eight problems for which 34 half-days were employed.

In the first five problems the force involved was a detachment consisting of a regiment of infantry, a battery of field artillery and sometimes a troop or more of cavalry. The problems were varied by placing them on different kinds of terrain, by varying the time available for the preparation of the position, and by variations in the probable direction, nature,

and strength of the expected attack. For problems involving a force of this size three half-days were employed.

On the first half-day a general examination of the terrain was required, with a statement of the general position to be occupied; division into sectors, and force assigned each; position and strength of the reserve; the position of the artillery, kind of fire to be employed and shelter to be constructed; disposition and use of the cavalry.

On the second half-day a more detailed examination of the terrain was required, with division of the force into first line and supports; location and design of the infantry works and garrison of each; position and shelter for supports; communications and approaches to be constructed; obstacles; clearing of the foreground; and demolitions to be executed.

On the third half-day the problem was discussed on the ground. During the discussion the instructor read a summary of the various solutions, and required different officers to explain any unusual dispositions, inviting a free discussion of all the points involved. Details were then made to trace the various trenches and positions. The locations were discussed by the whole class, and the best location at each point decided upon. When the time permitted, the whole line was traced on the ground simultaneously, by assigning officers as commanders of the various units and requiring them to issue their orders and trace the trenches of their commands. Each officer was provided with a sharpened stake about 3 feet long to which was attached 25 yards of tracing tape or cord. With these stakes the actual length of the trenches to be constructed could be traced on the ground by assigning the proper number of officers at each trench. In this way the officers can get a proper

idea of the amount of ground covered by the trench of any unit.

After a discussion of the problem an approved solution was issued by the department.

The sixth problem involved a force of a detached brigade consisting of 3 regiments of infantry, a squadron of cavalry, a battalion of field artillery, a company of engineers, a company of signal corps, and a field hospital. For this problem five half-days were employed.

On the first half-day the following requirements were solved: general position to be taken up; the division into sectors, and the force assigned each; the position and strength of the reserve; the location of the field artillery, character of the protection to be provided, and kind of fire to be used; disposition and use of the cavalry; duties to be assigned the engineer and signal companies; location of the field hospital, ambulance and dressing stations.

On the second half-day the first sector was taken up in detail in the same manner as in the smaller problems. The third half-day was devoted to a discussion of the previous work.

On the fourth half-day the dispositions of the second sector were required; and were discussed on the fifth half-day.

The seventh problem involved the dispositions and defensive works of a division with siege artillery, which was part of a force of a corps of three divisions required to take up and hold, for about a month, a strong position covering the bridges across the Missouri at Leavenworth and Fort Leavenworth, assuming about ten days were available for the preparation of the position.

Ten half-days were allowed for the solution and discussion of this problem, which was taken up first in general and then in detail as in the sixth problem.

The eighth problem involved an attack of a brigade, with siege and field artillery, an engineer battalion, signal company and field hospital, by regular siege methods, on a part of the line prepared for defense in the seventh problem; under the assumption that the position had been invested by a force of two corps with a siege train. Four half days were devoted to this problem.

On the first half-day were required: the location of the brigade park; the location of the siege artillery, character of the emplacements, observing stations; the location of the field artillery, character of the protection to be provided.

On the second half-day: location and construction of the first parallel; and the approaches to the front and rear.

On the third half-day: location and construction of the second and third parallels and approaches; duties assigned the engineer battalion and signal company; location of field hospital, ambulance and dressing stations.

The fourth half-day was devoted to a discussion of the problem and laying out the parallels and approaches.

The chief value of these problems is their solution on the terrain itself, and the actual laying out of the works on the ground. The map is only used to enable the instructor to determine the dispositions of each officer and to have a record of the work done by each.

The following general instructions were issued the staff class for the course:

1. Each officer will be equipped with a pad 5x8 inches, pencil, pocket knife, field glass, scale of yards 3 inches to 1 mile, scale of slopes, pamphlet on

"Modern Method of Fortifying a Position",* and Part V, Engineer Field Manual.†

2. A map for each problem, scale 3 inches to 1 mile, will be issued.

3. On the half-days scheduled for the discussion of problems, each officer will be issued tracing tape and stakes for locating trenches on the ground.

4. In the field problems all decisions and locations will be made after a careful examination of the ground. The map is issued only for purposes of identification and record, and all works will be clearly and accurately indicated on it to scale.

5. The solution of the problem will include any necessary explanation of the notations made on the map; brief reasons for decisions made or work to be executed; drawings of profiles and sections of work not in the manuals issued; estimates of time and force required to execute each part of the work; order in which each part is to be undertaken; methods to be used; tools and material necessary; arrangement of working parties, and total time to be devoted to the preparation of the position.

After several problems of the same type have been worked out in detail as above described, so that the student officers understand the amount and kind of work that can be done in a given time, the class may be given a situation and required to trace the trenches, approaches, points of support, and positions of supports, reserves, artillery, etc., in the time that it would have to be done in actual service. Officers may be assigned to commands, and required to issue their orders, with and without maps of the terrain.

When the entire position has been traced upon the ground, the class should go over it and discuss the various locations.

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*In the following discussion this will be referred to as pamphlet.

†This will hereafter be referred to as E.F.M.

The following problems selected from those given the Staff Class are given as examples of the simpler ones in the course. A solution of each problem is also given with the dispositions indicated on the map. It must be understood that these are in no sense map problems but are solved on the actual terrain, and that they are indicated on the map only to give an idea of the dispositions made on the ground.

The maps are all of a scale of three inches to one mile, too small a scale to indicate the dispositions accurately.

FIELD PROBLEM NO. 1.

General Situation:

A Red battalion which was sent from Platte City, Mo., (12 miles east of the Taylor S.H.) to capture supplies collected at Lowemont, Kan., (6 miles west of the Taylor S. H.) having encountered a superior Blue force at the latter place, has retired via the Millwood road.

Special Situation,--Blue:

The Blue pursuing force: 1st Infantry; Battery E, 3d Field Artillery; and Troop C, 5th Cavalry, is under command of Colonel A, who has orders to drive the Red force east of the Missouri River, and seize the Fort Leavenworth bridge.

The remainder of the Blue force (2d and 3d Infantry) which was delayed at Lowemont, cannot reach the Taylor S. H. before 3 P.M., September 23, 1908.

At 10 A.M., when Colonel A at the head of the main body arrives at Taylor S. H., he receives a captured message stating that five battalions of infantry and one battery of field artillery are on their way to reinforce the Red battalion, and expect to reach 986 at noon.

The cavalry reports that the Red battalion has deployed on the edge of the woods near Kern, leaving a small force near 854.

Colonel A decides to take up a position and to prepare it for defense, in order to hold back the enemy until the arrival of the remainder of the Blue force.

The Leavenworth bridge has been destroyed.

Required:

1st Part

1. The general position to be taken up.
2. Division into sectors, and force assigned each.
3. The position and strength of the reserve.
4. The position of the artillery, kind of fire to be employed, and shelter to be constructed.
5. The disposition and use of the cavalry.

2d Part

6. For each sector:

a. The division into first line and supports.
b. Location and design of infantry works and garrison of each.
c. Position and shelter for supports.
d. Communications and approaches to be constructed.
e. Obstacles to be constructed.
f. Clearing of the foreground.
g. Demolitions to be executed.

3d Part

Discussion of the problem on the ground.

SOLUTION—FIELD PROBLEM NO. 1

1st Part

1. Hill 883—hill 875—hill 862, overlooking Salt Creek. This position has a clear field of from 400 to 600 yards west of Salt Creek, a strong obstacle in its front, and its flanks are well protected. Salt Creek

is about fifty feet wide, with two to four feet of water, a very soft bottom, and vertical banks ten to fifteen feet high. The extreme front is 1500 yards, but the main position, excluding hill 862, is 1100 yards long. The working parties will be under long range infantry fire (1600 yards) of the enemy at the edge of the woods east of Kern, but can be protected by a force thrown out to the front near Sharp.

An alternative position is that along the ridge 932—886, which has the advantage of being out of range of the enemy, but would give up the obstacle of Salt Creek and the ground to the west, and would make a later advance all the more difficult. It has practically no better field of fire and has no strong positions for the flanks. (See paragraphs 7-16 of pamphlet).

2. Right sector: Kickapoo—Leavenworth road inclusive to Millwood road exclusive. Left sector: Millwood road to hill 862, both inclusive. One battalion is assigned to each sector; the machine gun platoon to the left sector. (See paragraphs 18 and 72 of pamphlet).

3. At 865, one battalion. This is a central location, well covered by the road cut, and is near the more exposed right flank. (See paragraph 21 of pamphlet).

4. At hill 886. Indirect fire will be used at first; if necessary, direct fire will be used to reach the attacking infantry. No artificial cover will be constructed. This position is well protected from the hostile artillery which would probably be posted on Hancock Hill. It covers the edge of the woods east of Kern at a range of 3200 yards, enfilades the ravines on each flank of the main infantry line and is well separated from the infantry positions. (See paragraphs 13 and 60 of pamphlet).

5. The cavalry will be ordered to keep touch with the enemy; and when driven in, cover the right flank, sending a squad to the left.

2d Part

6. a. For each sector: three companies in the first line; no local supports; sector support, one company. Local or company supports will not be employed, as the reverse slopes are too gentle to afford cover from artillery fire; the firing trenches will probably not be subjected to much artillery fire; there are no good covered approaches to the firing line, and the enemy's attack is likely to develop suddenly from Salt Creek. (See paragraphs 19 and 70 of pamphlet).

b. See map. Trenches are constructed for eight companies, 120 yards per company; total length 960 yards. With tasks of five feet per man, this will require $\frac{3}{5} \times 960 = 576$ men.

Profile: standing trench, see fig. 1. This has an area of cross section of $5\frac{1}{4}$ square feet. The soil is clay and may be classed as medium. $5\frac{1}{4} \div 4 = 1\frac{1}{2}$ hours required to complete the trench (E. F. M. part V, paragraph 40). No concealment, loopholes, nor dummy trenches, as work will have to be done in view of the enemy, and the time is limited. Trench for H company will be concealed by the standing corn. The profile adopted with its low and flat parapet, is very inconspicuous. (See paragraph 39 of pamphlet).

Machine gun emplacement constructed by platoon in two hours, with sand bag loopholes, covering the Millwood road. (See fig. 2) Sand bags will be stored in trench so that the guns may be raised to fire over crest of parapet, if wider field of fire becomes necessary.

Tools required: Those carried by the men and in the wagons, including those of the re-

serve. See appendix. Practically no tools can be obtained from the neighboring farms. Work will be done in one relief, seventy-two men in each company with shovels, twenty with picks.

c. See map. G Company will scarp the reverse slope and throw the earth to the front so as to give cover for men sitting, for a length of fifty yards. This requires $\frac{3}{5} \times 50 = 30$ men, $\frac{1}{2}$ hour, and will be done when the company completes its firing trench. A company is protected by a retired firing trench as shown on map. (See paragraph 48 of pamphlet).

d. None, on account of lack of time, men, and tools. (See paragraph 47 of pamphlet).

e. None except those involved in f. (See paragraph 51 of pamphlet).

f. Standing corn in front of E and H companies broken down parallel to the front by dragging a log over it with a team. Trees and brush along the west side of Salt Creek slashed. (See paragraph 52 of pamphlet) For this work there are detailed $105 - 92 = 13$ men from each of the eight companies, for $1\frac{1}{2}$ hours, with the axes and hatchets carried by the companies. (See appendix).

g. The Daniels houses in front of E and G companies will be burned. The bridge at 789 should not be destroyed as it would be needed for a future advance of the detachment. (See paragraph 53 of pamphlet).

The work to be carried on simultaneously except the support position for G company. The men will be worked $1\frac{1}{2}$ hours in one relief. Total time to complete the preparation of the position, two hours.

The 3d Battalion detailed for the reserve is assumed to have been in the advance guard.

It will keep down the fire of the enemy while the trenches are being constructed, by crossing Salt Creek and occupying the hill west of 854. When the work is completed it will fall back to its position at 865.

FIELD PROBLEM NO. 2.

General Situation:

A Blue division is retreating through Leavenworth towards Atchison (18 miles northwest) pursued by a Red Division.

Special Situation—Blue:

The Blue rear guard consisting of:

2d Infantry,
Battery B, 3d Field Artillery,
Troops C and D, 7th Cavalry

has, on September 14th, halted for the night near the Taylor house on the Leavenworth-Kickapoo road. At 6 P. M. the rear guard commander receives orders to hold the ground south of Plum Creek until noon September 15th. Information is received that the immediate pursuing force of the enemy consists of about 4000 men of all arms, and is camped in Leavenworth, with outposts on the ridge west of town.

The rear guard commander decides to take up a defensive position and to fortify it as strongly as the time permits.

Required:

1st Part.

1. The general position to be taken up.
2. Division into sectors, and force assigned each.
3. The position and strength of the reserve.
4. The position of the artillery, kind of fire to be employed, and shelter to be constructed.
5. The disposition and use of the cavalry.

2d Part.

6. For each sector:

a. The division into first line and supports.
b. Location and design of infantry works and garrison of each.
c. Position and shelter of supports.
d. Communications and approaches to be constructed.
e. Obstacle to be constructed.
f. Clearing of the foreground.
g. Demolitions to be executed.

3d Part.

Discussion of the problem on the ground.

SOLUTION—FIELD PROBLEM NO. 2.

1st Part.

1. The main line of defense: Along the J. Aaron ridge from road 874—812 to include hill 862. An advanced line from the Sprong house—hill 883—hill 875 will also be held. The main line has a length of 1800 yards; it has a good field of fire of about 800 yards; its left flank is strong, the right is rather weak, but can be covered by the artillery and cavalry; the reverse slope is steep and offers good cover for the reserve; the hedges and barbed wire fences in front afford good obstacles. In order to give more depth to the position and delay the enemy, the advanced line is occupied by part of the force (See paragraph 56 of pamphlet). This position has a front of about 1700 yards and a good field of fire of about 500 yards, its flanks are weak, and the reverse slopes are too gentle to afford cover for supports and reserves from artillery fire; it is therefore not suitable for the main position. In this problem the ground south of Plum Creek has to be held for five or six hours, and this can best be done by causing the enemy to deploy before the advanced position, the defenders

of which can retire by the ravines in rear without masking the fire from the main line. (See paragraphs 7-16 of pamphlet).

2. Right sector: from the road 874—812 to the Leavenworth—Kickapoo road inclusive. Left sector: from the Leavenworth—Kickapoo road exclusive to hill 862 inclusive. One battalion will be assigned to each sector, the machine gun platoon to the left. (See paragraph 18 of pamphlet).

3. At 803, one battalion. This is a central position well covered by the steep slope. (See paragraphs 21 and 72 of pamphlet).

4. At hill 849. Indirect fire will be used. No artificial cover will be constructed. This position covers the exposed right flank of each line and enfilades the ravines and railroad along which the main attack of the enemy is likely to be made. It is well separated from the infantry positions, especially the position of the reserve. It would be very difficult for the enemy's artillery, which is probably superior, to find this position; and it is about 4000 yards from Sentinel Hill and Bell Point near which the enemy's artillery would probably be located (see paragraphs 13 and 60 of pamphlet). Crook Point affords a good observing station.

5. To reconnoiter to the front at daylight on September 15th, gain contact with the enemy, delay his advance, and cover the right flank, sending a platoon to the left. To execute the demolitions given in 6 g.

2d Part

6. a. For each sector: two companies in trenches in the main line, and two in the advanced line. (See paragraphs 19 and 70 of pamphlet.)

b. See map. Trenches for 12 companies, 120 yards per company, total length 1440 yards. This re-

quires $\frac{3}{5}\times1440=864$ men, or 72 men per company. Profile, standing trench, see fig. 1. Area of cross section $5\frac{1}{4}$ square feet; $5\frac{1}{4}\div4=1\frac{1}{2}$ hours, add $\frac{1}{2}$ hour for night work: gives total time 2 hours. Trenches will be concealed with grass in places where it is growing, by corn in the corn fields, and by top soil in plowed ground. No loopholes will be constructed on account of lack of time and materials. Dummy parapets shown on the map will be constructed by plowing two or more furrows. (See paragraphs 39, 55 and 77 of pamphlet.)

Machine gun emplacement constructed by platoon in two hours with sand bag loopholes (see fig. 2.) A wide field of fire will probably be necessary: this can be secured as explained in Problem No. 1.

Tools required: Those carried by the men and in the wagons (see appendix); as there are not sufficient for all the men working at once, the work will be done in two 2-hour reliefs, 492 men in each, including the work under d. Six teams and plows will be requisitioned from the neighboring farms to assist in the construction of the trenches, and to make the dummy parapets. The reserve will assist in the construction of the trenches in the main line.

c. No supports proper will be used; the four companies in the main line will act as such for the four companies in the advanced line. (See paragraph 48 of pamphlet).

d. See map. For profile see fig. 3. Total length 200 yards. Requires $\frac{3}{5}\times200=120$ men, 2 hours, or 30 men from each of the four companies on the advanced line. These approaches will enable the defenders of the advanced line to retire gradually under cover when the enemy's

attack has sufficiently developed. (See paragraph 47 of pamphlet.)

e. None except those involved in f. (See paragraph 51 of pamphlet.)

f. Standing corn in front of trenches broken down parallel to the front by dragging logs over it with teams. (See paragraph 52 of pamphlet.)

g. The steel bridges over Salt Creek at Frenchman's, at 789 on the Millwood road, and the railroad bridge at the mouth of Salt Creek will be disabled by explosives by the cavalry. Requires five pounds of dynamite per bridge, placed at the panel point of each truss, resting on the abutment. (See paragraph 128, E. F. M.) The railroad trestle at Miocene will be burned. Work will be done by patrols, four men to each bridge, after the cavalry has been forced behind Salt Creek. For tools and explosives carried by the cavalry, see appendix.

Total time to prepare position four hours. No man will work more than two hours. The work should be commenced by 7 p. m. and finished by 11 p. m., by moonlight.

All work except that in 6 g, carried on simultaneously.

FIELD PROBLEM NO. 3

General Situation:

A Blue army based on Kansas City, is operating along the Missouri Pacific R.R. against a Red army, based on Omaha. In order to protect its line of communications against cavalry raids of the enemy, the Blue army has fortified various points along the railroad in its rear.

Special Situation—Blue:

Colonel A, with the 6th Infantry and Battery C, 3d Field Artillery, has been ordered to fortify Kicka-

poo, where there is a round-house, repair shops and materials for the repair of the railroad. It is not believed that an attack by more than a cavalry brigade with artillery is to be feared. No forces of the enemy are reported within sixty miles of Kickapoo. Required:

1st Part

1. The general position to be fortified.
2. Division into sectors and force assigned each.
3. The position and strength of the reserve.
4. The position of the artillery, kind of fire to be employed and character of protection to be constructed.
5. Interior lines of defense.

2d Part

6. For each sector:

a. Division into first line and supports.
b. Location and design of infantry works in the first and interior lines.
c. Position and shelter for supports.
d. Communications and approaches to be constructed.
e. Obstacles to be constructed.
f. Clearing of the foreground.
g. Demolitions to be executed.

3d Part

Discussion of the problem on the ground.

SOLUTION—FIELD PROBLEM NO. 3

1st Part

1. Hill 1000 — 873—B. Meyers—hill 903. This line is 3000 yards long—too long for the garrison of the town, (see paragraph 70 of pamphlet); but it is necessary to hold it, as the field of fire on the left would be too restricted if the line was drawn in to the line 865—hill 923. The field of fire on the right

is good for 400-500 yards; on the left, for 900-1000 yards. Section Lane and Plum Creek form good obstacles on the left. The low ground along the Missouri River is intersected by numerous sloughs and is too marshy and wooded for an attack from the east.

2. Right sector: north and west of the line 842—865—38. Left sector: south and east of the same line. One battalion is assigned to each. (See paragraph 18 of pamphlet.)

3. At 38; one battalion and machine gun platoon. (See paragraphs 21 and 72 of pamphlet.)

4. In the ravine northwest of hill 923. Indirect fire will be employed with no artificial cover. Other positions will be selected for indirect fire so that all the slopes in front of the position may be swept by fire. Observing stations will be located on hills 1000, 903, and 923. The probable positions of the enemy's artillery are Crook Point and hill 1042. (See paragraphs 13, 23, 27, 30, 59, 60, and 63 of pamphlet.)

5. No interior line for right sector; for left: line 865—hill 923. The front line is so long that it may be necessary, if an energetic attack is made, to draw in the left, giving a line about 1500 yards long. (See paragraphs 6, 17, 56, and 57 of pamphlet.)

2d Part

6 a. For each sector: three companies in the first line, each with one section in firing trenches and three in local support; sector support one company. (See paragraphs 19 and 70 of pamphlet.)

b. Location shown on map. Trenches for ten companies in the first line (9 company trenches and two platoon trenches); and for four companies in the second; 120 yards per company; total length 1680 yards. Profile: Fig. 5 of pamphlet, see also paragraph 39. The soil is clay and may be classed as medium (See paragraph 82 of pamphlet). To con-

struct trenches will require $\frac{3}{5} \times 1680 = 1008$ men, eight hours, working in two 4-hour reliefs. (See paragraph 89 of pamphlet.) Loopholes will be constructed of sod, sand bags, or stove pipe, materials to be obtained in vicinity. Trenches will be carefully concealed with sod, top soil or brush. (See paragraphs 40, 46, and 55 of pamphlet.)

Splinter proof cover will be provided for one section in each company trench, of type shown in Fig. 3 of pamphlet; six square feet per man or 150 square feet for each company trench; total 2100 square feet. This will require 150 men four hours, not including earthwork. (See paragraphs 43 and 93 of pamphlet.)

Machine gun emplacements of type shown in Fig. 2, with the addition of splinter proof cover constructed by platoon in four days at hill 1000, hill 923, hill 903, and covering the road and railroad east of hill 1000; see map. Splinter proof cover of type shown in Fig. 38, E. F. M.

c. Company supports shown on map at S. The sector supports at C and G. Protected by scarping reverse slope, $\frac{1}{2}$ yard per man. This will require 200 men four hours to construct. Similar shelter will be constructed for the reserve by 100 men in four hours. (See paragraph 48 of pamphlet.)

d. Approaches shown on map, leading to the more advanced trenches, where no natural covered approaches exist. Total length 800 yards; profile, fig. 10 of pamphlet. These will require 480 men four hours to construct. The existing lateral communications are sufficient. (See paragraphs 47 and 67 of pamphlet.)

e. Slashing in the wooded ravines leading to the position, along the river road, and where orchards and woods are cleared. Section Lane hedges prepared as an obstacle by clearing out to im-

prove the field of fire and filling the road cuts with the debris. See f for estimate of time.

High wire entanglements, five yards wide, constructed in front of trenches where no hedges or slashings have been prepared. Total length 2000 yards, this will require 600 men four hours to construct, material taken from barbed wire fences. (See paragraphs 51 and 93 of pamphlet.)

f. Woods and orchards slashed in front of trenches to at least 600 yards. The houses that interfere with the field of fire will be torn down and the material used for splinter proofs, etc. This This will require the labor of 400 men four hours. (See paragraphs 52 and 93 of pamphlet.)

g. None.

The tools carried by the men and in the the wagons are sufficient, with a few that can be obtained in the town and neighboring farms, including teams and plows. Men will be worked four hours per day.

The work should be undertaken in the following order: 1st line trenches, clearing, approaches, shelter for supports and reserve, 2d line trenches, obstacles, splinter proofs.

Total time required to execute the work outlined above, three days of four hours. When this work has been completed, small working parties will be employed each day to extend the clearing of the foreground, improve the concealment of the trenches, strengthen the obstacles, and increase the protection for the supports and reserve.

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Instructor.

APPENDIX

The following extracts from General Orders of the War Department give the tools carried by the different arms, which could be used for intrenching:

Intrenching tools carried by a company of infantry, G. O. No, 23, 1906:

½ ft. folding rule
15 pick mattocks
45 intrenching shovels
4 hand axes
3 wire cutters

The following engineer equipment is furnished each company of infantry to be carried in the extra regimental wagon, G. O. No. 221, 1907:

Augur, 1-inch	1
Axes	6
Crowbar, 12 pounds	1
Hatchets	6
Machets with sheaths	20
Nails, assorted, pounds	10
Pliers, wire cutting	7
Rule, 2-foot	1
Saw, hand, crosscut, with sheath	1
Rope, 2½-inch, feet	250

The following engineer equipment is furnished the cavalry, to be carried on pack animals, G. O. No. 221, 1907:

To each troop:

Augur, 1-inch	1
Axes, 6-pound	4
Crowbar	1
Hatchets	4
Nails, assorted, pounds	5
Pick mattocks large,	5
Pliers, wire cutting	6
Rules, 2-foot	2
Saw, crosscut, with sheath	1
Shovels, large	15

PACK DEMOLITION OUTFIT

To each squadron:

Box, match, tin	1
Caps, detonating	100
Chisel, cold, 1½ pound	1
Crowbars	2
Drills, double bitted	2
Explosive, pounds	50
Fuse, Bickford, feet	200
Fuse instantaneous, feet	200
Hammers, drilling, 7-pound	2
Hammer, engineer's, 3-pound	1
Pliers, nose cutting	1
Shoes, mule, sets	1
Spoon, drilling	1
Wrench, monkey	1

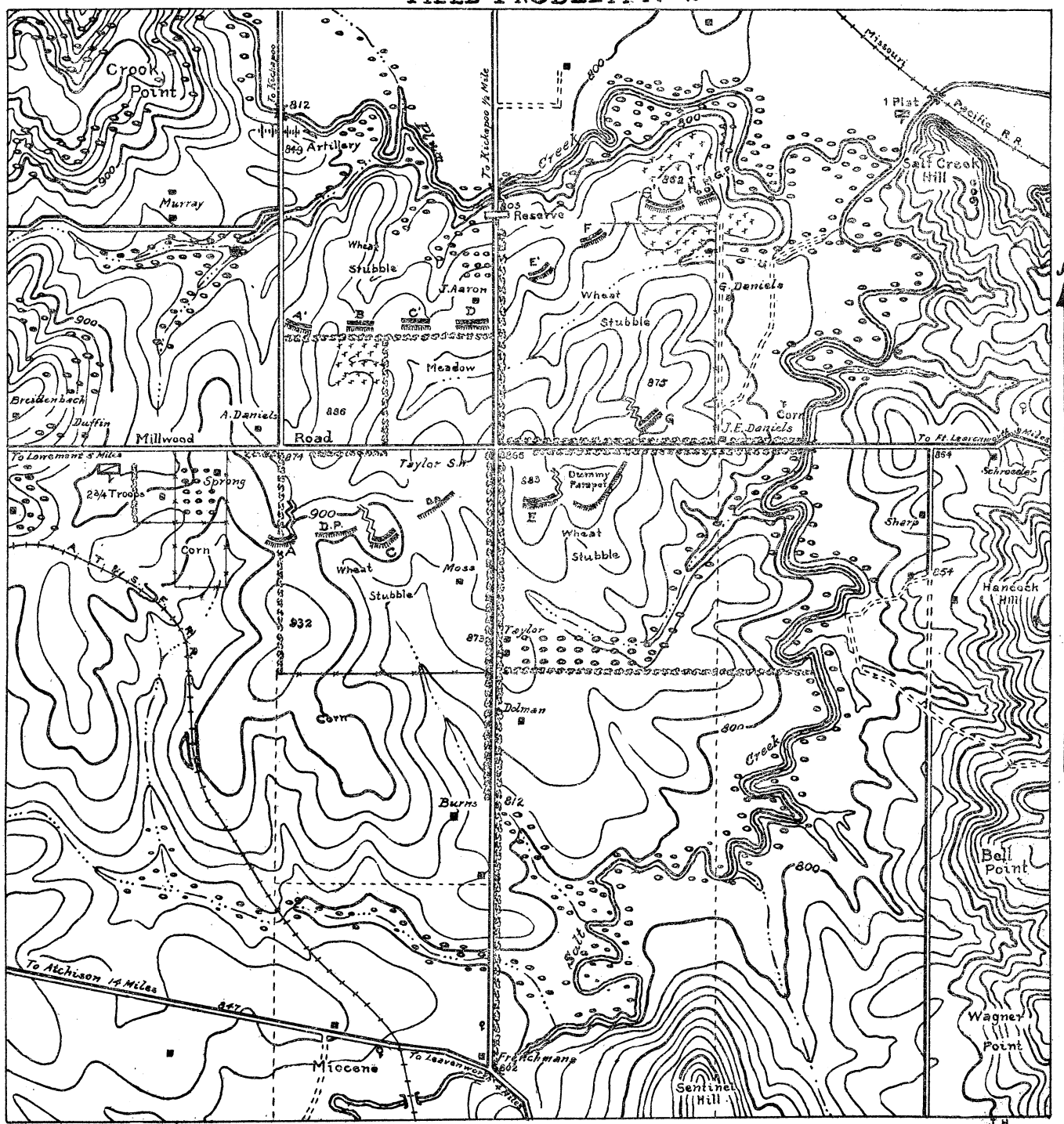
Allowance of tools for field service, G.O. No. 95, 1908.

	Regimental Headquarters	Battalion Headquarters	Band	M.G.P.	Company	Total in Regiment
Infantry						
Axes	10	2	4	4	6	96
Hatchets	10	2	4	4	6	96
Pickaxes	3	1	2	2	4	58
Spades	3	1	2	2	4	58
Artillery					Battery	
Axes	6	2	4		3	32
Hatchets	6	2	4		3	22
Pickaxes	1	1	2		7	48
Spades	1	1	2		7	48
Cavalry		Sq. Hdqrs.			Troop	
Axes	6	2	4	4	6	92
Hatchets	6	2	4	4	6	92
Pickaxes	1	1	2	2	4	56
Spades	1	1	1	2	4	56

In addition to the above, each escort wagon carries one axe, one pickaxe, and one spade. The allowance of escort wagons is as follows:

	Regiment	Battalion	Company
Infantry	23	6	1
			Battery
Artillery	23	10	3
		Squadron	Troop
Cavalry	34	10	2

FIELD PROBLEM Nº 2

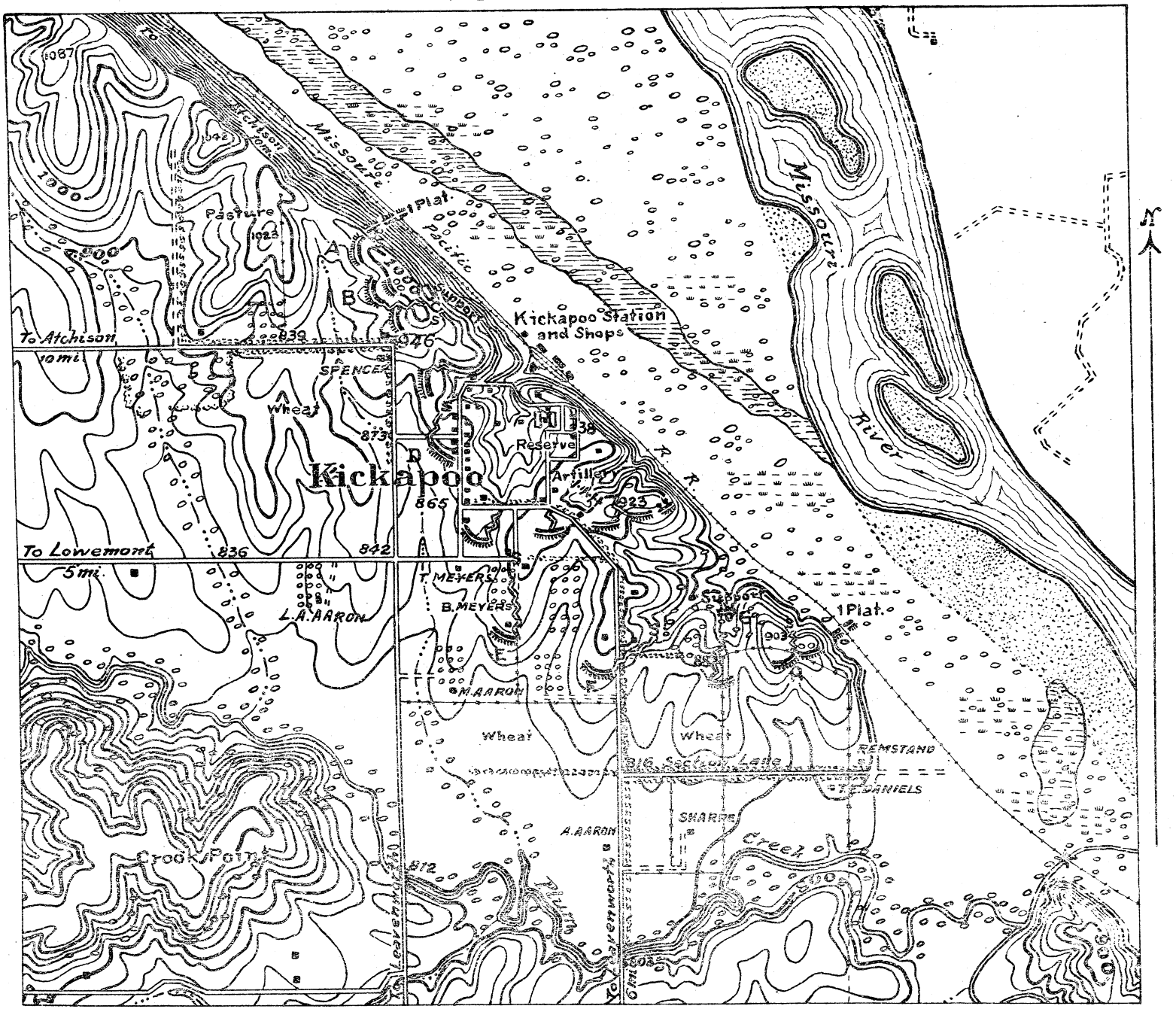


Scale. 3 Inches = 1 Mile

V. I. 20 Feet.

500 250 100 0 500 1000 1500 2000 Yards

FIELD PROBLEM Nº 3.



Scale: 3 Inches = 1 Mile V. I. 20 Ft.

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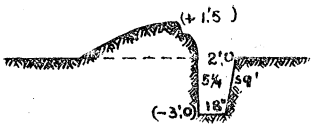
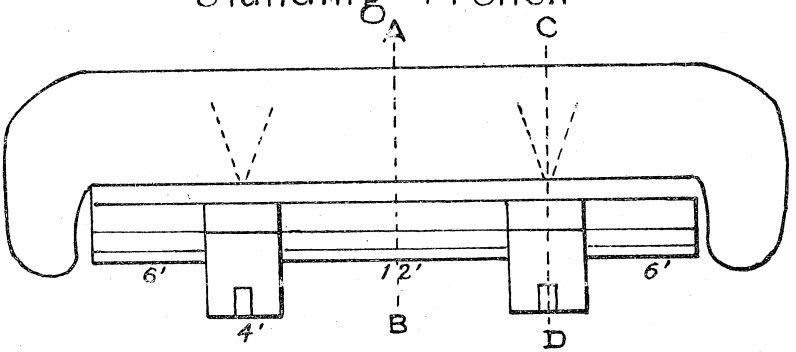
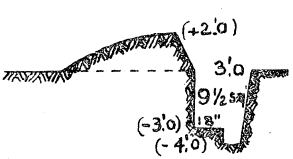


Fig. 1

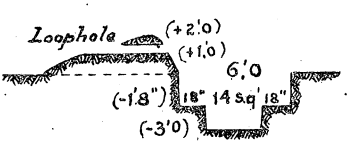
Standing Trench



Plan



Section A-B



Section C-D

Fig. 2

Emplacement for 2 Machine Guns.

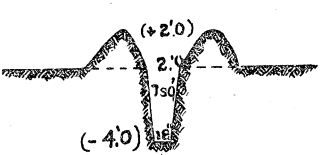


Fig. 3

Communicating Trench