Volume II. Number 4.

THE FIELD ARTILLERY JOURNAL

OCTOBER-DECEMBER, 1912

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PUBLISHED QUARTERLY *by*
THE UNITED STATES FIELD ARTILLERY ASSOCIATION
702 SEVENTEENTH STREET, N.W., WASHINGTON, D. C.
$4.00 PER ANNUM

The Field Artillery Journal

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Entered as second-class matter, March 14, 1911, at the Postoffice at Washington, D. C.

The United States Field Artillery Association

ORGANIZED JUNE 7, 1910

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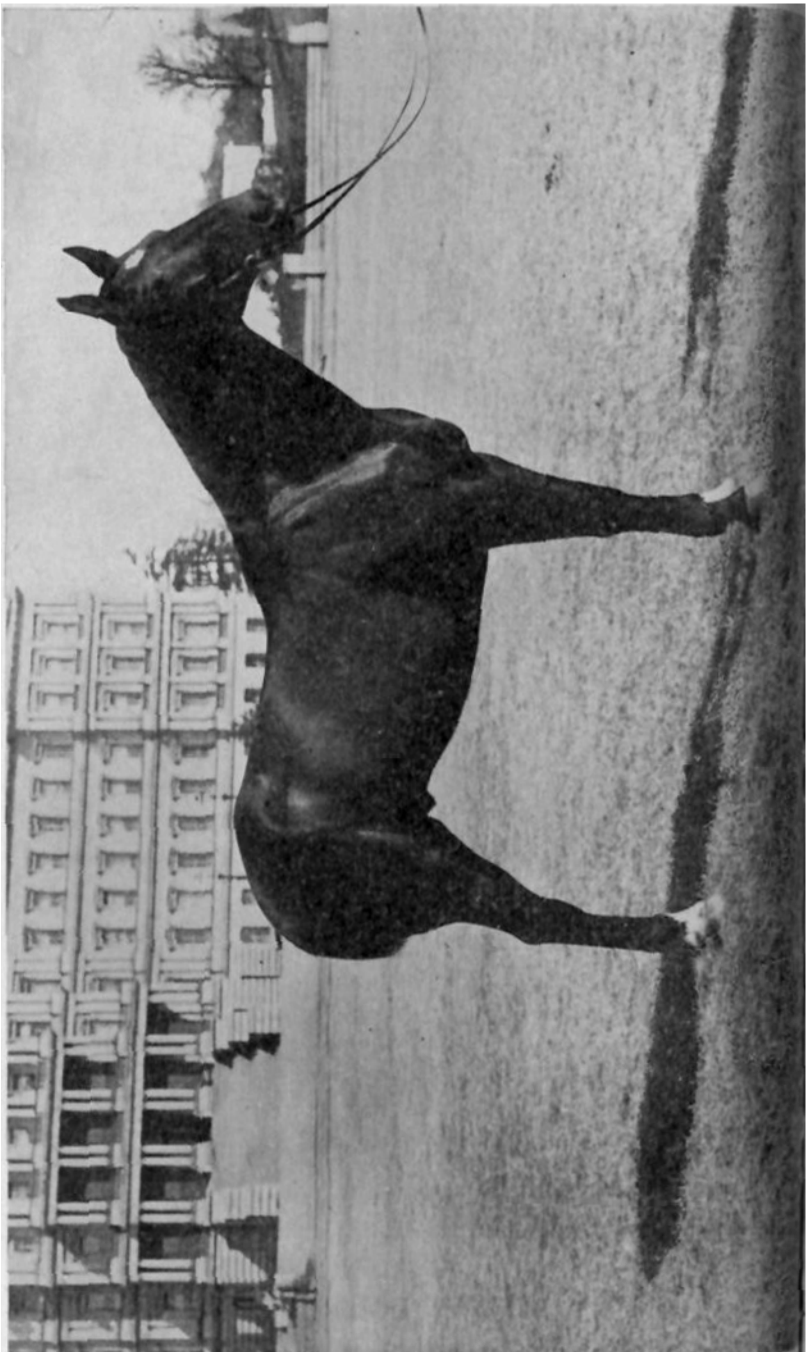

The Field Artillery Journal

Vol. II OCTOBER-DECEMBER, 1912 No. 4

FIELD SERVICE EXERCISES FOR A BATTALION OF LIGHT ARTILLERY

BY G. AUBRAT, MAJOR OF FIELD ARTILLERY.

BERGER-LEVRAULT & CO., PUBLISHERS, PARIS.

SECOND EDITION.

Translated for the FIELD ARTILLERY JOURNAL.

(CONTINUED FROM SEPTEMBER NUMBER.)

EXERCISE WITH MATÉRIEL

In Co-operation with an Infantry Battalion.

General Situation.

The enemy (Blue) occupies Châlons. A Red detachment, after a forced march, passes through Mourmelon and reaches the Vesle about nightfall. It occupies Louvercy, Bouy and Vadenay (Fig. R″).

The orders of the detachment commander are to hold the line of the Vesle until 10 a. m., when the head of the Red main body may be expected. That part of the detachment in Bouy consists of one squadron of cavalry, one regiment of infantry (four battalions), and a battalion (three batteries) of artillery.

One infantry battalion and two batteries actually take part in the exercise. Two companies and the two batteries represent the Red detachment, the other two companies represent the head of a Blue column on the La Veuve road. The Blue companies are intended to deploy on both sides of the road, and illustrate the

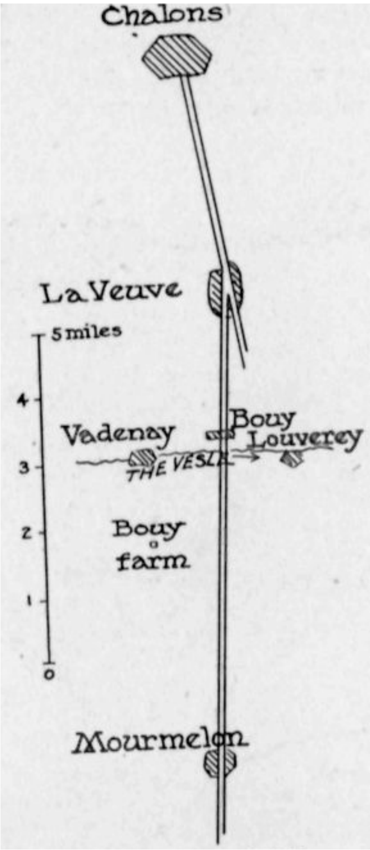

Fig.R."

progress of the action in this section of the field. The director plans to give successive situations to the artillery as the combat develops, but first explains on the ground everything that he thinks necessary to a clear understanding of the problem, as follows:—

Outposts.

"The 1st Battalion forms outpost, while the rest of the detachment is quartered at Bouy. The command not having reached Bouy until nightfall, the dispositions are very simple. One company is sent out on the La Veuve road, to the edge of the wood 2,500 meters from Bouy, and another about the same distance out toward Grandes Loges (Fig. S″). The other two go out on side roads, one to the right of the Grandes Loges road, to connect with the outpost of the troops at Louvercy, and the other to the left, to connect with the outpost from Vadenay.

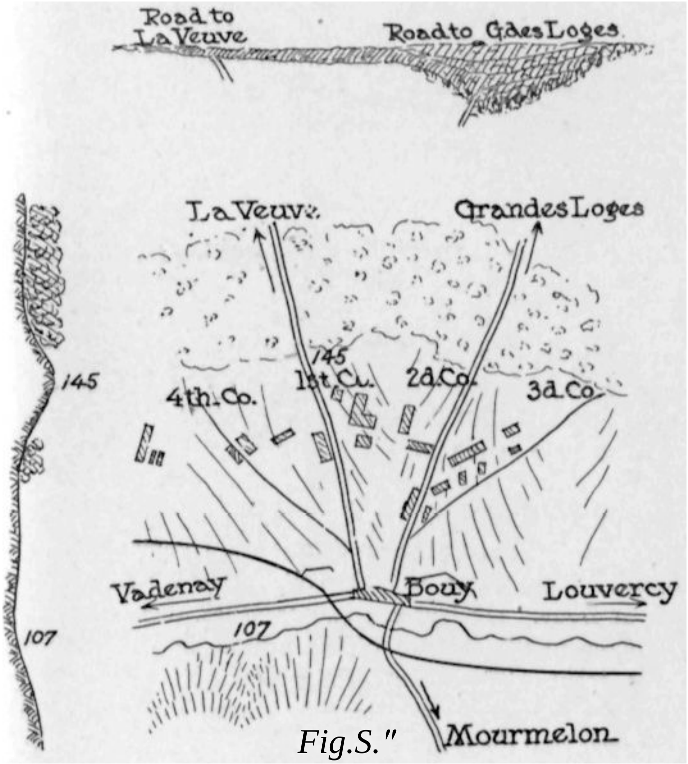

Fig.S.″

"The night passes without incident. Before daylight in the morning the squadron passes the line of outposts and moves out to reconnoiter toward La Veuve and Grandes Loges.

Reconnaissance by the detachment commander.

"At daybreak, the detachment commander, with the commanding officers of the infantry regiment and of the artillery battalion, reconnoiters his position. The reconnaissance confirms his idea, gained from study of the map, that the line of resistance should be through Bouy.

Description of the ground.

"The horizon is formed by the woods about 2,800 meters from Bouy, which show a perfectly horizontal line except for a dip where the road to Grandes Loges passes. The map shows that these woods form a continuous band of varying width, reaching more than 2,000 meters in the direction of La Veuve. In front of the woods the ground is sloping and covered with stubble; at the foot of the slope are a number of groups of trees; from there, the ground is open, and sloping gently down toward Bouy. This is shown in the profile (Fig. S″).

"As the detachment commander completes his reconnaissance, the squadron falls back before superior hostile cavalry, bringing information that a hostile column of all arms has reached La Veuve and is advancing upon Bouy. Rifle fire is heard, showing that the enemy is in contact with the outposts. The second battalion is sent out to the woods at the foot of the slope, to support the outpost and delay the enemy as long as possible.

Preparations for Defense.

"The detachment commander directs the commanding officer of the infantry regiment to have his other two battalions prepare a position at Bouy. He lays out two trenches, one on each side of Bouy, following the contour of the ground and entirely invisible from the front. The main infantry position is formed by the ditches of the Louvercy road, the right entrenchment, Bouy, the left entrenchment, and the railway embankment. A machine gun platoon is placed on each flank.

Orders for the Artillery.

"The battalion will delay the advance of the enemy as long as possible, firing upon any troops crossing the crest or descending the slope, and carefully observing the road from La Veuve. It will avoid engaging hostile batteries which remain masked, as they will be unable to do any considerable damage to the infantry of the defense. The positions should be so selected as to enable the batteries to hold out even against much superior artillery; one battery will be to the right of Bouy, and the other two to the left, near the Vesle. The battalion commander will make a detailed reconnaissance of his positions, and be ready to occupy them and open fire."

With reference to the artillery positions, the director adds: "It would be well for everyone to understand the reasons for selecting these positions. The dense screen of poplars in the valley gives the artillery the choice of two general positions—one on this side of the Vesle, the other on the other side, say 2,000 meters in rear of Bouy, firing over the trees. My idea is that in order to support the infantry properly the artillery should be on this side. I place two batteries on the left and only one on the right, because the La Veuve road, where the enemy's main column will probably appear, is covered better from the left."

Orders of the Battalion Commander.

"Our detachment expects an attack by superior forces. No reinforcements can be expected before 10 a. m.; and the line of the Vesle must be held at any cost.

"Our outposts are in contact with the enemy in the woods on the horizon. The rest of the infantry is entrenching the main line of defense, which includes the ditches along the road to Louvercy, an entrenchment on the right of the Grandes Loges road, Bouy, another entrenchment on the left of the La Veuve road, and the railway embankment."

During their reconnaissance, the battalion and battery commanders have carefully examined the positions for the various batteries, and marked out the field of fire for each (Fig. T″). The one on the right of Bouy is beside the Louvercy road, near the cemetery. The slight embankment of the road will serve to stop bullets close to the ground, but not to mask the pieces; however, the battery assigned to this position can get a little concealment by cutting some trees and bushes and placing them in front of the guns.

The positions on the left are close to the stream, and have a little more than mounted defilade against the horizon. Guns in these positions can clear the mask when firing upon targets on the opposite crest, but not when the target is lower down. The depression through which the road to Grandes Loges passes marks the extreme right of their field of fire.

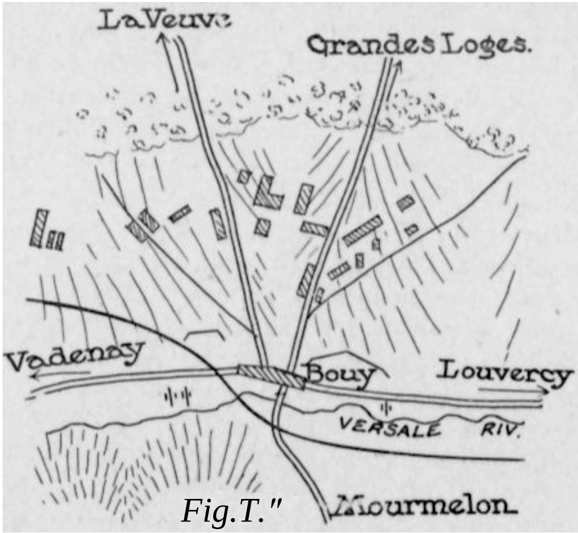

Fig.T."

Having determined all this, the battalion commander continues his orders as follows:

"The battalion is to delay the enemy's march as long as possible. To this end, it will first observe the whole front, and particularly the road from La Veuve, and fire upon any troops that may appear. Later, if the enemy crosses the crest, it will observe the ground on this side, and fire upon any troops descending the slope. It will not engage any hostile batteries masked behind the crest, for they can do very little damage. Even if the hostile artillery should temporarily neutralize some part of our artillery or infantry positions, our target will continue to be troops advancing toward Bouy."

When the battalion and battery commanders return and report the results of their reconnaissance to the detachment commander, they receive orders to put the batteries into position at once and fire as soon as a target appears. The battalion commander gives the following additional orders:—

"The battalion will take position at once.

"The first battery will occupy the position on the right. It will observe the whole front, but will not fire upon any target near the La Veuve road until after the other two batteries have opened upon it, and will then fire to their right. It will open at once, without further orders, upon any target to the right of the Grandes Loges road.

"The second and third batteries will occupy the position on the left. They will observe everything to the left of the depression where the Grandes Loges road crosses the hills, but will not open fire without orders from me.

"I shall be near the 2d Battery, at the railway crossing.

"The whole front to be observed by the battalion is about 600 mils. The 300 mils in the center is assigned to the 2d Battery, the La Veuve road being the axis of the sector. The 1st and 3d Batteries will each observe 150 mils, on the right and left respectively. Batteries will be prepared to fire instantly at targets in any part of the front, in spite of superior artillery which will probably try to neutralize them."

The director assigns the two batteries present to represent the 1st and 2d Batteries of the battalion. Accompanied by the battalion commander, he inspects the dispositions of each battery commander.

First Battery (Figs. U″ and V″).

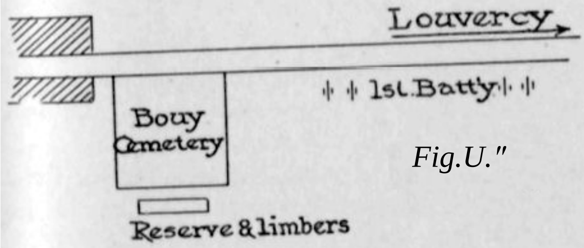

Fig.U.″


Fig.V.″

The four pieces are placed beside the road with extended intervals,—100 meters between the two platoons, and 20 between the two pieces of each platoon. The wheels are sunk into the ground, to take full advantage of the cover afforded by the road embankment. The captain says that in actual service he would further mask his pieces with trees and branches, so as entirely to conceal them; thus the enemy, while he might neutralize the battery, would be unable to destroy it. A position is selected for the limbers and reserve near the firing battery, behind the cemetery wall. A road is reconnoitered for communicating to the rear without passing through Bouy.

The battery commander selects two aiming points. No. 1, for the right of his sector, is the tallest poplar on the La Veuve road; No. 2, for the left, is a tall pointed fir tree, to the right of the Grandes Loges road.

Second Battery (Figs. W″ and X″).

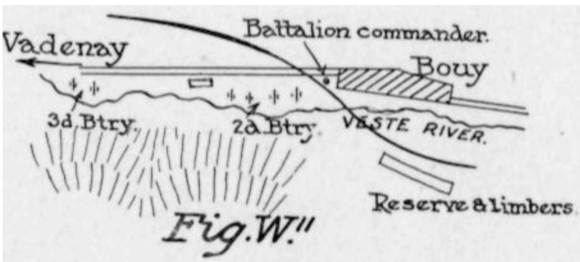

Fig.X.″

The pieces are placed part way down the slope of the bank of the Vesle, with at least mounted defilade against the hills on the sky line. The limbers and reserve are on the right, close to the railway embankment, which is here five or six meters high and gives excellent cover. To get to Bouy and the country beyond, carriages can pass under the railway, in the stream bed.

The angle of site is measured, and found to be about plus 15 for all the pieces. The orders of the battery are to be ready to fire at once upon any target appearing within its 300 mil sector; to accomplish this, two plans suggest themselves.

1. The sheaf may be formed with a distribution, difference of 10 mils, the guns remaining unanchored; and the whole sheaf may be shifted to any target that may appear. Thus, suppose a skirmish line 50 mils (125 meters) long appears on the crest to the right of the La Veuve road (Fig. Y″), its right being 80 mils to the right of the tall poplar upon which the directing gun is trained. The captain commands "subtract 80," and fires a salvo or volley with

the data obtained from previous registration; each piece then returns to its original position in observation.

2. The sheaf may be formed so as to cover the whole front, and the pieces anchored; sweeping fire from all or a part of the guns will then reach any part of the sector (Fig. Z″).

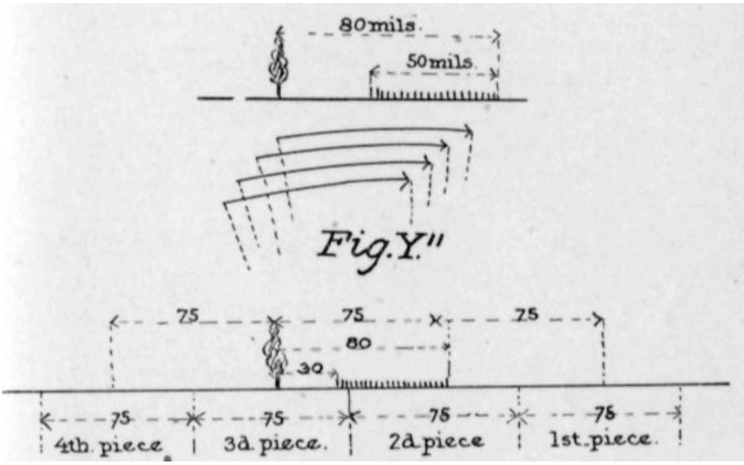

Fig.Z.″

The total front is 300 mils, so that the distribution difference must be 75. The captain gives the following deflections:

No. 1, limb 14 micrometer 150.

No. 2, limb 0 micrometer 25.

No. 3, limb 0 micrometer 100.

No. 4, limb 0 micrometer 175.*

No. 3 piece is laid on the aiming point by sending men forward to the crest to get the line, and the others lay on its sight; all then select aiming points, and read the deflection.

Suppose, now, a skirmish line 50 mils long appears, with its right 80 mils from the aiming point. The battery commander designates No. 2 piece to fire, using the data obtained from previous registration, firing two, three or four shots and sweeping to the right or left, as he sees fit. It is arranged beforehand that the

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*Corresponding to "deflection 6250, increase by 75" with the American matériel.—*Translator*.

direction of the piece is to be changed by five turns of the handwheel after each shot, so as to place the bursts 10 mils apart.

Again, suppose the skirmish line is 200 mils long, 150 mils to the right of the aiming point and 50 mils to the left. The first three pieces open fire, sweeping from right to left; if necessary, to cover the whole target, all four pieces fire.

The battery commander discards the first plan, for two reasons. In the first place, it makes it necessary to move the guns frequently by hand, and the men have to stand up unprotected by the shields; since the pieces have not flash defilade, the enemy's artillery fire would soon put enough men out of action to cripple the battery. Besides, only 40 mils front can be covered at a time, and the enemy's infantry may appear on a broad front.

The second plan permits of anchoring the guns and sheltering the men. The only disadvantage is that the whole front cannot be covered completely, for when the guns are anchored the direction is never so perfect that they can fire upon the whole front without any gaps. This is immaterial, however, for to stop a line of infantry it is not necessary that every part of its be under fire. It is only necessary to have shrapnel bursting along the whole front.

The 3d Battery would be placed farther to the left, and its dispositions would be similar to those of the 2d.

The dispositions of the batteries being settled, the director, taking position near the 2d Battery, continues his statement of the problem.

"One company is on outpost, on both sides of the La Veuve road, at the edge of the woods; the company that you see marching on the La Veuve road is to take position in the woods at the foot of hill 145, to support the outposts if they are driven in. The enemy is represented by the companies wearing white cap covers, which will soon be coming out of the woods."

Special Situation No. 1.

"The outpost company on the La Veuve road, with those on its flanks, is forced to fall back. The Red artillery officers, observing the action with their field glasses, see the infantry come back out of the woods, then form a skirmish line and continue firing upon the enemy."

Solution No. 1.

The battalion commander sends orders to the commander of the 2d Battery to register the ground near the La Veuve road, and to determine the corrector of the day. His guns being already anchored, he at once opens fire with a range that is certainly beyond the Red infantry, and with a corrector that will probably give high bursts,—say range 3,400 and corrector 24. He fires single shots, very slowly, so as to get good observation of each one; then, if necessary, fires a battery salvo. The corrector being determined,—say 19,—it is noted on the gun shields, together with the initial deflection of each piece.

The captain then selects one of his guns, say No. 2, to get the range to the edge of the woods. Using time fire, he gets the bracket 2,600-2,800. Passing then to percussion fire, his first shot at 2,700 is lost, his second at the same range is short.

Special Situation No. 2.

"A few minutes after this firing, the infantry fire increases, and our skirmish line falls back down the hill by echelons, in the sector of observation of the 2d Battery."

Solution No. 2.

To cover the retreat of the infantry, the battery commander opens continuous fire, interval 30 seconds, upon the edge of the woods, using corrector 19 and range 2,700, and sweeping so as to cover the same front as the infantry skirmish line.

Special Situation No. 3.

"Our infantry has now reached the foot of the slope, and occupies the clumps of trees there. The enemy's skirmishers begin to appear along the crest in front of the woods on the sky line."

Solution No. 3.

The battery commander registers the ground now held by the enemy's infantry, firing first with No. 4 piece, then with No. 1. A few rounds give him an idea of the ranges to be used; he fires with No. 4 at 2600, then successively 2400, 2200, 2000, 1900, and with No. 1 at 2600, 2400, 2200, and 2000.

Special Situation No. 4.

"Hostile skirmishers appear on the crest, on a front of 30 mils; their right is two finger-breadths, or about 70 mils, to the right of the aiming point."

Solution No. 4.

The battery commander opens fire with No. 2 piece, range 1,500, sweeping to the left. The first shrapnel bursts 75 mils to the right of the aiming point, the second 65 mils, and the third 55. Only these three directions can be used, unless the direction of the piece when anchored happens to be good enough to permit firing only 45 mils from the aiming point.

Special Situation No. 5.

"The enemy's infantry gradually extends its front."

Solution No. 5.

As soon as it extends beyond the front beaten by the 2d Battery, the other two batteries take up the fire.

Special Situation No. 6.

The battalion commander has taken post on the railway, near the grade crossing on the Vadenay road, a little to the right front of the 2d Battery. He hears and sees projectiles bursting to his right, evidently intended for the 1st Battery. He soon sees the flashes of hostile guns, in front of the woods on the sky line, appearing over a crest to the left of the La Veuve road.

Solution No. 6.

The opportunity to fire with the 2d Battery upon the hostile artillery is tempting, for the ground about it has been registered; but the battalion commander gives no orders, and the 2d Battery continues to observe the ground in front of the enemy's battery, and to fire upon infantry whenever opportunity offers.

Special Situation No. 7.

A few moments later, the battalion commander hears and sees projectiles bursting on his left, and observes gun flashes on the right of the road. The Red artillery is silenced; the enemy has discovered the positions of all three batteries.

The hostile infantry advances, but is checked by the fire of the Red infantry among the trees at the foot of the slope.

Solution No. 7.

Cease firing, and wait.

Special Situation No. 8.

The hostile artillery fire slackens.

Solution No. 8.

The Red artillery again opens fire upon the hostile skirmishers, who, being on a descending slope, find some little cover from the Red infantry, but are in plain sight from the guns.

Special Situation No. 9.

The hostile artillery opens fire again upon the Red batteries.

Solution No. 9.

The Red artillery ceases firing.

Special Situation No. 10.

While this artillery action is going on, the Red batteries firing at every opportunity upon the Blue infantry, and the Blue batteries trying to keep them silent, the opposing infantry lines hold each other in check. After a time, however, the hostile infantry begins to extend its right, taking advantage of the cover found in that part of the field, and then to gain ground again; our infantry is driven back from the cover of the trees. The enemy is reinforced, and his skirmish line reaches the bottom of the slope, where it finds shelter among the trees. Two hostile batteries take position on the slope, and fire upon our infantry retreating toward Bouy.

Solution No. 10.

The 2d and 3d Batteries, well concealed behind the bank of the Vesle, cannot be entirely silenced by the enemy's artillery; they are able to fire upon the hostile batteries in the open, enough to interfere with their fire upon our infantry. Each gun is given one of the hostile guns as its target; and the fire is conducted with a view to silencing and destroying them.

Special Situation No. 11.

The enemy's infantry among the trees at the foot of the slope is steadily reinforced, and finally starts to come out of the woods on the right of the La Veuve road. The 1st and 2d Red battalions,—the one which was on outpost and the one sent forward to support it,—rejoin the 3d and 4th, and the whole regiment occupies the defensive line in front of Bouy.

The infantry and machine guns are in action all along the line; but the Red artillery is silenced by the continuous fire from the Blue batteries, which constantly increases in intensity. The entrenchment on the right, toward which the Blue infantry attack is directed, is also under artillery fire.

It is now ten o'clock, and the artillery of the main body begins to make itself felt. Batteries are taking position near Bouy, and firing upon the Blue artillery and infantry.

Solution No. 11.

The battalion commander finds that his batteries are somewhat relieved, and reopens his fire.

In this way the exercise may be continued indefinitely.

EXERCISE WITH MATÉRIEL.

(*Both sides represented.*)

General Situation.

A Red division, coming from the west, has spent the night at Vouillé on the Auxance. It is pursuing a Blue force, defeated in a previous engagement, which is retiring eastward. The Red division is marching by Vouillé, Auxance, Migné, and the road on the left bank of the Auxance leading to Preuilly, with the intention of crossing the Clain at Bonnillet and continuing toward Montamisé. It is covered by detachments in front and on the flanks.

The division commander is at the head of the 1st Battalion of artillery, which is between the third and fourth battalions of the advance guard infantry regiment. The second artillery battalion is behind the leading infantry battalion of the main body, about 5 kilometers in rear.

At Migné, the division commander learns that the enemy has effected his withdrawal, by a rapid march; that a column containing artillery crossed the bridge at Bonnillet at 11 o'clock, and that at this time (1 o'clock) the whole Blue force is probably across; that the bridge at Chasseneuil has been destroyed, and that the enemy appears to intend making a stand on the right bank of the Clain, to dispute the crossing. He also receives orders from the

Red army commander, to attack vigorously at once, and try to get possession of the bridge at Bonnillet, so as to continue the pursuit; and to connect with the detachments on his flanks, on the right toward Buxerolles, and on the left between Chasseneuil and Preuilly.

Personnel.

The divisional artillery consists of two battalions, each of three batteries,—one with its guns and the others represented by mounted details. The assembly is at 1 o'clock, in front of the church at Migné.

Program.

1. Occupation of position by the first battalion, and immediate opening of fire.
2. Occupation of position by the second battalion, and direction of the fire of both battalions.

An officer is sent out to show flashes representing the fire of the hostile artillery; to avoid premature disclosure of information, his instructions are given him in a sealed envelope, not to be opened until he has reached the maneuver ground.

The party being assembled, and the general situation being understood, the director says:

"Before giving his orders, the division commander would consult his map. Let us also study it, and see what conclusions we can reach.

"The ground where the advance guard will probably have to deploy consists of three distinct zones—the valley of the Auxance, the right (southern) bank, and the left (northern) bank (Fig. D‴). The valley is wooded, and permits troops to reach Grand Pont and Preuilly unseen, and deploy opposite Bonnillet. It is an excellent line of approach for infantry, and, in fact, is the only one; from the other side of the Clain, the enemy's infantry could count the men in our skirmish lines descending the slopes on either side of the Auxance valley, at from 1000 to 1500 meters range.

"To the right of the Auxance, at Chardon Champ, there appears to be a good artillery position (hill 133). Its approaches are covered, and the range to the hills across the Clain (122), probably occupied by the enemy, is about 2,500 meters.

"On the other side of the Auxance the slope to the Clain is much more gradual, and the artillery position (132) is farther back, at a

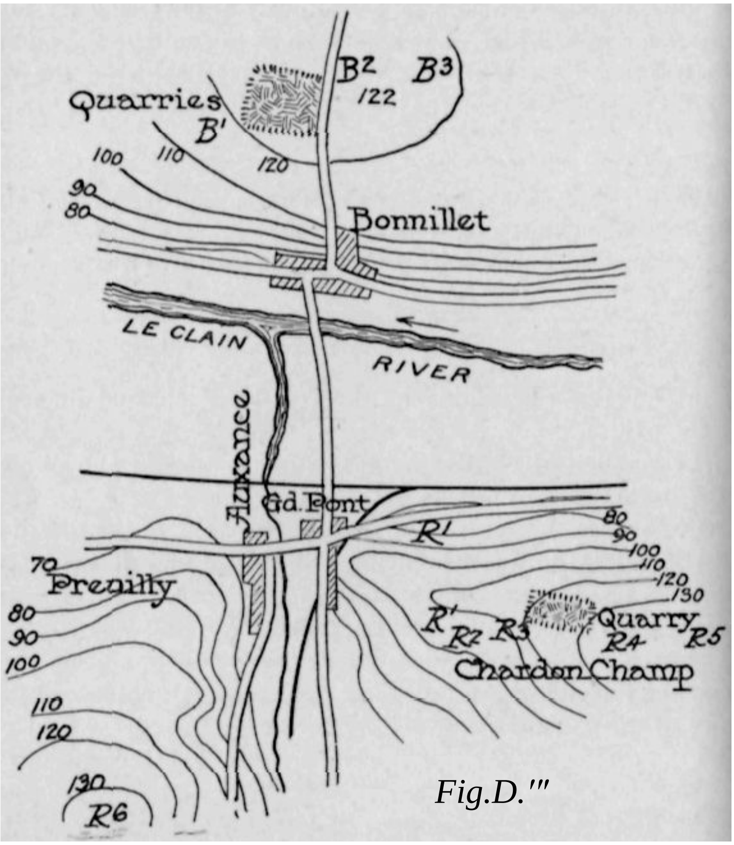

Fig.D.'''

range of over 3000 meters. Besides, the march of approach is longer, for it is necessary to follow the arc instead of the chord.

"In the present situation it is important to get the batteries in position close up, as soon as possible. I will send both battalions to Chardon Champ; the position has plenty of space for six batteries. Still, the infantry should have some artillery close at hand, so it might be well to send one battery with the advance guard.

Orders to the Commander of the Advance Guard.

"The advance guard will continue the march, by the road on the left bank of the Auxance, and will seize the bridge at Bonnillet so as to enable the rest of the division to cross the Clain without delay.

"One battery from the second battalion will report to you when the battalion reaches here, which will be in about three-quarters of an hour.

Orders to the Artillery Commander.

"Come with me on reconnaissance to Chardon Champ. Let the 1st Battalion follow at once; and send orders to the 2d Battalion to join you there, sending one battery to Preuilly by the left bank of the Auxance, to report to the advance guard commander."

The first problem for the artillery being now fully stated, the director calls upon the artillery commander and his battalion commanders to give their orders. The following orders are those approved by the director.

Orders of the Artillery Commander.

1. To the commander of the 1st Battalion, verbally:

"Come with me, and let your batteries follow."

2. To the commander of the 2d Battalion (in writing; considered as received half an hour after sent):

"I am starting for Chardon Champ. Join me there, with two of your batteries. Send the third from Migné to report to the advance guard commander, following the road to Preuilly on the left bank of the Auxance."

Orders of the Commander of the 1*st Battalion*.

To the senior captain, verbally:

"I am going on reconnaissance with the artillery commander. Take command of the batteries, and follow me at a walk; I will mark the road."

Orders of the Commander of the 2*d Battalion*.

To the senior captain, verbally:

"I am called to Chardon Champ to reconnoiter, by the artillery commander. Take command of the batteries, and follow at 8 km. per hour; I will mark the route. At Migné you will cross to the right bank of the Auxance. Detach the 3d Battery at that point, and send it by the left bank to Preuilly, to report to the advance guard commander."

The director calls the attention of all the officers to this series of orders, pointing out that it appears, more or less varied, in almost every situation, and that officers of all grades should habituate themselves to receiving orders of this kind, and basing their own upon them. Then, in order to form the column properly he orders the different elements to start from the church as follows

1.—The director, the artillery commander and the commander of the first battalion, with their reconnaissance parties:

2.—Ten minutes later, the batteries of the first battalion:

3.—Thirty minutes later, the commander of the second battalion with his reconnaissance party:

4.—Forty-five minutes later, the batteries of the second battalion

The director moves at a trot to Chardon Champ. On the way he points out on the ground the features noted on the map: (1) that the valley of the Auxance is thickly wooded; (2) that a long detour is necessary to get batteries to hill 132 on the left bank of the Auxance; (3) that there is a fine artillery position at Chardon Champ.

Just before coming in sight of the enemy's position, he halts most of the party, and reconnoiters the position accompanied by only a few officers, among whom are the artillery commander and the commander of the first battalion.

The ground where the infantry action is commencing is in the valley of the Clain. Four sharp lines run the whole length of this zone (Fig. D‴):—a main road, a railway, the Clain, and a small road. Another small road crosses the valley to the Bonnillet bridge, perpendicularly to these. On the right of this there is no cover for infantry advancing toward the Clain, after passing the ditches along the main road and the embankment of the railway On the left, along the Auxance, the ground is more or less cut up and covered with trees, and forms an excellent approach to the Clain and Bonnillet bridge.

The division commander, at Chardon Champ, has before him the panorama shown in Fig. E.‴ In the immediate foreground is the valley of the Clain; beyond are slopes covered with crops with the stream itself at their foot. The bridge is clearly visible beyond it, the road passes through the village of Bonnillet, and can be seen ascending the slope. The village is built along the two roads which intersect here; the buildings begin at the Clain, and run half way up the hill. In the distance can be seen the belfry at Montamisé.

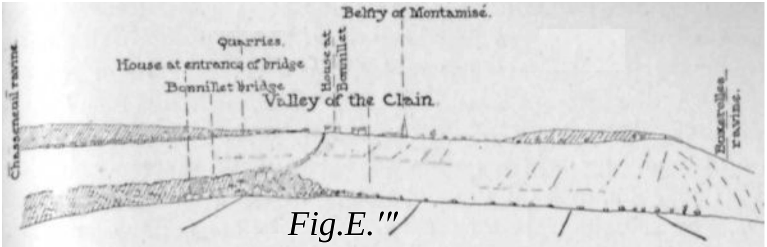

Fig.E.'"

To the right of the Bonnillet—Montamisé road is a long cultivated ridge. Farther to the right the ground falls off sharply to the ravine of Buxerolles. To the left of the road the ground is ragged and broken, over a front of about 100 mils; the quarries at Chardon Champ suggest to the observer that there may be quarries there also. To the left of the quarries the ground falls off gradually to the ravine of Chasseneuil.

The reconnaissance being completed, the director gives out the following as the orders of the division commander to his artillery commander:

"The advance guard is to seize the bridge at Bonnillet. The infantry will approach it under cover, by way of Preuilly. Support this advance, and later assist the infantry to cross the bridge, firing upon the hostile troops holding the other side."

The artillery commander calls up the commander of the first battalion, goes over the position with him, explains the situation, shows him the ground allotted to his battalion, and then gives the following orders:

"The artillery is to support the infantry in a dash for the bridge. One battery will be placed on the crest, behind this hedge, prepared to fire upon the immediate defenders of the bridge, on a front of 100 mils on each side. The other two will be placed as counter batteries, with at least flash defilade."

It is found that there will be no difficulty in getting flash defilade for the counter batteries. The range to the Bonnillet ridge is about 2500 meters, and its height is about the same as the position of the battery. The quadrant elevation, then, is 70 mils, or, in other words, the slope of departure is 7 on 100. The slope of the ground is about 1 on 25, or 4 on 100. Hence, wherever on the slope the guns are placed, the trajectory will clear the crest.

But, considering the angle of site of the bridge and the slope of the ground at the position, it is found that fire can not be brought to bear upon the bridge unless the battery is placed on the crest itself; it can not have even sight defilade against the Bonnillet ridge. The range is only 1600 meters, and the difference in altitude 30 meters; the slope of departure is therefore 40/1000 minus 30/1600, or 2 on 100. The slope of the ground being, as before, 4 on 100, the trajectory will not clear the crest if any defilade at all is taken. Hence it is decided to post the battery behind a hedge (Fig. D‴ and F‴), where the matériel will be out of sight and exposed only to neutralization, not to demolition.

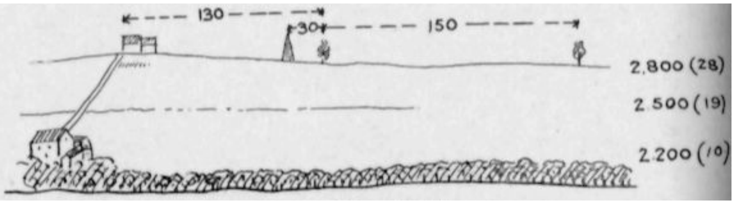

Fig.F.‴

These dispositions being arranged, the artillery commander goes to the other side of the quarries to find a position for the other battalion.

The commander of the first battalion gives the following orders to his adjutant:

"Send up the battery commanders to reconnoiter positions, As soon as they have started, take command of the batteries yourself and bring them up well in rear of this ridge,—the leading battery on the left, 400 or 500 meters in rear of the hedge, the rear battery on the right, behind the quarries, and the other between them Take an agent with you to guide the battery commanders.

"Put the battery which has its guns at the head of the column and halt on this road so as not to injure the crops."

While waiting for the captains, the major carefully studies the enemy's position, and decides upon the details of his own dispositions. When the captains arrive he explains the situation, and gives the following orders:

First Battery.

"Your position is behind this hedge; you will fire for neutralization on a front as broad as possible,—100 to 150 meters on each side of the bridge. Prepare your fire in advance, but do not take position until necessary. The other two batteries will be in observation as counter batteries."

Second and Third Batteries.

"Take position here, with flash defilade against the opposite crest, wide interval between batteries. The 3d Battery will have its right on the road by the quarries; the 2d will be in the green field about half way between the other two batteries.

"The registration point will be the lone house on the hill, to the right of the Montamisé road. Angle of site zero, range to the crest 2500, distribution difference 15.

"I shall be with the 2d Battery. The 3d Battery will open fire first, without further orders."

By the time these orders are completed, the batteries have arrived in rear of the positions assigned them. The captains make their dispositions and give their orders; when they seem to have finished the director assembles the party and has the battalion commander get full reports from them.

In the 2d and 3d Batteries, the preparation of fire has been simple; the captains have formed the sheaf and directed it upon the designated point. The slope of the ground at the position being considerable, 1 on 25, both have found good observing stations within 50 meters of the guns.

The captain of the 1st Battery has taken as an aiming point the gable of a house to the right of the bridge; he gives an angle of site of minus 20, and the following deflections:

No. 1, limb zero micrometer 25; No. 2, limb zero micrometer 75; No. 3, limb zero micrometer 125; No. 4, limb zero micrometer 175.[1]

The range being about 1500 meters, a change in deflection of 15 mils moves the point of burst 25 meters. He therefore gives orders for each piece to sweep through the whole extent of its traverse on the axle, making seven turns of the handwheel between

[1] Corresponding to "Deflection 6325, increase by 50," with the American instruments.—*Translator*.

shots; in this way he expects to cover completely a front of some 100 meters on each side of the bridge.

All the dispositions being now fully understood, the director proceeds to test them by assuming successive tactical situations.

Special Situation No. 1.

"Rifle fire is heard to the left, in the valley of the Auxance and toward Bonnillet. The advance guard begins to pass through Preuilly and engage the hostile infantry entrenched on the right bank of the Clain. Artillery fire is also heard, and shrapnel burst in front of Preuilly. Gun flashes appear in the folds of the ground at the extreme left of the quarries."[2]

Solution No. 1.

The captain of battery R‴ fires upon battery B′; his commands and the remarks of the director are as follows:

Captain.	*Director.*
Add 100; anchor; by battery from the right; corrector 18; range 2400.	Direction and height of burst good; short.
Range 2800.	Over. B′ continues fire.
Range 2600.	Short.
Progressive fire; corrector 18; range 2500.	The guns of B′ are invisible; observations refer to a high slope to the left of the quarries, on both sides of which flashes have been seen.
Corrector 18; range 2700.	Over.
Range 2650.	Over. B′ fires again upon the infantry.
Volley fire two rounds; corrector 20; range 2600.	The fire of B′ is not affected. Think over your problem; I will come back to it in a moment.

Special Situation No. 2.

"The first battalion of the advance guard, though suffering some loss, has gained ground. Its skirmish line has been extended to the left of Preuilly, and toward Grand Pont. Firing is heard at the foot of the hills, directly in front of us. Some of the skirmishers are working down toward the bridge, availing themselves of the cover on the left of the Grand Pont—Bonnillet road.

"Captain R′, you decide that it is time for you to come into action; give your orders accordingly. We will come with you, and

[2] These flashes are shown by a party at the targets, the signal being given by firing a bomb or a blank charge at Chardon Champ.

observe your occupation of position. Put two guns actually into position; you will find that you can do this without injuring crops."

Solution No. 2.

The captain has arranged all the details of his occupation of position, and has completed his preparation of fire. His gunners are at the position, behind the hedge. At his signal, two pieces take position, and the chiefs of the other two sections join their gunners.

Captain.	*Director*.
By battery from the right; corrector 18; range 1500.	Bursts 50 mils apart; distribution good, two shots to the right of the bridge and two to the left; height of burst good; salvo short with respect to the houses, walls, and hedges on the right bank.
Range 1700.	Over.
Range 1600.	Bracketting.
Percussion shrapnel; individual fire by piece; adjust to 50 meters.	Brackets:—Nos. 1 and 2, 1600—1650; Nos. 3 and 4, 1650—1700. The skirmish line is nearing the bridge, and you decide to commence fire for neutralization.
Continuous fire, sweeping, two rounds per gun per minute. The men have orders to sweep the whole extent of the traverse, seven turns of the wheel between shots.	

Special Situation No. 3.

"Shrapnel fire is opened upon R′, compelling it to suspend its fire. Fall out two men at No. 1 gun and one at No. 2, as wounded.

"After some little time, the battalion commander locates the flashes of the guns doing this firing; they are barely visible over the crest, a little to the right of the house used as a registration point."

Solution No. 3.

The battalion commander orders R″ to reply to B″, which is firing upon R′.

Captain.	*Director*.
Subtract 20; anchor; by battery from the right; corrector 18; range 2500.	Direction and height of burst good; short.
Range 2900.	Over.
Percussion shrapnel; range 2700.	Over. B″ continues fire upon R′.
Range 2500.	Short.

Progressive fire; corrector 20; range 2600.	
Nos. 2, 3 and 4 cease firing.	
No. 1, percussion shrapnel, range 2600.	Over, behind the crest; the size of the ball of smoke shows that it is short of the target.
Range 2700.	Smoke ball smaller.
Range 2800.	Still smaller.
Range 2900.	Still smaller.
Range 3000.	Still smaller.
Range 3100.	Smoke barely visible.
Two rounds, range 3100.	Same observation.
Range 3200.	Smoke ball larger.
Range 3300.	Same observation.
Two rounds, range 2700.	Short of target.
Two rounds, range 3000.	Smoke equally visible.
Two rounds, range 3200.	Same observation.

The conclusion is that the chances of hitting the target are good, with ranges 2800, 2900, 3000 and 3100.

Special Situation No. 4.

"B′ fires again upon our infantry coming out of Preuilly. The skirmishers are getting near the bridge. A machine gun is heard, which seems to be posted to sweep the approaches to the bridge. R′ opens fire for neutralization."

Solution No. 4.

The battalion commander directs R‴ to fire upon B′, and R″ upon B″.

The captain of R‴ realizes that he will have great difficulty in silencing B′. By slow percussion fire with one piece, he has determined the form of the ground at the target, and concluded that even when B′ is firing he can not expect to reach its men except by shell fire, grazing the crest and scattering fragments of rock. He therefore commands: "Continuous fire; shell; two rounds per gun per minute." The target has previously been divided among the guns, and each has obtained its range to within 25 meters.

The captain of R″ commands: "Fire for neutralization; four shots per gun per minute." The men are instructed to use ranges 2800, 2900, 3000 and 3100 in turn; No. 1 piece starts with 2800, No. 2 with 2900, and so on.

Special Situation No. 5.

"In spite of R″, B″ continues its fire, and R′ has to cease firing. It becomes evidence that the first battalion can do little to support the infantry attack. It has set fire to a few houses in Bonnillet, but can not keep down the fire of the defenders of the bridge.

"The commander of the second battalion, preceding his batteries by a few minutes, reports to the artillery commander, who is with the commander of the first battalion near the house at Chardon Champ. We will go there to continue the exercise."

The director has the captain of R′ limber up, move his battery by the road on the right bank of the Auxance, and halt it with the head of column opposite the first house in Grand Pont. When all the officers are assembled at Chardon Champ, he asks the artillery commander to give his orders to both battalions.

Solution No. 5.

"The first duty of the artillery is to keep down the fire of the defenders of the bridge.

"The second battalion will take position to the right of this house, and open fire at once upon the defenders, one battery firing to the right of the bridge and the other to the left. The ground will not permit taking flash defilade; but at least the guns must be concealed. This is possible, for, although the bridge is 40 meters lower than the gun position, the slope is very gentle, not over 1 on 100.

"R‴, whose fire upon B′ is ineffective, will prepare to act as a counter battery to cover the movement of the second battalion. R′ will give the second battalion its firing data for the bridge."

The director adds: "Battery R″″, which has brought its guns, may put them in position. We are now at the place which gives its name to Chardon Champ (Thistle Field), and there is no danger of injuring crops."

The commander of the first battalion gives the captain of R‴ the following orders:—"Cease firing upon B′ and prepare to act as counter battery for the second battalion. Get from R″ the firing data for B″."

The commander of the second battalion halts his batteries in rear of their positions, which are well separated, calls up the captains to reconnoiter, and gives them their orders for occupying the position.

The gunners are posted on the line of dismounted defilade against the Bonnillet crest. The batteries come into position together, at a trot. Each captain selects an aiming point on the sky line, in the direction of the bridge, and forms his sheaf with a distribution difference of 25; the right flank battery directs its guns to the right of the bridge, the other to the left.

The initial data are: angle of site minus 20, corrector 18, range 2500. The range is intentionally made long, so as to run no risk of hitting friendly infantry. The battalion commander directs the two captains to get a 100-meter bracket for the whole battery, and narrow it to 25 meters for each piece; then, with shell, to set fire to the houses and destroy the enemy's cover; and, finally, to fire for neutralization with time fuzes, each piece firing alternately in two directions, differing by six turns of the traversing wheel, so as to cover a front of 25 mils per gun, regulating the rapidity of the fire according to circumstances.

The director assembles the whole party near the battery which has its guns, and gives its captain the following firing problems.

R′′′′ opens fire upon the skirmishers lying under cover to the right of the bridge. The director causes B′′′ to show flashes, and announces that R′′′′ is under such severe fire that the men have to take cover. R′′′ coming into action the director permits R′′′′ to resume its fire from time to time, in the pauses of the fire from B′′′, and continue, little by little, the program assigned it by the battalion commander.

After a time the director assumes that the fire of the defenders of the bridge is kept down by batteries R′, R′′′ and R′′′′, and that the Red infantry begins to cross the bridge. R′′′′ increases its range; the Red infantry continues to cross, and the captain soon sees parties of hostile infantry running back up the hill. He prepares to fire upon the infantry to the right of the bridge, assuming that R′′′ will take care of all on the left, and that R′ will assist either of the other batteries that seems to need it. He commands:—

"Cast loose. Deflection difference 10 in each platoon; aiming points,—1st platoon, the round-topped tree to the right of the church tower, 2d platoon, the round-topped tree one hand breadth to the right of the other (Fig. F′′). Without anchoring."

He already has the firing data for the bottom of the slope—angle of site minus 20, corrector 18, range 2100. Measuring with his field glass the angular height of the slope, he finds it to be 20 mils, and so takes as his constant angle of site minus 10, the true angle for a long hedge about the middle of the slope. Thus, by changing his corrector, he can fire upon any part of the area.

With one gun, he fires a series of shots decreasing in range by

200 meters, thus constructing a scale on the ground which gives him the approximate range to various landmarks,—the crest, a hedge just below the houses to the left of the church tower, the long hedge, etc. Certain important ranges he gets more closely by additional shots. All this information is noted on a rough sketch (Fig. F′″). A salvo gives the direction of all four guns, and the other correctors and the angular distances between the various landmarks are determined with the field glass. The battery is then in a position to reach any target appearing on the slope, for the ground offers no cover.

After simulating fire, the director dismisses the battery and takes up the critique of the exercise.

Critique.

"To-day's exercise has very well illustrated certain points relating to the positions of infantry batteries. You have observed that, although we had six batteries, we could bring the fire of only three to bear upon the defenders of the bridge; and even these three had not full liberty of action, being under effective fire from hostile artillery. The fire of the two counter batteries was not sufficient, and the three infantry batteries could not be sure of supporting the infantry when needed.

"As for the 6th Battery, R″″′, so long as B′ remains in position, it can accomplish nothing unless it gets into position behind the crest 132 northwest of Preuilly; and to reach this position it will have to make a very long detour.

"I believe that it is possible to get better results with one battalion than we did get with two, by making better use of the ground. Let us consider again what it is that the artillery is expected to accomplish. It is ordered to support the infantry in a dash for the bridge; and to this end it must keep down the fire of the defenders during the advance of the infantry. Where should the batteries be placed?

"Certainly not in the position of R′, where the slope was so sharp that the guns had to be placed on the crest to fire upon the bridge. This place is better, for the slope is more gentle, and we can get a little more than sight defilade against the opposite crest without getting the bridge into a dead angle. But the guns can not be drawn back any more than this, for the fire must be in perfect accord with the movements of the infantry, and both fire for adjustment and for effect should be by piece; and in any case we could not find flash defilade on this ground. So in either position the batteries may be silenced, wholly or partially, and can not answer to calls upon them.

"In all cases like this, we must choose between two plans. We may put our counter batteries into position in observation, with the maximum possible defilade, and engage any hostile artillery discovered behind the opposite ridge; then, when the time has come to fire upon the enemy's infantry, bring up the batteries designated for this purpose to the crest. Or, we may seek positions in the low ground, which can not be reached by fire from hostile batteries concealed behind the crest.

"It is evident that the second plan is the better; for it forces the hostile batteries to come close to the crest to fire upon the batteries in the low ground, and thus expose themselves to our counter batteries. The first plan requires our own batteries to come up to the crest first; here they are unable to fire without the protection of the counter batteries, and if the enemy is entirely concealed this protection will fail.

"In the case under consideration, the question is whether or not a position can be found at the foot of the Chardon Champ heights to fire upon Bonnillet. As a matter of fact there is such a position, and any observant officer sent out to reconnoiter should quickly find it."

The director takes the party to the point where R′ went into position, and continues:—

"Suppose you were ordered to look for a position in the low ground, to fire upon the vicinity of the bridge. A glance into the valley shows you at once that the position, if it exists, must be directly in front of you, on account of the woods to the left of the Grand Pont—Bonnillet road. Naturally, then, you go down into the valley of the Auxance, and take the road to Grand Pont. Passing through the village, you reach the main road to Poitiers."

The party then moves to Grand Pont, and the director goes on:—

"The road we have followed has on its right the steep slopes of the valley, and on its left the woods; it thus makes an excellent approach to Grand Pont, and the battery can go on to the Poitiers road under cover of the houses and walls of the village. Coming out of the village, you see to the left front the trees in the valley, and to the right the Poitiers road; without hesitation, you turn to the right and follow the road.

"Moving as we are now doing, you notice that you continue to get cover from the buildings and walls; crossing the bridge over the railway, you come at once to this battery position. You see that the view of the Bonnillet bridge and its vicinity is excellent; that you can easily follow the course of the attack, being a little to the flank of the line of advance; that the embankment and the hedges will conceal the guns and men; and finally that the limbers can be placed close to the guns, out of sight and perfectly protected from artillery and infantry fire.

"The solution of the problem, then, is to place one infantry battery here, and two counter batteries entirely concealed behind the crest at Chardon Champ."

The director has R′ occupy the position, and simulate fire. He then dismisses the enlisted men of the party, and, with the officers, goes on across the bridge and up to the top of the hill. As they cross the bridge, he says:—

"My assumption as regards the enemy was, that we were opposed by the rear guard of a force that had been defeated and was falling back. This force is seeking, by a rapid march, to get across the Clain, destroy the bridges, and leave a rear guard on the right bank to delay the pursuit as long as possible.

"The rear guard is made up of several distinct detachments, each guarding certain crossings. The one at Bonnillet, guarding the line between the ravines of Buxerolles and Chasseneuil, consists of a four-battalion regiment of infantry with a machine-gun platoon, a battalion of three batteries, a platoon of cavalry and a platoon of engineers. While the main body is crossing the bridge and going on toward Montamisé, the commander of the rear guard makes his preparations for defense. The machine guns are posted to sweep the immediate approaches of the bridge."

Going on to the military crest, near the hedge, he continues:—

"The rear guard commander gives the following orders:—

"'We are required to delay the enemy as long as possible at the Clain, and to destroy the bridge before retiring. My information indicates that we may be attacked at any moment.

"(To the engineer officer): 'Make your preparations to blow up the bridge.'

"(To the colonel of the infantry regiment): 'Defend the line of the Clain between the two ravines with three of your battalions. Keep sufficient reserve in rear of the crest to support the troops posted in the low ground, for they will doubtless be driven back up the hill in more or less disorder. You may have half the cavalry platoon to connect up the different elements of the regiment. With your other battalion I intend to prepare a rallying position at Prunier and Germonière.'

"(To the artillery commander): 'Dispose your batteries so as to enable the infantry to delay the enemy as long as possible. You will be able to put guns in the broken ground around the quarries, well concealed, to fire upon the hostile infantry when it shows itself; and batteries in observation behind the crest farther back will be able to cover the whole front. Reconnoiter also artillery positions to be used later in the defense of Prunier and Germonière, and make your arrangements for getting the batteries into these positions without delay when the time comes.'

"The question now is: What is the artillery commander to do in carrying out these orders?

"He has three distinct problems: he must find positions (1) to fire upon infantry, (2) to observe the whole front, (3) to cover the retreat."

Solution of the First Problem.

"The advance of the infantry will be by the best covered route, which is the valley of the Auxance (Figs. C‴ and G‴). Knowing the direction of this valley, it becomes evident that in order to enfilade it the guns must be on the right of the road. To fire upon infantry, they must be on the military crest. This was the reasoning that led the artillery commander to select the position of B′."

The director leads the way to the crest, near the house selected by the commander of the first battalion as his registration point; here he gives the solution of the second and third problems.

Solution of the Second Problem.

"It seems very probable that the enemy's artillery will appear at Chardon Champ; but still we must be prepared to fire to the right as well as to the left of the Auxance valley. There is no suitable position on the right of the road, for the quarries shut off the view: the only thing possible is to get the maximum defilade on the left. Here we have no trouble in finding mounted defilade, and in some places almost flash defilade. The artillery commander selects the most favorable positions for firing both to the right and

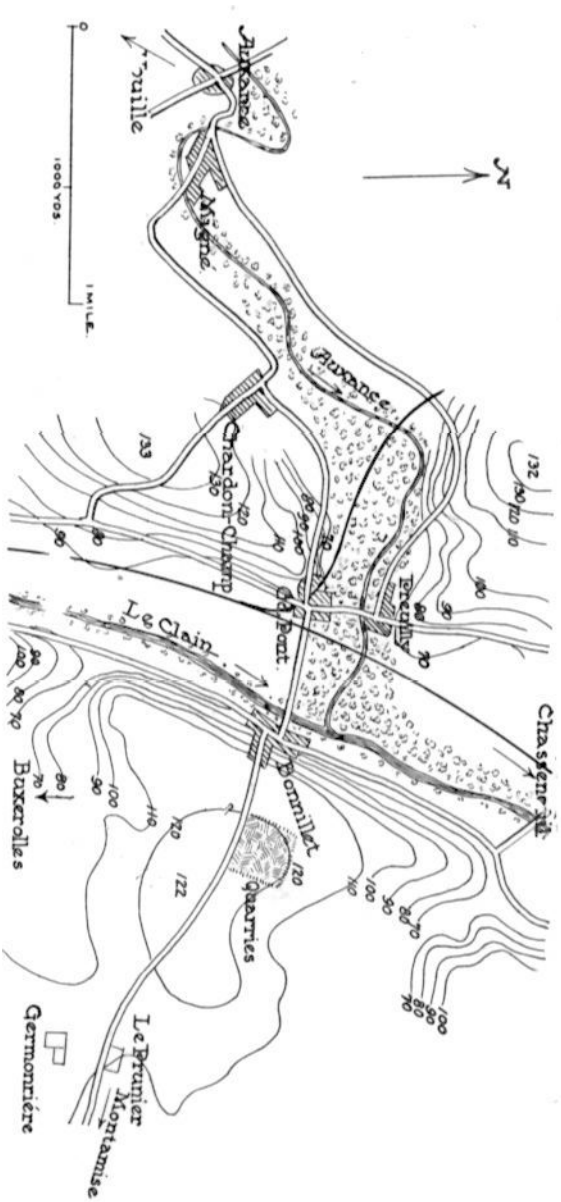
Auxance
Migné
Auxance
Chardon-Champ
Le Pont
Preuilly
Le Clain
Chasseneuil
Bonnillet
Quarries
Buxerolles
Germonnière
Le Prunier
Montamise
1000 YDS.
1 MILE.

Fig.C.'''

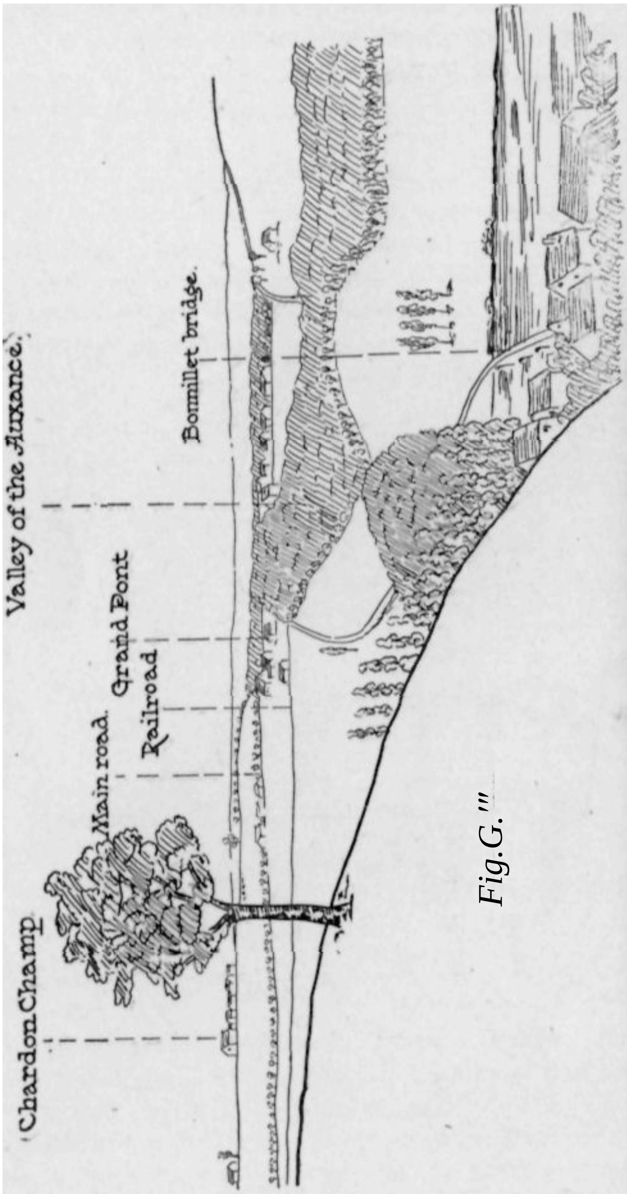
Valley of the Auxance.
Bonnillet bridge.
Grand Pont
Railroad
Main road.
Chardon Champ

Fig.G.'''

left of the valley, but keeps the batteries in readiness, limbered. Preparation of fire is made in so far as possible."

Solution of the Third Problem.

"You can see Prunier and Germonière from here. The battery sent there will have to fire upon this crest. It would look as if there were a favorable position to the right and rear of Germoniére. This should be pointed out to the reconnaissance officer; going down to examine it, he would find that it was entirely satisfactory, and he could lead the batteries to it when the time came."

This terminates the exercise. To show the reader precisely what preparation was made for it, the instructions given the officer detailed to represent the enemy's artillery follow.

Instructions for Simulating Hostile Fire.

The enemy's artillery consists of three batteries. B′ is placed at the extreme right of the quarries, B″ and B‴ to the left of the Montamisé road, with mounted defilade against the crest at Chardon Champ (Fig. H‴). *Right* and *left* here refer to an observer at Bonnillet, looking toward Chardon Champ.

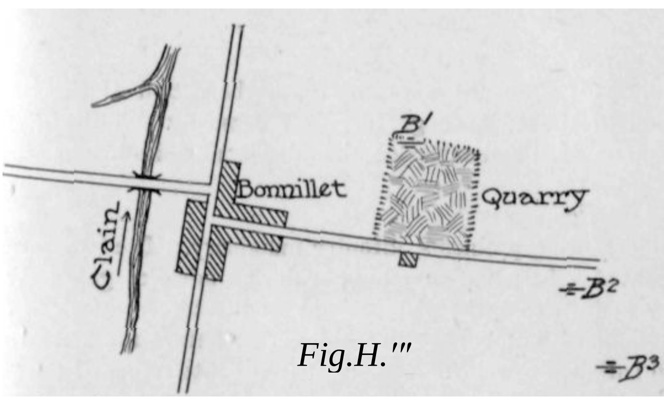

Fig.H.‴

The fire of these batteries will be simulated as follows:—

At the first signal, a bomb fired on the crest to the right of the house at Chardon Champ, not earlier than 2 o'clock, fire from B′ will be simulated by six flashes shown at 10 seconds interval on the high banks in front of the quarries, where they can be seen from Chardon Champ. At the second signal, the fifth or sixth of a series of blank charges fired from behind a hedge, about 2.15, show six flashes in front of B′ and B″, at 10 seconds interval. At the third signal, the fifth or sixth of a series of blanks fired behind a crest to the left of the house at Chardon Champ, about 2.45, simulate the fire of all three Blue batteries at once, by six flashes at 10 seconds interval.

EXERCISES IN FIELD FIRING.

General Situation.

A Red advance guard is marching from Baconnes toward Suippes (Fig. I‴), with orders to attack and drive back the enemy (Blue). It encounters the enemy near the Ouvrages Blancs, and at once opens the engagement. Other columns are assumed to be marching parallel to the advance guard, on its right and left.

On this general situation a series of problems was prepared; four days were devoted to the solution of these, and the ones that appeared most interesting as studies of infantry and artillery maneuver and fire were selected by the director and their solutions discussed. A battalion of infantry, a machine gun platoon, and two batteries took part in the exercises.

First Session.

Solution of problems connected with the action of the leading battalion of the advance guard. One company and the machine gun platoon fired ball cartridge, the other companies blanks.

Second Session.

Artillery firing problems, infantry imaginary. The two batteries represented a battalion marching with the advance guard. Each battery in turn took the place of one of the three batteries of the advance guard battalion, during the period before the arrival of a second battalion to reinforce it; in the most interesting of the problems, service ammunition was used.

Third Session.

The battalion was assumed to be the fourth battalion of the advance guard regiment; with the other three (imaginary) battalions, it made an attack upon the Ouvrages Blancs. The two batteries represented two of the six batteries assumed to be engaged. Both infantry and artillery fired blanks.

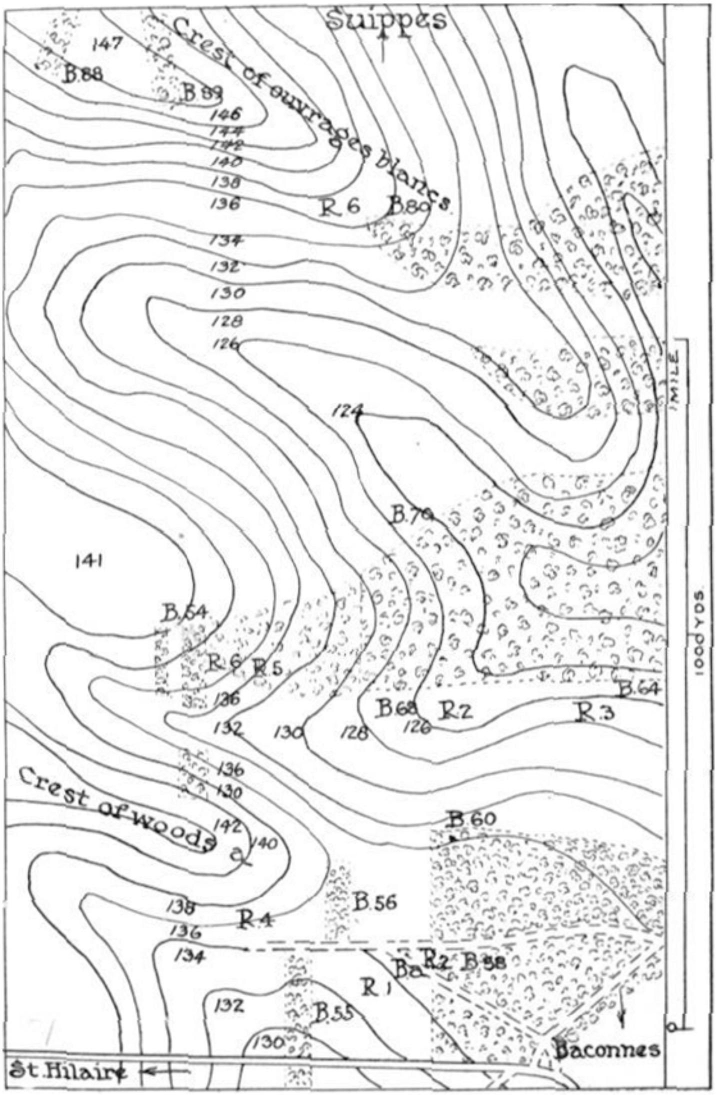
Suippes
Crest of ouvrages blancs
147
B.88
B.89
146
144
142
140
138
136
R.6
B.80
134
132
130
128
126
124
1 MILE
B.70
141
B.54
R.6
R.5
136
132
130
128
B.68
126
R.2
R.3
B.64
1000 YDS.
136
130
Crest of woods
142
140
B.60
138
R.4
B.56
136
134
R.2
B.58
R.1
132
B.55
130
Baconnes
St. Hilaire

Fig. I'''

Fourth Session.

The infantry was imaginary. Each of the two batteries in turn took the place of one of the six batteries engaged, from the time when the fourth battalion came into action until it occupied the Ouvrages Blancs. Part of the firing was with service ammunition.

Reports of the artillery work in the second and fourth sessions follow.

SECOND SESSION.

The director assembles the officers near the woods *a*, fig. I‴, reminds them of the general situation and of the object of the day's exercises, and then announces

Special Situation No. 1.

"The moment selected is that when the advance guard commander orders the first artillery battalion into action.

"The advance cavalry has found that the enemy occupies the position where we now are. The leading battalion of the advance guard has attacked, has easily driven back the infantry patrols opposed to it, and has advanced as far as the edge of the woods (B 54 and B 70, Fig. I‴), where it is halted.

"When the exercise begins, the firing line is entrenching, to hold the ground gained, and to get protection from the fire of the hostile infantry, which is under good cover in the edge of the woods on the horizon (B 80, 88, 89, Fig. I‴ and J‴), and in trenches on the front slope of the Ouvrages Blancs crest.

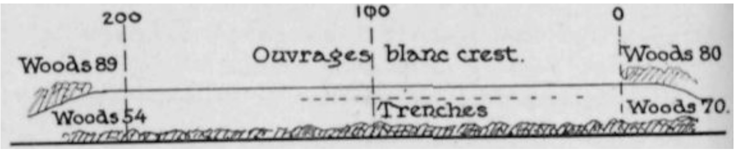

Fig.J.‴

"The second battalion is to our left; profiting by the cover afforded by the woods (B 56, 54) it is gaining ground. The third battalion is on our right, its head at the St. Hilaire road; the fourth is farther in rear. The head of the main body is just visible on the horizon, in the direction of Baconnes.

"The advance guard commander directs the first artillery battalion to fire upon the trenches, which are the most advanced part of the enemy's lines, to draw off fire from the first infantry battalion and enable the men to entrench to better advantage. He leaves the choice of position to the battalion commander."

Battalion Commander's Reconnaissance.

The battalion commander estimates the front of the trenches at not to exceed 100 mils. This front he can cover with one battery. Two positions attract his attention; the first is in the edge of the woods (B 60), and the other behind the crest, between the two patches of woods (B 58, 55).

The first position, B 60, has all the disadvantages inherent in positions in the edge of woods. It is easy to range on, so that the enemy can neutralize the battery with comparatively little fire. The second position, behind the crest, seems better, especially if the battery can get flash defilade; the battalion commander goes to verify this point.

The slope of the ground, estimated by the usual method based on the difference in height of mounted and dismounted men, is in round numbers 5 on 100 $\left(\frac{2.5 - 1.7}{18} = \frac{4.5}{100}\right)$. The range to the crest on the horizon is not known; but the battalion commander is not sure that it is over 2000 meters, and the angle of departure for this range is 50 mils. Besides, the trenches are considerably below and in front of the crest. Hence the battalion commander decides that if he takes flash defilade to fire upon the trenches his projectiles are likely to strike the covering crest. The best he can do will be to take sight or dismounted defilade.

These considerations lead him to place the battery designated to fire upon the trenches, in the interval between the woods 58 and *a*, with dismounted defilade against the Ouvrages Blancs crest; and a counter battery between *a* and 55, with flash defilade. To this end, he gives the following orders:

To the commander of Battery R′.—"Take position between these two patches of woods (*a* and 55), with flash defilade against the crest opposite you; remain in observation, to neutralize any artillery that may open fire upon the second battery (R″). This battery will be on your right, on the other side of these woods (*a*), firing upon the enemy's infantry. As soon as you are in position, get the range to the opposite crest, and the corrector of the day. Take the left point of the woods to the right (B 80) as your registration point."

To the commander of battery R".—"Prepare to come into action rapidly between these two woods (B 58 and *a*), with dismounted defilade against the opposite crest. The first battery will commence firing; I will give you the range and corrector obtained. You will then take position and open fire at once upon the trenches that you see below the crest, to keep down the fire from them and enable our firing line to entrench to better advantage.

"The front of the trenches is about 100 mils; their right is about 20 mils to the left of the registration point."

Action of the First Battery.

The captain puts his battery in position with flash defilade, and prepares his fire. The front to be observed is about 300 mils; the crest appears to be oblique to the line of fire. He lays his directing gun upon the right of the sector, and forms the sheaf with a distribution difference of 100, by laying the other guns upon it. Each piece thus covers a fourth of the sector, and the captain uses them successively to find the range to the crest in four different directions. The ranging fire is as follows:

No. 1.—	Range	2000.—	Graze, short.
1.—	"	2400.—	Graze, over.
1.—	"	2200.—	Graze, short.
2.—	"	2300.—	Graze, short.
2.—	"	2500.—	Graze, over.
3.—	"	2400.—	Graze, short.
3.—	"	2500.—	Graze, on the crest.
4.—	"	2500.—	Graze, short.
4.—	"	2700.—	Graze, over.

He next determines the corrector of the day, as follows:

No. 1.—	Corrector	20,	range	2300.—	Height of burst	6 mils.
2.—	"	20,	"	2400.—	"	5 "
3.—	"	20,	"	2500.—	"	6 "
4.—	"	20,	"	2600.—	"	4 "

This firing shows that the range to the crest varies from 2300 meters at the right to 2600 meters at the left, and that the corrector of the day is 18. The battery commander sends this information to the battalion commander; he then casts loose his guns and forms a new sheaf on the right gun, with a distribution difference of 20. The battery is then ready to fire upon any target that may appear within its sector.

Action of the Second Battery.

The captain brings his battery close up to the position by a road through the woods 58, and posts his gunners. He gives them as an aiming point the extreme left of the woods on the horizon to the right of the crest, which has been selected by the battalion commander as his registration point. The right of the trench is 30 mils from the aiming point; and the front to be covered is 100 mils, requiring a distribution difference of 25. The sights are set as follows:

No. 1, limb zero micrometer 130; No. 2, limb zero micrometer 155; No. 3, limb zero micrometer 180; No. 4, limb 2 micrometer 5.*

As soon as the captain receives from the battalion commander the message,—"range to the crest 2300, corrector 18," he gives the signal to take position. The battery comes up quickly and unlimbers, and the limbers are sent back into the woods; the teams are exposed less than a minute. The captain opens fire upon the trenches with the following data and results:

Range 2000, corrector 16.—Short.
Range 2200, corrector 16.—Over.
Range 2100, percussion shrapnel.—Short on the right, over on the left.

While the captain is observing this last salvo, bombs representing the enemy's projectiles are exploded in front of the battery. The director announces that the battery is under fire, and falls out one chief of section and one cannoneer as killed. He informs the battalion commander and the captain of the first battery that neither guns nor gun flashes are visible on the horizon, and that none will be visible during the exercise.

After a few moments, the director notifies the captain that he may resume his fire; he takes up his adjustment for the right portion of the trench, and gets the bracket 2100—2150.

* Equivalent to "deflection 30, increase by 25."—*Translator*.

After another interruption due to the enemy's fire, he gets the bracket 2150—2200 for the left half. When the enemy's fire is again simulated, the director states that the direction of the shot furrows indicates that the guns are concealed behind the middle of the crest; this information is transmitted to the battalion commander and to the other battery.

The captain now has his firing data. He gives the following instructions for the fire for neutralization:

"Add 80; anchor. Each piece will fire series of three rounds, sweeping by five turns of the hand wheel; one shot to the right and one to the left of the present direction. Corrector 18. Range, first platoon 2100, second platoon 2150. Continuous fire, one round per gun per minute; commence firing."

After a few rounds, the director stops. the firing. The captain states that it is his intention, as long as his guns are not silenced, to continue firing at the present rate until the infantry finish their shelter trenches, say twenty minutes; after this, he means to fire more slowly, for this rate of fire would empty his six caissons in about an hour and a half.

Action of the First Battery.

The director joins the captain of the first battery, and gives him the following problems:

"You see in the distance a line of skirmishers (Fig. K‴), which suddenly appears over the crest. The other battery can not fire upon it, being at the moment itself under fire."

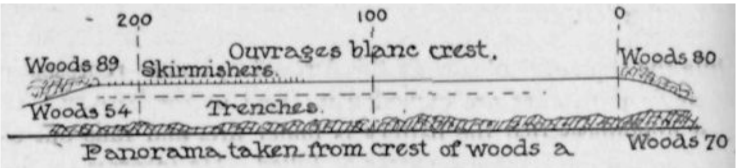

Fig.K.‴

The captain commands:

"Add 150; without anchoring; corrector 18; range 2600."

"Without ammunition; volley fire two rounds; range 2500."

"With service ammunition; percussion shrapnel; range 2500."

The last salvo is fired to verify the (simulated) volley.

"You know, from the direction of the shot furrows, that the enemy's artillery is probably behind the middle of the crest. Just as the second battery is bringing up its limbers, you see that the teams are under shrapnel fire. What do you do?"

The captain commands:

"Without ammunition. Add 80; range 2600."

"Range 2700."

"Range 2800."

The director then has the captain limber up and place his battery near the St. Hilaire road. It is now to be considered as the third battery of the battalion; the first is supposed to be still in position. The director states a new problem to the battalion commander.

Special Situation No. 2.

"The fire of the first battery upon the line of skirmishers was effective, but nevertheless many of them crossed the crest and reached the trenches. It thus becomes evident that the extent of the trenches is greater than at first supposed, and you find it necessary to assign two batteries to fire upon them.

"The enemy's artillery is still invisible; you consider that the second battery may be silenced at any time. Shrapnel have been bursting between the woods 60 and 68, and parts of the third infantry battalion passing here have suffered some loss.

"Go on reconnaissance, to find a position for the second and third batteries to fire upon the trenches."

Result of Reconnaissance.

The battalion commander reconnoiters a position on the front slope, which can be reached under cover, and where the flashes will be partly concealed; and decides to place the second and third batteries here. He sends for the captains, and gives orders to have the batteries brought up under cover of the woods 64, while the reconnaissance is being completed.

The second battery is withdrawn from its position by its lieutenant. Each carriage is moved to the rear by hand, and one limber from each section is sent up to bring both piece and caisson together back into the woods. Both batteries are then conducted to the point of assembly.

The battalion commander gives the captains their positions and targets; the batteries occupy the positions without difficulty. The third has flash defilade behind the trees; its limbers are to its right front. The second can not entirely conceal its flashes, but its concealment is sufficient to make it very hard to range on; its limbers are to the left, on a line with the guns.

Action of the Third Battery.

The captain looks for the line of flash defilade, and finds that he must be at least 125 meters in rear of the trees that form his screen.* The guns being in position, they are laid in direction as follows:

The captain can not lay any of the pieces directly upon the target; but by placing himself in rear of No. 4 piece he can find a tree in the mask which is exactly in line with the right edge of the woods 89. The piece is laid upon this tree with the sight set at *limb zero micrometer 100;*† the captain goes to his observing station and measures the angular distance from the direction of the gun to the left of the target. Finding it to be 150 mils, he commands:

"No. 4 subtract 150; lay parallel, on No. 4 sight."

The guns being laid parallel, he modifies the distribution so as to cover the whole front by the commands:

"Without anchoring; No. 3 subtract 30; No. 2 subtract 60; No. 1 subtract 90; percussion shrapnel; range 2000."

"Corrector 16; range 2000."

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* This distance was determined as follows:

The height of the trees is about 10 meters. This was estimated by posting a man on horseback at their foot; observing from a little distance, his height appeared to be about one-fourth that of the trees. The range is at least 1700 meters; the angle of departure is 40 mils, or 1 on 25. The slope of the ground is also 1 on 25, but in the opposite direction.

Hence, for a projectile to clear the trees, it must rise 10 meters; this rise may be obtained by placing the guns 125 meters back from the mask, where they will be 5 meters below the tree tops, and allowing for 5 meters rise on the trajectory. Or, if a defilade of only 3 meters is taken, the guns may be placed 175 meters from the trees; the projectile will rise 7 meters in that distance, and clear the trees by 4 meters. All this

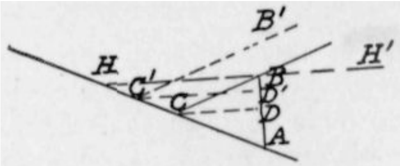


Fig.L.‴

will be evident from an inspection of Fig. L‴, in which HBH′ is the line of sight of the enemy, C the first proposed position, and C′ the second.

† Equivalent to "deflection zero."—*Translator.*

These two salvos verify the direction and determine the corrector. The battery can now be placed in observation; the captain has the pieces anchored and proceeds to determine his ranges. After firing several rounds by piece, he decides to give the first platoon *range 1800*, and the second *range 1850*. To cover a front of 35 mils with each piece, he orders continuous fire, three rounds, sweeping by six turns of the hand wheel, one shot per gun per minute.

The director stops the firing after three minutes.

Action of the Second Battery.

The firing of the second battery is similar to that of the third.

The trees of the woods 68, forming the mask, are from 4 to 5 meters high. Considering the range and the slope of the ground, a mask 6 meters high would be necessary to conceal the flashes of guns 50 meters behind the trees. At this distance, the guns are 2 meters above the foot of the trees; the muzzles of the guns are 1 meter above the ground; and the range being 1700 meters, the projectile rises 2 meters before reaching the mask. hence the projectile will just clear.

Ammunition Expenditure.

Very little ammunition was required for this exercise, as will be seen from the following statement.

Battery.	*Kind of fire.*	*Rounds.*
R′	Adjustment upon the crest	12
	Fire upon infantry (simulated)	0
	Verification of data	8
R″	Adjustment upon trenches	24
	Fire for effect, one minute	4
R‴	Adjustment upon the target of R″	16
	Fire for effect, one minute	4
R″	Adjustment upon trenches	12
	Fire for effect, one minute	4
	Total	84

FOURTH SESSION.

As before, the director assembles the officers at the woods *a*. After referring to the general situation and the purpose of the exercise, he announces.

Special Situation No. 1.

"The advance guard commander has decided to attack, with his infantry regiment and six batteries. The first infantry battalion is still in its shelter trenches in the edge of the woods; the second has one company at 54, and the other three a little to the left and rear to protect the flank; the third is at 70, and connects with the column on the right. The cavalry is on the extreme left, and connects with the column on that flank.

"The advance guard commander orders the fourth battalion, now on the St. Hilaire road, to reinforce the first and second, and, with them, attack the Ouvrages Blancs; the artillery, now consisting of two battalions, to support the attack."

Disposition of the Artillery.

The disposition of the artillery is decided upon after a conference between the advance guard commander and the artillery commander. It is stated by the director as follows:

"The batteries of the first battalion will remain where they are; those of the second battalion will take position as follows:

"R″″ on the left of R′ and of the woods 56, with flash defilade; R″″′ and R″″″ to the right of the woods 54, on the slope of hill 141. Batteries R′ and R″″ will be under the command of the captain of R′; the battalion commanders will retain command of their other batteries.

"R′ and R″″ will remain in observation as counter batteries; R‴, R″ and R″″′ will fire upon the enemy's infantry; R″″″ will observe the ground on the left of the attack, and advance with the infantry to the captured position. The three infantry batteries will each cover a third of the line, R‴ taking the right, R″ the left, and R″″′ the center.

"The captains of R‴ and R″ cannot see our advancing infantry until it comes within 500 or 600 meters of the enemy; in regulating their rate of fire they will conform to R″″′, whose captain can see the whole advance."

The two batteries now illustrate the action, first, of R′ and R″″, then of R″ and R‴, and finally of R″″′ and R″″″, part of the firing being with service ammunition.

Action of R′ and R″″.

The captain who, in the previous exercise, commanded R′, puts his guns in their former position, and fires one shot per gun to verify his direction and corrector. He then sends orders to R″″ to take position to the left of 56, with flash defilade, in observation, ready to fire upon any target appearing in its front which cannot be reached by R′. The registration point is the left extremity of the woods on the right of the crest.

At the same time he transmits the corrector of the day, 18, and the range to the crest—2300 meters on the right and 2600 on the left. With this assistance, the captain of R″″ gets his adjustment with eight rounds only.

The batteries being ready, the director sends for the two captains and gives each of them a firing problem (Fig. M‴).

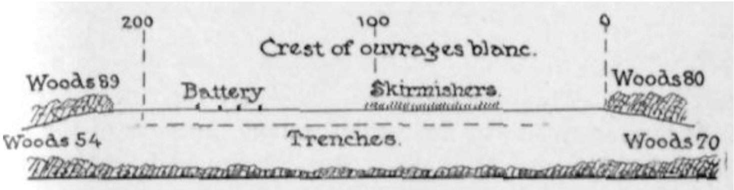


Fig.M.‴

"Captain R′, two batteries of the second battalion have taken position to the right of 51 and opened fire. A hostile battery comes into position just behind the crest, apparently to fire upon them. When the hostile battery is in position, you can see only the upper parts of the guns; these are represented by the targets that you will find about a hand-breadth to the left of the registration point. When I signal 'Commence firing,' you are supposed to have discovered the enemy, and may go ahead.

"Captain R″″, as the other battery opens fire you discover a long line of skirmishers, at wide intervals, crossing the crest. This line is represented by the silhouettes that you see to the right of the artillery targets.

"Return to your batteries, and I will give the signal for commencing."

At the director's signal, Captain R′ commands:

"Add 150; diminish by 10; anchor; range 2500."

"Without ammunition; zone fire; range 2500."

"With service ammunition; shell; range 2500."

"Range 2800."

"Range 2700."

"Range 2650."

"No. 1 only; fire for demolition."

At the same time R″″ fires upon the skirmish line. The captain's commands are:

"Add 40; without anchoring; volley fire two rounds; range 2500."

The director then has the batteries limber up and move to the positions occupied by R″ and R‴ at the end of the preceding exercise.

Action of R″ and R‴.

The two batteries being in position, the commander of the first battalion sends for the captains. He reduces the front to be observed by each to 100 mils, R‴ to close in its sheaf to the right and R″ to the left. R′″″ is to fire between them, and they are to regulate their rate of fire upon it. The director tells the two captains to fire one salvo each to verify their new directions, and then prepare for fire for neutralization. In view of the reduction of front, the captains direct that the fire be by series of two shots only.

The salvos having been fired and instructions given for the fire for effect, the batteries limber up and take position in readiness to the left rear of position of R″″ in the previous exercise, and now represent R″″′ and R″″″.

Action of R″″′ and R′″″″.

The commander of the second battalion makes a reconnaissance of the crest to the right of 54, and then returns to the batteries; he gives his instructions for the march of approach, for occupying the position, for opening fire, and for the fire for adjustment and for effect; he brings the officers forward to examine the ground over which the battalion is to pass, and the positions for the batteries.

The battalion crosses the exposed ground at a gallop, and takes the trot when it reaches cover; each battery then halts, well concealed, in rear of its own position. The captains and gunners go forward and mark the places for each gun. When all is ready, the batteries come into position rapidly, so as to expose the teams for as short a time as possible.

Each captain determines such firing data as he requires, by fire for registration. The captain of R″″″ registers the ground to the left of the line of attack, getting the range by percussion shots to the woods B 88, 89, and to a clump of trees in front. The captain of R″″′ adjusts by piece upon the part of the trenches assigned to him.

This firing being finished, the director assembles all the officers, first at one battery and then at the other, gives out firing problems, and discusses the solutions of the captains.

Fire of R″″″.

"Captain R″″″, the attack has begun. Our infantry is advancing upon the trenches. Batteries R″, R″′ and R″″′ are firing upon the enemy's line. You see hostile skirmishers coming out of the woods (B 88, 89), and advancing rapidly; just behind are four companies. This formation is represented by the line of silhouettes and the artillery targets. As soon as you see this counter attack, you decide to fire upon it; you may commence as soon as you are ready."

The captain commands:

"Add 20; diminish by 10; anchor; range 1800."

"Without ammunition; zone fire; corrector 15; range 1600."

"With service ammunition; shell; range 1600."

"Range 1900."

The last two salvos are fired to mark out the area beaten by the (simulated) zone fire.

Fire of R″′″.

Moving over to R″′″, the director asks the captain to explain his dispositions. The captain answers:

"Judging by the firing of the second and third batteries, this battery has a front of about 80 mils to cover, or 20 mils per gun. The range being 1600 meters, the battery cannot cover this front completely without sweeping; but since it has had to take position at this short range, with its guns barely concealed, I considered it impossible to arrange any complicated methods of fire—all that can be expected of men serving their guns here, under infantry fire, is to fire straight to the front."

The director approves this arrangement, saying:

"The situation of this battery is very different from that of R″ and R″′. They have a good position behind the woods, and can prepare their fire at leisure, protected from sight and from fire. For them, the idea of firing series of three rounds, sweeping by five turns, or 10 mils, is perfectly practicable; but not so for this battery, which is under fire.

"We will now consider how the fire of this battery is to be conducted, and then use what little ammunition we have available to illustrate the most interesting parts of this fire.

"The captain, we will suppose, opens fire upon the infantry as the attack begins, at the rate of one round per gun per minute. The other two batteries, according to orders, fire at the same rate.

"The advance of the skirmish line gradually extends along the whole front. Small groups work forward under the protection of fire from the rest and from the three batteries, and the whole line slowly gains ground. Twenty minutes after the artillery has opened fire, the skirmish line has gained 400 meters, and is 600 meters from the trenches. At this moment comes the counter attack, which caused R′″″′ to fire upon the infantry coming out of the woods 88 and 89, and R″″ upon the skirmish line crossing the crest. At the same time the captain of R″′″ accelerates his fire to two rounds per gun per minute; R″ and R′″ conform.

"The three batteries continue this fire for ten minutes; by this time the skirmishers are within 300 meters of the trenches. The batteries now pass to percussion fire, making the rate four rounds per gun per minute so as to get about the same effect of neutralization.

"Under the present circumstances this percussion fire may continue, as long as the infantry is not closer to the trenches than 200 or 300 meters. This seems in conflict with the rule that such fire must cease when the infantry is closer than 500 meters, but here its continuance is justified. The fire is perfectly adjusted upon the trenches; the ground is rising, and has been registered; the range being 1600 meters, projectiles fired at the trenches pass fully 20 meters above the heads of the skirmishers—as much over them as if, on flat ground, they were 500 meters from the trenches, since to 10 meters height on the trajectory must be added 10 more due to the slope of the ground.

"This fire having continued for say two minutes, the attack may be supposed to be so close that the captains successively increase their range, according to the progress of the infantry in their respective sectors. Thus, the captain of R″″′ might fire one percussion salvo at 1700, another at 1800, then resume time fire with a salvo at 1900, and continuous fire, one round per gun per minute, at 2000, until the infantry and battery R″″″ reach the crest. This fire constitutes a barrier which isolates the men in the trenches from their supports. If necessary, R′ and R″″, previously in observation of the crest, can now add their fire to that of the three infantry batteries.

"Meanwhile R″″″ moves forward, and, as soon as the infantry reaches the crest it takes position there.

"It will be of interest to see what amount of ammunition is required in this fire for neutralization.

20 minutes time fire, 1 round per gun per minute	20
10 minutes time fire, 2 rounds per gun per minute	20
2 minutes percussion fire, 4 rounds per gun per minute	8
2 percussion salvos, range 1700 and 1800	2
1 time salvo, range 1900	1
4 minutes time fire, 1 round per gun per minute	4
Total per gun	55

"The service firing of the battery R′″″ is as follows:

"1. *Two minutes time fire, two rounds per gun per minute*—8 rounds.

"The object of this firing is to familiarize the party with the cadence of this rate of fire.

"2. After a short pause to let the smoke clear away, *two minutes percussion fire, four rounds per gun per minute*—32 rounds.

"This firing is done without relaying between shots, to demonstrate that the accuracy of percussion fire is such as to permit of supporting the infantry until very close to the trenches.

"3. After another short pause, *one percussion salvo at 1700;* after a minute's interval *one percussion salvo at 1800;* after another minute's interval, *one time salvo at 1900*—in all, 12 rounds.

"As before, this firing is done without relaying.

"4. *Two minutes time fire, one round per gun per minute*—8 rounds.

"The object of this fire is to show the necessity of supporting the infantry clear up to the crest, and to familiarize the party with the cadence of this rate of fire.

"The total ammunition expenditure of the battery is 60 rounds."

As soon as R″″″ finishes its firing, R″″″ takes position on the crest and fires a few blanks.

The total ammunition expenditure for the exercise is as follows:

Battery.	*Kind of fire.*	*Rounds.*	
R′	Verification of former adjustment	4	
	Fire for effect		
	Verifying salvo	4	
	Verification of zone fire	8	
	Finding 50-meter bracket	8	
	Fire for demolition with one piece	10	
		—	34
R″″	Registration	8	
	Verification of fire upon infantry	8	
		—	16
R″ } R‴ }	Verification of beaten zones, after redistribution of targets to three batteries	8	
		—	8
R″″″	Registration	8	
	Verification of zone fire upon counter attack	8	
		—	16
R′″″	Adjustment and registration	20	
	Fire for neutralization	60	
		—	80
	Total		154

CONCLUSION.

At the beginning of these studies, their purpose was stated to be *to prepare battalion commanders, and the troops under their command, for war*. To this end, such exercises should be conducted with the following ideas in mind:

To develop the initiative of officers and noncommissioned officers in the field, and put them in a position to solve promptly the problems that will confront them on the battlefield;

To habituate officers to formulate their orders in such a way as to enable scouts, agents, etc., to perform their duties properly;

To prepare the entire personnel for the duties that will devolve upon them in service; and, finally,

To give to all ranks full confidence in themselves and in their superiors.

The proper method of giving this instruction is evident; there should be no hesitation to-day in adopting the method of *concrete cases*. But the number of concrete cases is infinite, and infinite also is the number of possible solutions. To be able to select in each concrete case the most appropriate solution, an officer must know how to choose with discrimination from among the methods described in the Regulations, and must be able to apply these methods in a thousand and one different ways. The *Regulations,* as the word implies, contain only the *rules* to be followed in the general case; they deal only with average conditions.

Knowledge of the Regulations is only the beginning of the training of an officer. It is not enough that he should know what the Regulations say; he must be able to apply them. If he does not, he is like the scholar who studies his text book in geometry, but never solves any problems.

Let us pursue this analogy a little farther. The Regulations are the text book; the concrete case is the problem. When we come onto the battlefield we should be prepared to solve our problems in maneuver and fire, in spite of the excitement of action; just as in school, when called to the blackboard, we were expected to be ready to solve our problems in geometry in spite of the excitement of the examination.

The methods of preparing for battle and for the examination are not unlike. The student is required to solve great numbers of problems similar to those that will be given him on examination, and he is kept in training by constant practice. The same plan should be followed in preparing an officer for war, except that in this case the necessity for establishing habits is much more urgent. It must not be forgotten that the majority of officers have never seen war. Suddenly they come under fire; they are compelled to act under extreme excitement, under circumstances entirely unfamiliar, and after enduring great fatigue. Under such conditions no one, unless it be here and there a most exceptional man, has full control of all his faculties. To have any chance of success, officers must be so accustomed to the problems to be solved that the solution will come to them instinctively, by reflex. They must keep in training by constant practice throughout their entire military careers. It is only thus that they can hope to acquit themselves creditably.

Unquestionably, the instruction must be by means of concrete cases. Every variety of exercise may contribute to preparation for war, whether with or without troops, with both sides represented or only one, with actual firing, with blank firing, or with no firing at all. *The essential thing is that the exercises shall place the officers in situations imitating as nearly as possible those to be looked for in war*. If this is done, officers will soon get into the habit of thinking along the right lines, will form definite opinions, and will learn to solve their problems quickly and correctly.

The one difficulty, then, for the instructor, is to prepare concrete problems and organize exercises in such a way as to suggest war conditions; but this difficulty is a very serious one. A few suggestions as to how this difficulty may be overcome are here given, as a sort of summary of the considerations which guided the organization of these exercises. Special emphasis is placed upon questions of fire, for they are less familiar than those of maneuver, and also less constantly studied by most officers.

The rapid fire gun has never actually been used on the battlefield, and it differs so radically from its predecessors that it is difficult to judge what it will do. The next war will have its surprises, even for those officers who have considered the question most. But we have certain positive data, from which we may deduce something to guide us.

A battery of four 75 mm. guns has more power than all the artillery of a division (six six-gun batteries) had with the 90 mm. guns. It can fire more projectiles in a given time, and can distribute them more accurately both in breadth and depth, since the distribution is automatic, and does not depend upon the skill of a large number of men. The commander of a rapid fire battery, then can do more and do it better than a divisional chief of artillery a few years ago. And in making this comparison, we speak only of the average captain, not of a captain with exceptional skill and unlimited ammunition, and with his battery in an entirely concealed position.

But it does not necessarily follow that the importance of the artillerist has increased in proportion to the power of his guns. This would be the case only if the rapid-fire batteries could fire upon the same targets as the 90-mm. batteries, which, in all probability, will rarely be the case. The last war, although fought only with accelerated fire guns, demonstrated this clearly; witnesses all agree that the power of the rifle and the gun have created a void on the battle field. Batteries will, as a rule, seek masked positions; and their targets will usually be troops which are exposed for a few moments only, or else so sheltered that fire upon them can have only the effect of temporary neutralization.

This brings us to certain very interesting conclusions in regard to instruction.

Since, in the next war, artillery will rarely have a target upon which it can adjust methodically, this kind of fire should not often be illustrated in our exercises. Nothing will be lost by omitting it, for adjustment upon troops in the open is the easiest of firing problems. Practice should be chiefly in occupying masked positions and preparing fire; in adjusting upon conspicuous landmarks, and registering the ground; and in instantaneous fire for destruction, delivered at the proper moment, and fire for neutralization distributed over a broad front and carefully regulated according to the tactical requirements.

When the relatively short period of adjustment and registration is past, the chief characteristic of the fire called for is *instantaneity*. This is essential, if the fire for destruction is to be delivered at the proper moment, and the fire for neutralization properly regulated. To this end the following conditions are indispensable.

1. *The battery commander must have full and complete initiative within his own sector of action.*

If he has to wait for orders, he can never open fire or vary his rate of fire at precisely the proper instant.

2. *He must have fairly extensive knowledge of the methods of combat of the other arms.*

To use his initiative intelligently, he must be able to judge the situation, so as to act in accord with the troops that he is supporting. Harmonious action is planned by the commander of the whole force, but it is not realized in action unless the subordinate officers have acquired the necessary training in time of peace. Theoretical knowledge is not sufficient; there must be fixed habits.

With the powerful rapid-fire gun, the preparation of officers to work in harmony with the other arms becomes more important than ever before. For if the gun, by reason of its rapidity of fire, has great power of neutralization, the duration of its action is, for the same reason, more limited. Artillerymen must use their ammunition intelligently; and officers of the other arms should never miss a chance of getting for their troops the utmost advantage from the support of the artillery.

3. *He must be prepared to decide without hesitation upon the kind of fire for effect best suited to a given target.*

To sum up, our exercises in time of peace should be so organized as to prepare officers

(1) To occupy positions with any desired degree of defilade;

(2) In such positions, to handle any kind of fire (for adjustment, registration or effect); and, in particular, to deliver an instantaneous fire for destruction, and regulate with all required nicety their fire for neutralization;

(3) To act in perfect harmony with the infantry;

(4) To leave to battery commanders, and at times even to chiefs of platoon, their proper degree of initiative.

By reason of the necessary decentralization of command when the action has once commenced, battalion and higher commanders should, to-day more than ever, apply the maxim that "to command is to foresee." They should acquire the habit of giving general orders; instructions rather than detailed orders.

The duties of the battery commander have grown more important. When the action is at its height, he is the only one who can decide as to the proper target and method of fire for his battery. Technical knowledge is no longer sufficient for him; like the higher commanders, he must have enough appreciation of the progress of the battle to form a judgment of the general situation. And what is said of the battery commander applies with equal force to the chief of platoon, who is likely to be called upon to take the place of his superior, or to handle his two guns independently.

Dogmatic instruction will not do for the artillery officer. All his science, all his skill in maneuvering and firing will be useless if he lets slip the fleeting opportunities for action. In maneuvering, he must avoid the extreme prudence which would lead him always to take wholly masked positions, and the excessive temerity which would place him always on the forward slope and close to the infantry. In firing, he must be prepared at any moment to deliver whatever kind of fire for effect may be most appropriate to the given target. According to the situation, he must be alternately miserly and prodigal of his ammunition.

Two qualities are in the highest degree indispensable to him—initiative and swift decision. All officers of artillery must possess these; and only exercises on varied ground can develop or create them. These exercises only can give the proper education for officers, stimulating the development of energy, the passion for personal action, the spirit of initiative, and the thirst for responsibility.

THE MOST SUITABLE TYPE OF HORSE FOR FIELD ARTILLERY.

BY MAJOR CHARLES P. SUMMERALL, 3D F. A.

In view of the efforts that are being made by the Quartermaster's Department to improve the quality of service mounts, it is believed that a careful consideration by artillery officers of the most suitable type of horse for the field artillery would be productive of much good. It is expected that opinions will differ, since officers must form their ideas from their individual experiences and their personal preferences, but all should be open to conviction as to the properties most essential for artillery purposes. THE FIELD ARTILLERY JOURNAL affords a medium for the expression of such views and it would be helpful if a free discussion could be invited as to the merits of the different types.

As a means of arriving at a basis of reasoning, let us consider the purposes for which artillery horses are required. Their work may be divided into two classes, differing greatly in the demands upon the animal.

Scouts and agents should be mounted and equipped, practically the same as cavalrymen. They must ride long distances and across country, often at a rapid gait. They require quick, intelligent, surefooted, weight-carrying animals. Such horses are described in the specifications for cavalry mounts, where it is prescribed that they shall be well-bred, of superior class and have quality, weighing from 950 to 1100 pounds, depending on height, which should be from 15 to 15¾ hands. They should have great heart action, courage and endurance and be well shaped and well muscled. A predominance of thoroughbred blood gives the qualities most desired and such horses should, in time, be furnished from our remount depots.

There is a sharp line of demarcation between these horses and those required for the batteries and the ammunition trains and one class is not suited to the work of the other. The horse for the latter is, primarily, a draft horse and, secondarily, a saddle horse, but the fact that the last requirement is secondary, does not mean that it is unimportant. The caisson, loaded, weighs about 4600 pounds and the piece, about 4400 pounds. The heavier load should be taken as the standard and if we add the weight of six cannoneers to the caisson, we have a total of at least 5500 pounds behind six horses, or over 900 pounds per horse. In addition to pulling this weight, one horse in each pair must carry the driver. These loads must be taken over difficult roads and soft and rough ground, across ditches, streams and obstacles, through woods and up and down steep slopes. They must go wherever guns are wanted, regardless of obstructions. The horses must travel long distances at rapid gaits and in all conditions of climate and weather. Long and wearying marches must be sustained and the exposure incident to field service must be borne without exhaustion. Within the past ten years, our batteries have made continuous marches of from five hundred to nine hundred miles, through bottomless adobe mud, over arid waste; and across mountain ranges. In the Philippines and in Cuba they have struggled to overcome difficulties of ground that required the limit of endurance. Distances and rates of marching in campaign that may not seem hard for cavalry, become serious undertakings, when, to the weight of the man carried, we add the draft of nine hundred pounds. The tasks for which artillery must be prepared are illustrated by the march of the 62nd Battery. Royal Artillery, to the battlefield of Modder River. In spite of the heavy ground, it covered sixty-two miles in twenty-eight hours, but it was at a cost of forty-six horses that died or were permanently disabled.

Although the loads are now as great as is consistent with mobility, it is probable that the weight of the carriages must be increased in order to strengthen certain parts. We must then consider the alternatives of reducing the amount of ammunition carried or of adopting some means of increasing our power of locomotion. Experience has shown that the former can not be entertained. Our ammunition carriages are as numerous as road spaces will permit. No adequate provision exists in our service for replenishing the supply and we can not part with a single round that our carriages now hold. The horses must therefore be such that they can take care of any increased weight of matériel.

While the question of mobility is serious with light batteries, it is vital to the efficiency of horse artillery. In spite of the reduction of the load by the weight of the cannoneers, it will require superior horses to draw the guns and accompany cavalry. In war, cavalry will want its guns and when a cavalry leader starts on those raids and wide flanking movements that contribute so abundantly to the success of campaigns, he must know that nothing he requires is impossible for the artillery he is fortunate enough to possess.

Genuine concern is felt by some European cavalrymen over the ability of the horse artillery to keep up with them and they do not

relish the idea of having the artillery delay their progress. The design of a special gun with such lightness that it can surely be taken along under all conditions and rates of march and that can be handled in action without the delays incident to limbering and unlimbering has been seriously discussed. But the power of the gun can not be sacrificed to considerations of mobility. In our service it has been wisely determined to use the same gun for horse and light batteries and its mobility to meet all requirements must be assured by the quality of the horses supplied.

With the exception of the agents and scouts, the individually mounted men in the batteries should ride the same type of horse as is required for the teams. Their duties make no special demands upon their mounts and these should be available for teams when needed. The suitability of the team horse for the saddle must not be overlooked. The comfort of the rider is an important consideration not only because his endurance is prolonged by ease in the saddle but because he is less liable to injure the horse. A sore back is not so apt to occur when the rider keeps his proper position and the action of the horse is smooth and regular.

In order to equalize the work in draft, the positions of the horses in the teams must be changed daily on the march and the near and the off horses should likewise be shifted in their places to take their turns at carrying the driver. These conditions require that all team horses should be of the same size and type.

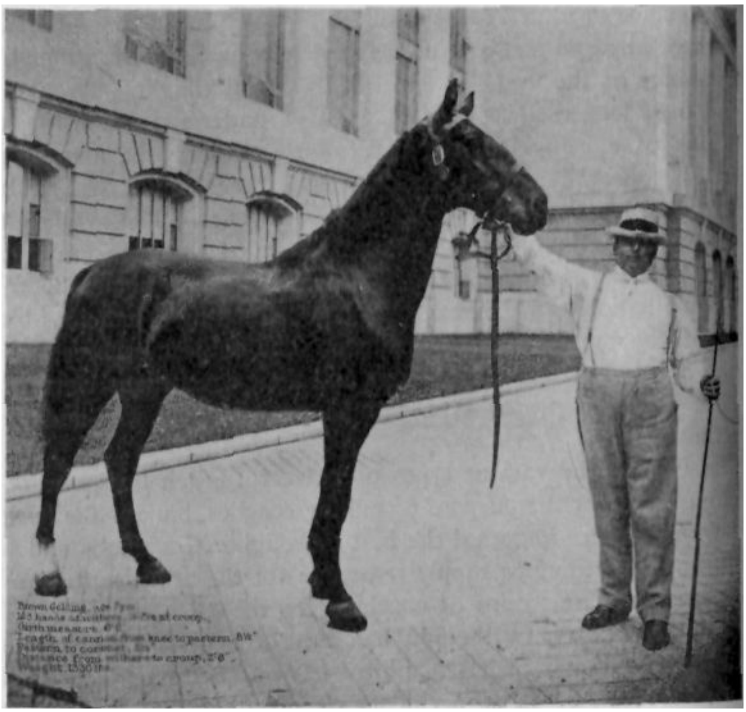
While the appearance of a horse does not always affect his power to endure and to do work, it nevertheless, must be taken into account in selecting an animal for military purposes. Handsome, showy horses are always inspiring and they are a large factor in cultivating the soldierly pride of a mounted command.

The work done by a horse in draft conforms to the mechanical principles governing the application of force. In order to overcome the inertia of the load, friction, etc., a certain amount of energy is necessary and this energy in any case depends upon the mass of the horse and his muscular strength. The greater the mass, the less the demand upon the muscular strength, so that the latter is conserved to impart motion to the mass and the load.

It is accepted as a principle that a horse should pull by throwing his weight into the collar and the most economical expenditure of muscular power results when the part of the weight pressed against the collar is equal to the resistance of the load. A light horse in a gun team must therefore pull at the expense of his nervous and muscular energy, if he does his share of the work. The ratio of a horse's weight to the maximum load he can pull can not be fixed definitely because so much depends upon the muscular peculiarities of the animal. The Morgan breed, though small, was famous for power in draft, and from time to time one sees a light horse that exhibits great strength and endurance in harness. Few light horses, however, possess the mysterious qualities of the descendants of old Justin Morgan, and we must not be misled by the work of a few into supposing that they represent small horses generally. Experiments have shown that a horse weighing 1500 pounds, when tested by dynamometer, was able to pull 1980 pounds with the attachment to the load two feet from the ground and 1732 pounds when the attachment was three feet from the ground. With the attachment the height of our singletrees, the load pulled would probably be a mean of the above amounts. On the average, we may therefore expect the maximum effort of a horse to overcome a resistance of a little more than his weight. In moving an artillery carriage at rapid gait and up steep grades or over soft ground, the resistance of the load far exceeds its actual weight. To take this load over long distances, day after day, under the exhausting conditions of a campaign, the horse must not only be able to pull, but he must have great muscular endurance, quick action, large heart and lung power, courage and intelligence. The artillery type must therefore possess the characteristics of the high grade draft horse and the thoroughbred. These qualities are not easily found in combination and they can only be obtained by a judicious blending of the breeds possessing them. The subject of breeding has been carefully studied by officers and their conclusions warrant the belief that the proper type can be produced by well-understood methods.

In Europe the various types of powerful coach horses were developed, not for the purpose of pulling coaches, but for the business of war. France imported the best thoroughbred stallions and went into horse-breeding to supply remounts for the army, and Germany fostered her fine strains of coachers for the same reason.

In our country, no thought has ever been given to producing a horse for military purposes and we have been forced to be content with "weeds" or those accidents of breeding that are not quite good enough for commercial or private needs. The term "artillery plug" has been applied to them with more justice than it is pleasant to admit. But just as the sport of racing diffused qualities that improved our cavalry mounts, so the sport of hunting has developed a type that is almost ideal for artillery mounts. The heavy hunter stands today as the embodiment of the highest equine virtues. He traces his origin to the thoroughbred and one of the heavy breeds, most frequently in this country the Percheron or the Clydesdale. He measures 16 to 16½ hands high and weighs from 1150 to 1300 pounds. With long sloping quarters, deep chest, powerful muscles and big joints and bone, he combines the courage, the speed, the action and the endurance of the thoroughbred. The same qualities that enable him to follow the hounds over fences and ditches, fields and forests for fifteen or twenty miles at a time, carrying 180 to 200 pounds, would make him snatch a gun carriage out of difficulties or take it to any place



where it might ever be wanted. There is no difference of opinion among horsemen as to his merits. Professor Roberts says of him: "I believe it is not too much to say that, as a rule, two good half or three quarter bred horses will do as much as three ordinary horses of equal weight. They are as useful on the farm as they are ornamental on the hunting field and under saddle; they are as indispensable in a cavalry charge as they are graceful in carrying a lady in a park. They can pull a harrow or bring up a gun carriage after all their cold-blooded relations have wilted and quit. So much for the blooded horse as a sire of high-class animals with courage and endurance, which qualifications are required in the hunter more than in any other class of horses."

A gentleman who raises pure Percherons and thoroughbreds writes: "I own a gelding, sired by an imported English thoroughbred horse and out of a half bred Percheron mare. This horse is 16 hands, sound and I use him for a farm horse. He will road you 11 miles an hour and do it as easy as any horse I ever had. He glides over the ground with very little effort and has tremendous girth measurement." This gentleman believes that the proper selection of Percheron mares and standard or trotting-bred stallions would also produce a fine type of artillery horse. Breeders commonly use the graded thoroughbred for farm purposes and it has been demonstrated that the increased power and speed of such horses give a profitable return for their cost.

A very fine horse of the hunter type is owned by the Hon. Henry L. Stimson, Secretary of War. Through his courtesy, the accompanying photograph (see frontispiece) and the following measurements have been secured: Height at withers, 16 hands 1½ inches; belly to ground, 35½ inches; girth, 74½ inches; middle of knee to end of cannon, 12 inches; around cannon below knee, 9 inches; around top of hoof, 16 inches; around gaskin, 19 inches; around rear cannon below hock, 10¾ inches; shoulder blade to hip bone, 34½ inches; lower point of shoulder to top of withers, 27½ inches; point of hip to point of hock, 39 inches; point of poll along face to upper lip, 28½ inches; between eyes across face, 8 inches.

The demand for such horses has been very limited and no special effort has been made to breed them. They appear here and there by accident, and when mature and schooled they command high prices. We can not, of course, expect to equip our artillery with graded thoroughbreds or hunters, as the term is now understood, but it is not unreasonable to believe that the government could systematically create a demand for this type that breeders would be glad to supply. The conditions for producing them are abundant. Our service has had no experience with them because of the cost, but their performances are a matter of common knowledge among horsemen and they warrant belief in all that their admirers say of them.

Whatever possibilities the future may hold for giving us ideal mounts, the immediate present demands some energetic and intelligent action to improve our condition. Great mobility is one of the traditions of the field artillery. Since the days of Ringgold and Duncan, it has been the proud boast that where horses could find a footing, there guns could go and that cavalry could not leave them. We are now facing a situation where our mobility is in danger of passing from us. During the past year, a problem required a command to march twenty-five miles and go into position within six hours. The conditions of roads and weather were unfavorable and the effort taxed many of the horses to the limit of their endurance. A number fell in the harness, some died and others were not again fit for work and were condemned. It was a service test and it developed our weakness.

In a continuous march of 700 miles, a few years ago, the small and coarse bred horses, constituting the majority of the stock, soon grew thin from the sustained effort and required nursing along. One pair of very large, cold-blooded, sluggish horses, weighing probably 1400 pounds each, gradually failed until they were of little value in the team. Some large, well bred, active horses came through without any especial care and changed little in condition.

The following specifications for artillery horses have been in force since March 4, 1909:

"The artillery horse for light and horse batteries must be sound, *well bred,* of a superior class, and have quality; of a kind disposition, well broken to harness, and gentle under the saddle, with easy mouth and gaits and free and prompt action at the walk, trot and gallop; free from vicious habits; without material blemish or defect, and otherwise conform with the following description:

"A gelding of specified color, in good condition, from 4 to 8 years old; height from 15½ to 16 hands; weight from 1150 to 1250 pounds

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"The artillery horse for light and horse batteries is required for quick draft purposes, and should be heavy enough to move the carriage, ordinarily, by weight thrown into the collar rather than by muscular exertion."

These specifications describe an excellent type of horse and one still to be found in sufficient abundance for service demands. This is the animal that is sought by fire departments and by commercial and transportation companies to move heavy loads at speed. He is large of frame, short coupled, powerfully built, well muscled, rather short legged, with good head and small feet. He has mettle enough to endure sustained effort and breeding enough to go long distances at the trot. He is seen occasionally in the service and when stories are told of great feats in harness at critical moments, such a horse is the hero of the tale. In the days of travel by coaches, there was an abundance of such stock, but the demand for them decreased with the advent of railroads. We read, however, that now well-bred omnibus horses in England make thirteen or fourteen miles a day, drawing two tons each at the rate of seven miles an hour. Post horses make thirty-two miles per day, and van horses, drawing one and one-half tons each, one way, travel twenty-two and twenty-three miles per day regularly. These were the animals that the British government found most effective of all that were sent to South Africa during the Boer War.

The difficulty of obtaining the horse described in our specifications lies in the contract price. We cannot get a better horse than we pay for and such an animal has a well-established value, which greatly exceeds the contractor's bid.

Photographs of two such horses, used in a fire department, are shown with their measurements.

Previous to the Boer War, so little attention was paid by the British government to service horses that one breeder wrote:

"The miserable price offered by the government will not make it worth while for farmers to attempt to breed the horse that is required. However, any horse that is strong, and yet active enough, may be disposed of in this quarter if he is not up to the mark for other trades." As a result of the experience in South Africa, an effort has been made to stimulate the breeding of service horses in Canada and an idea of the type sought for artillery may be obtained from the following extract from Prof. Roberts' book:

"The artillery horse asked for by the army buyers is really a smart, active van or express-horse on short legs, with plenty of bone and substance and enough quality to insure staying power in fairly fast work. He should stand from fifteen and one-half to sixteen hands high, weigh not less than 1300 pounds and measure at least eight inches below the knee and seventy-two inches in girth. *** The first prize entry at Toronto last spring was of the lighter sort, being, in fact, the pure bred hackney mare 'Cassandra.' She stood 16 hands, weighed 1325 pounds and girthed 76 inches.

She measured 8¼ inches below the knee and 20¼ inches around the arm; from crest to withers, 36 inches; withers to croup, 29 inches; croup to tail, an important point in all military horses, 19 inches. Although in this particular instance the prize went to a hackney, it does not by any means follow that gun horses should be either wholly or partly of that breed. They may be obtained by the judicious use of the thoroughbred horse on mares of size, substance and action or by stinting good half-bred or roadster mares to a biggish hackney or a breedy coach sire. So long as they show sufficient quality to insure activity and endurance, and at the same time meet the requirements as to size and substance, the question of pedigree is of secondary importance."

The French specifications call for horses from 15 to 16 hands high with prescribed standards of compactness. The saddle horses for the use of non-commissioned officers and agents must fulfill all the conditions of the dragoon class and the cost is $218.00. The horses for the light batteries must possess a high spirit without nervousness. They must be well-proportioned, with a strong and well-ribbed barrel, close to the ground, free moving, with a good frame and standing squarely on strong legs. For horse batteries, the special service of which requires long marches at a fast gait, over all kinds of ground, the horses should have special qualities of resistance, gait and disposition. Boards are instructed to bear in mind that every horse bought for the artillery is liable to be ridden at any time.

Whatever objection there may be to large horses must be based upon quality and not upon size. The coarse bred mixtures that usually represent large horses in this country are truly objectionable. Because service is cheap, almost any big stallion is used as a sire in the country districts and instead of selected foundation mares, the females are bred without regard to the qualities transmitted. The farm wagons, the livery stable teams and the consignments to dealers alike testify to the lack of system in breeding. In the Middle Ages, the great war horse was a giant of his race. He bore his master with two hundred pounds of armor and whether in the tournament, in the crusade or in battle, he gave proof of his courage, his endurance and his activity. Today, the Percheron horse is admittedly the superior of all other heavy types for bottom and speed while drawing heavy loads. His maximum powers were developed in the days of the coach. From one relay to another, in hot weather and cold, and over hilly and difficult roads, he pulled not less than two and often three thousand pounds at the rate of nine to twelve miles per hour. Records of 196 Percheron trotting matches, over rugged, cut up or hilly tracks or over highways, show that activity is not inconsistent with large size.

The best result for 1¼ miles was 3 minutes, 50 seconds, and the average of 29 trials was 4 minutes, 12½ seconds.

The best result for 1 5-6 miles was 4 minutes, 58 seconds, and the average of 31 trials was 6 minutes, 40 seconds.

The best result for 2 miles was 6 minutes, 5½ seconds, and the average of 40 trials was 7 minutes, 20 seconds.

The best result for 2½ miles was 7 minutes, 35 seconds, and the average of 65 trials was 9 minutes, 15 seconds.

Two and five-sixths miles were covered in 11 minutes, 25 seconds, and three and two-fifths miles in 12 minutes.

Over a 2-mile course, harnessed Percherons have averaged 7 minutes, 36 seconds, in eight results and over a 2½-mile track, 11 minutes, 55 seconds in 14 results.

Other feats in harness show that one trotted 55 3-5 miles in 4 hours, 24 minutes. Another trotted 58 miles and back in two consecutive days over hilly and difficult roads. The first day, the distance was covered in 4 hours, 1 minute and 35 seconds, and the second day, in 4 hours, 1 minute and 30 seconds.

Well may a conservative breeder say of the Percheron, "We need look no farther for the dams of our artillery horses."

Artillery must march as well as shoot, and if the same efforts and ingenuity were exerted to secure mobility as are devoted to the design and manufacture of guns, carriages and ammunition, the ability of our batteries to answer every demand would be assured. In the meantime, earnest endeavor should be made to secure large, well-bred animals only, and the price paid must be sufficient to compete with private purchasers.

For our heavy field guns and howitzers, where the weight behind the teams is practically double that of the 3-inch matériel, a much stronger horse is demanded. The rate of march will be slow, but great power will be required to overcome difficulties of roads and country. Here, the Percheron or the graded Percheron is the ideal type. He is seen in fire departments and heavy draft vehicles in cities and he can be obtained in sufficient numbers in this country. Conformation should correspond to that already given for light batteries, but the weight should be in the vicinity of 1600 pounds. It is safe to say that eight of these horses would give to our heavy batteries all the mobility that they will need.

THE ARTILLERY COMBAT AND THE METHODS OF FIRE OF THE COUNTER BATTERY.

BY MAJOR E. BUAT.

Translated from the *Journal des Sciences Militaires,* March 15, 1912, by Major William Lassiter, General Staff.

INTRODUCTION.

In a preceding article[1] we have set forth some ideas with regard to infantry targets and the methods of fire applicable to them. It seemed that, in this particular matter, the regulations of September 8, 1910, called for some explanation; and this was our justification.

We have not the same reason for claiming our readers' attention in a discussion concerning the target constituted by artillery, for the regulations are very explicit on this subject and set forth in detail the methods of fire to be employed by counter batteries. And yet opinions as to the artillery combat are today so divergent that it is quite impossible to come to an agreement on the methods of fire to be employed, if an understanding is not first reached as to the purpose of these batteries.

The general procedure to be employed in commencing this struggle, in pursuing it, and in terminating it, when that is possible, do not appear yet to have been completely set forth. Moreover, certain experiments, more or less recent, and perfectly authenticated, executed with explosive projectiles, seem to have been ignored by a great many artillerists. Their testimony is perhaps of a nature to modify opinions neretofore formed as to the destructive power of our arm and consequently as to the probable issue of the artillery combat.

Finally, the regulations indicate methods which may be better understood if we accompany them with commentaries and if examples are furnished by way of illustration.

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[1] "*Les Methodes de Tir de la Batterie d'Infanterie";* translation published under the title "Fire against Infantry" in the FIELD ARTILLERY JOURNAL for September, 1911.

Neutralizing fire, to which we shall be obliged often to have recourse, merits also some discussion.

Such are the subjects to be treated in the following pages.

1. THE ARTILLERY COMBAT.

Effects of destruction and effects of neutralization.

In battle the artilleryman must be inspired with one idea—to destroy his target. It may be difficult to understand why he should burn his powder with any other object in view, the surest and most economical way of rendering his adversary harmless being to suppress him.

It is upon this notion of destruction that the recent regulations lay stress when they say: "Artillery acts by its destructive effect"; and again, "The essential object of artillery in war is the destruction of its adversary." It is evidently not always attainable; but we must exert ourselves, and remember that there is something more to be done than simply to oblige the enemy to take precautions, than merely to "cause the complete or partial cessation of his activity," than merely to neutralize him.

The effects of neutralization, which, moreover, are only temporary, are not to be compared as a demoralizing agency with the effects of destruction. The rule of conduct is then simple: destroy if we can, neutralize if we cannot destroy. Moreover, of all the targets which offer themselves to our choice, the most important of all is the hostile artillery. If we are not able to impose silence upon it we shall be ourselves reduced to inaction, and, powerless or nearly so, we shall count the shots received by our infantry. This is certainly the last role to which we would resign ourselves in the struggles to come; but as the enemy on his side will be no less animated by the desire to reduce us to powerlesssness, we must take it for granted that "to every attack will correspond an artillery combat, each of the two parties endeavoring to assure to its batteries liberty of action." To force the enemy's guns to silence, in order to have some batteries which may give direct support without interruption to the infantry—such is the goal.

Two conceptions of the artillery combat.

That there will be an artillery combat, in which will participate a number of batteries greater or less according to the manner in which the battlefield is divided up, few will deny; that this combat is only for the purpose of having a certain number of batteries free to fire upon the hostile infantry, all are in accord; where divergence of view begins is as to the effect, destruction or neutralization, which it is indispensable to obtain, in the course of the combat, upon the hostile batteries. According to the point of view held in this regard, the principles governing conduct of fire and even the employment of artillery may be quite different. Some, with their counter batteries, seek no other result than holding the enemy in leash, so to speak, in order to prevent him from interfering with our infantry batteries. They speak of anesthetizing the enemy, of silencing him, of neutralizing him—expressions which well indicate the result aimed at; the idea of destruction is absent. Others expect to carry on a merciless struggle with the opposing artillery, to disable it as much as possible and as soon as possible, then, as the advantage is gained, to divide their strength in two; one part, becoming smaller and smaller, to watch over hostile batteries whose favorable positions have saved them from complete demoralization; another part, becoming larger and larger, free to act and work for the direct and exclusive profit of the infantry.

Two different tendencies then exist. In the one camp, ambition is limited to preserving from hostile artillery interference a few infantry batteries, whose liberty of action must be assured, during the whole course of the combat, by numerous counter batteries. The latter, moreover, are to exercise merely a preventive action; they do not seek grave injury to the enemy's artillery, since they cover broad fronts, producing fire of but feeble density, and leaving their targets quiescent for the time being, perhaps, but practically uninjured. They claim to parry the danger, not to suppress it.

In the other camp, no objection is seen to employing from the beginning all the guns one possesses, if necessary, to determine definitely the fate of the opposing batteries; the more the task advances toward accomplishment, the less one keeps counter batteries and the more one increases the number of infantry batteries. Perhaps the danger does not disappear completely, but it will be greatly diminished; additions to the enemy's strength will hardly restore its original importance.

Consequence of these two tendencies for the infantry.

It is necessary to choose the part we are to play. It seems that this should henceforth be easy, since the regulations have decided the question. But if the regulations elect the principle of destruction, and prescribe that before declaring a decisive struggle impossible we must attempt it, they also make reservations. "Operating from masked positions, the struggle between the two opposing artilleries will be more stubborn than in the past and will continually be renewed." It will be so, incontestably, if the struggle goes on indecisively; and the advantage of having some batteries always at the immediate service of the infantry will be bought too dearly if there is the continuing fear of seeing the opposing batteries spring into renewed activity if the least help is opportunely brought them. To this indecisive struggle is to be preferred a contest openly provoked to extremity; there is always time to have recourse to neutralization if it is not possible to do better. To be continually attending to the enemy's guns is a negative operation; to disable him is to suppress the danger.

If we are successful, we can save our strength to support the infantry; and our infantry, even if inferior to that of the enemy, will be very strong because powerfully supported by its artillery. It is, then, very desirable to make the artillery combat decisive. Is it possible to do so?

Can the artillery combat have a decisive issue?

It is clear that if a negative answer must be made to this question, we should be forced to content ourselves with neutralization; but the task is not beyond our strength, as we expect to show. Of course we cannot claim to be able to destroy all the hostile batteries, and we have taken care to say that, even after an intense struggle, there will always be certain fractions which, not having been crushed, will demand the attention of counter batteries; but the essential point is that these fractions should constitute a minority, and that the remainder should be definitely put out of commission.

Objection is often made that shrapnel are powerless against the personnel of shielded artillery, masked by the terrain; but we forget that we are not confined to the exclusive employment of shrapnel. If our chests are supplied with high explosive shell, it is not for the purpose of leaving it there until the conclusion of the campaign. All the hostile batteries, moreover, can not be masked; and those that are, can not all have the same amount of cover. Defilade is relative; a battery that for one set of conditions may be masked, may no longer be so under other conditions.[2]

Moreover, our methods of fire and our projectiles permit us to destroy the personnel (and in certain cases the matériel) of batteries wholly or partially visible, or even merely indicated by flashes or smoke. Who would venture to affirm that the majority of the hostile artillery (flat trajectory guns) will not appear under one or another of these forms?[3] And the destructive effects to which we can lay claim are not imaginary; they are well attested, and the regulations make mention of them, although they interpret the experimental data with extreme timidity. The regulations estimate at 33 per cent. the losses suffered by a battery entirely defiladed, but enclosed in a 100-meter square which is struck by 50 high-explosive projectiles uniformly distributed; this seems a low estimate. But where is the organization which, in our days, is capable of resisting a fire which instantly mows down one-third of its strength? Furthermore, whoever has witnessed fire of this character, has found himself even in the neighborhood of the thunder of explosions, has preserved the remembrance of the shock produced by the bursting shell and the hurtling fragments, has approached the asphyxiating atmosphere of the beaten zone—such a one can form some idea of the intense and lasting demoralization experienced by the personnel submitted to such a test, even if its losses have not been greater than 33 per cent.

To the question, "Can we destroy the hostile artillery?" the answer is not doubtful. We can not destroy it entirely, even morally; but it is possible, undoubtedly, to destroy the larger portion of it.

Conduct of the artillery combat.

How are we, then, to open and conduct the combat in order to arrive at this end? The first care should be to determine approximately

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[2] Let us put ourselves in the well-known situation of Aug. 16, 1870. At the beginning of the action, the batteries of Bataille's division took position in rear of a crest midway between Vionville and Rezonville, to fire upon those installed by Major Koerber beyond Vionville. They were defiladed with respect to these latter batteries, but not so from the signal station of the Vierge, to which the Prussians soon came. Koerber's batteries themselves were perfectly defiladed from the east, on the side toward which they were firing, but they were taken under the oblique fire of the artillery of the 3d French Corps southwest of St. Marcel; and later the artillery of the 4th French Corps, arriving on the crest of the Poirier du Bois-Dessus, took them in reverse.

[3] Let any honest artilleryman (howitzer batteries aside) ask himself how often, in his own experience, he has taken position more than 200 meters from the covering crest.

the strength, or more properly the front, occupied by the artillery to be attacked. For this purpose it is necessary to make a sort of reconnaissance by fire, obliging the enemy to reveal his forces.

Our batteries, covering broad fronts with their fire, are engaged successively as the hostile front is revealed. The sheaf should be well opened so as to diminish the number of these decoy batteries, but should not be so broad that the fire loses its neutralizing power; for, if this were the case, the enemy would not be forced to bring into play new units, to restore to the cannonaded part of his front a liberty of action which it had not lost. A distribution difference of 20 to 25 mils seems in general the most suitable.

By this procedure, the reconnoissance of the front occupied by the hostile artillery is gradually effected. From the moment when the hostile line no longer gives evidence of prolonging itself, the reconnaissance is terminated, at least for the time being.

It remains now to strike, to crush, those batteries most exposed. We commence with those that are visible, pass to those which are partly so, and end with those which are hidden but which are certainly very near the covering crest. As for the others, we shall have to content ourselves with neutralizing them, since it is impossible to do better. However, if we succeed in obtaining decisive effects,—as we may reasonably hope to do,—on the batteries of the first three categories, the essential work will be accomplished.

The reconnoissance terminated, the procedure will then consist in utilizing the unemployed batteries to overwhelm the parts of the hostile line which are most vulnerable. As these unemployed batteries can not be very numerous, they will act successively upon the targets to be destroyed, commencing with the most favorable ones; while the rest of the artillery will assure them liberty of action, by keeping up, over the rest of the front, a simple fire for neutralization.

How may we determine that we have gained a decisive superiority over the hostile artillery? Superiority is recognized by sure indications. Slackening of fire may be but a deceitful indication; but there are more positive indications, as, for example, seeing the enemy's guns blown up, or finding that they keep silent when it is to their interest to be active. If our infantry moves on, if it approaches nearer and nearer to that of the enemy, which has been obliged to halt, and if still the hostile batteries do not fire, it is undoubtedly because they can no longer fire. The course of the infantry struggle is as a barometer, registering the results of the artillery combat.

Amount of artillery to leave as counter batteries.—Against such hostile batteries as have, through favorable positions or other causes, escaped the destructive effects of our fire, how many counter batteries must be left? This question has never been resolved except empirically. Sometimes it is decided to leave two batteries in a battalion to watch over the hostile artillery, sometimes only one. This distribution does not generally correspond to any definite idea, based on observed facts.

It seems possible, however, to imagine an experimental solution, whereby we shall have only the minimum number of counter batteries, neither more nor less; this may be two batteries out of three, or only one,—it is not impossible that we may dispense with counter batteries.

Let us suppose that over the front of action of a battalion we possess certain indications permitting us to believe that we have acquired a certain superiority. But in particular parts of this front, at intervals, the activity of the enemy is renewed. We must determine if it is truly necessary to devote an entire battalion to watching this front.

We will naturally try to contain the hostile artillery with but two of our batteries. For this purpose we divide up the total front between two of them; but as a matter of precaution we leave the third battery still in position, fronting its former target, ready to resume the fire. At the moment when the enemy fires, when we see his flashes or smoke, he is immediately assailed, while his men are at their posts, by *rafales* from the two batteries. If this fire has the effect of increasing the period of inactivity of the enemy, if our infantry pushes on, and if the enemy remains more and more indifferent, we must conclude that two batteries are sufficient to control him. Then we can use our third battery for the direct support of our infantry. If it happens, on the contrary, that we have been deceived as to our superiority, this third battery, still in position, is always there ready to resume the struggle which we had thought decided.

After having tried two batteries and determined that they suffice for the task, we will attempt employing but one, proceeding always according to the same prudent method. Finally, if despite the progress of our infantry, more rapid now that additional guns are coming to its support, the hostile artillery still shows no signs of abandoning the silence which it has such good reason to break, it must be that it is reduced to powerlessness. Counter batteries are then no longer needed.

To sum up, if we consider a sector of a battle field, where two forces of infantry, aided by artillery, are seeking a decision, we may say:

That combat between the two artilleries is inevitable.

That it is of the highest importance to make this combat decisive.

That the greater part of the batteries put into action occupy positions rendering them liable to destruction, partial or complete.

That it is necessary to determine the extent of front occupied by the hostile artillery, and hence its approximate strength.

That after this reconnaissance we can take steps to get destructive effect upon those batteries whose positions render them vulnerable, while the others are simply neutralized.

That superiority in this combat is recognized by sure indications, and notably by the course of the infantry action.

That it is possible to estimate fairly closely the number of counter batteries to be left to watch over the artillery still undestroyed.

The distribution of tasks among groups and battalions of artillery, for the reconnaissance of the adverse artillery, and later for the conduct of the decisive struggle, is generally the function of the commanders of the corps and divisional artillery; the estimate of the number of batteries to be left to watch over the hostile artillery pertains generally to the battalion commanders. We need not occupy ourselves here, then, with the details of these questions; for, the object and principles of the artillery combat once established, the present study aims only at exposing the methods of fire to be employed by the battery commanders.

2.—METHODS OF FIRE OF THE COUNTER BATTERY.

Various forms of artillery targets.—The following pages are only amplifications of the regulations; they complete the regulations, in the sense that they add certain explanations and illustrations to the indications there contained.

The forms assumed by artillery targets are not very numerous. They may be classified as follows:

1.—Batteries wholly or partly visible.

2.—Batteries whose matériel is not visible, but which may easily be located between two limits.

3.—Batteries not far removed from their masks, and visible by flashes or smoke.

4.—Batteries on a forward slope (in rear of a covering crest).

5.—Invisible batteries.

Batteries wholly or partly visible.—Batteries of this kind are extremely vulnerable; they are the first whose absolute destruction should be sought, once the reconnaissance of the enemy's line has been completed. This is effected in two phases,—first destruction of the personnel, and then, if time permits, of the matériel.[4]

It being necessary to secure destructive effect as economically as possible, we must seek a bracket of 50 meters, in order to reduce the depth of the zone to be searched. But as this requires a certain amount of time, it is important to deprive the hostile battery promptly of all possibility of firing or of escaping. To this end, before entering upon the real fire for destruction, we seek a large bracket and then search its depth with time fire. Subjected to these *rafales*, the cannoneers are forced to seek shelter behind their shields, and all movement, whether by hand of by the use of the limbers, becomes impossible.

This result is generally obtained in the course of the reconnaissance of the enemy's front. Destruction is then sought, either by a new battery or by a battery which has the target in its zone.[5]

In this latter case, the sheaf being adjusted to the target, we get a 50 meter bracket with high explosive shell. The more this is closed in, the less chance the enemy has of escaping destruction.

The fire for effect then consists in beating systematically with shell a rectangle 50 meters deep and of width equal to the front of the target. To this end, we employ series of three shots each, fired at the limits and the mean of the 50 meter bracket, each series

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[4] It may happen that after having fired upon a target of this nature a battery may be employed immediately for the direct support of infantry which has urgent need of such support. In this case, destruction of the matériel is deferred until later.

[5] This will be the case when all the batteries have been utilized in the reconnaissance. The fact of being barely equal, or even inferior in strength to the enemy, is only one reason the more for endeavoring to weaken him. When one battery narrows its sheaf, the others should open theirs, and make up for their greater dispersion by more rapid fire. The essential thing is that during the operation they must neutralize the rest of the front.

separated from the preceding one by a certain number of turns of the traversing wheel. The result is almost complete destruction of the personnel, however well protected behind the shields; and it will be unusual if we do not get, in addition, a lucky hit or two causing destruction of matériel.

For example, suppose a visible battery bracketed between 3000 and 3400; the captain, having adjusted the sheaf to the front of the target (by hypothesis 100 meters, or 30 mils) commands: "Corrector so and so; progressive fire; 3000;" then, without delay,—"Shell; 3400."[6] The salvo is over; 3200 short; 3300 over; 3250 over. The bracket is then 3200—3250. Fire for effect is immediately taken up at the commands: "One round; 3250, 3225, 3200," followed by "To the right 2 turns; 3250, 3225, 3200," and finally "To the left 4 turns; 3250, 3225, 3200." The commands follow each other without interruption. Thirty-six projectiles thus come in series of three at intervals of about 12 meters, upon half a hectare of ground, including the target. In two or three minutes the fire effect mounts to a total which means absolute annihilation. Such a decision may be said to have been gained very cheaply.

If the battery attacked is visible only in part, we can generally, by aid of the flashes, determine its approximate front, and proceed as in the previous case.

Fire for destruction of the matériel follows immediately if time permits. With one of his pieces, the captain attacks successively the various groups of carriages. He may use percussion shrapnel, if necessary, to husband his shell. Whatever the projectile adopted, he fires series of four shots at the mean of the 50 meter bracket two at least and three at most should be over. The elevation is changed 25 meters in the appropriate sense if the desired proportion is not attained. The direction should be perfect.

For example:—the enemy's right piece has been bracketed between 3200 and 3250. The captain, with his right piece, fires three rounds at 3225, modifying the direction each time, if necessary. The piece being adjusted in direction, he commands "Measure the deflection." If the first three shots are short, it is useless to fire the fourth of the series, and the elevation is at once increased to

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[6] It may happen that 3400 will be short, since beyond 2500 meters the shell does not range as far as the shrapnel. This is the reason for commencing with 3400; if the range were less than 2500, it would be preferable to commence with the short limit of the 400-meter bracket.

3250. The proper proportion of shorts and overs being observed the fire is continued until effect is obtained. The captain then passes to the destruction of another group of carriages, and in each group attacks successively the gun and caisson. The regulations, interpreting the results of numerous tests, estimate that at ranges of 2500 to 3500 meters 15 to 25 projectiles should suffice to damage one of the two carriages; that is, an average of 20 shots. This means that with about 120 rounds, less than two caissons full, we should be able to secure the complete destruction of the personnel and matériel of a six-gun battery; about 150 rounds, if we count the previous fire directed against the personnel.

Batteries easily located between two limits.—A battery whose smoke or flashes appear from between two features of the terrain,—a crest and a line of trees, for example,—is capable of being bracketed more or less narrowly. The amplitude of this bracket indicates the depth to be searched in order to have a certainty of reaching the target. It may be that the bracket will be too large for one to think of systematically searching the entire suspected area; but this case is rare, for there almost always exist indications tending to show the position of the battery near one or the other limit. However this may be, in case of doubt, it is proper, if the hostile battery is dangerous and its destruction is important, to assume its position to be near one of the limits, and, especially, that it is near the covering crest.

We will suppose here that the limits are sufficiently near together for one to have no hesitation in choosing between the two possible decisions,—to seek the destruction of the target, or to abstain from doing so for fear of excessive ammunition expenditure. It may be remarked, however,—and this is a general remark, upon which we can not insist too strongly,—that it is often more economical to expend a considerable amount of ammunition at once, rather than fire a few rounds at intervals for many hours.

Under the assumed conditions, we know the depth to be searched, and flashes or smoke furnish indications as to direction. It can not be expected, however, that the exact front will be very clearly defined; it is best not to adopt too narrow a sheaf. If we observe only a few flashes, but these always in the same places, we may direct the axis of the sheaf upon these. A distribution difference of 15 mils is indicated for such conditions.

We then proceed to cover the selected area as systematically as possible. When the enemy finds himself bracketed, he will not fail to protect himself by his shields, and shrapnel will not then be powerful enough to produce complete demoralization. Hence we should employ high explosive shell.

The method is quite similar to that already indicated for attacking artillery which is entirely visible:—time fire for searching the area in depth, to oblige the personnel to remain behind the shields; verification of the limits of the bracket, using shell; then systematic fire equally distributed over the whole suspected area. Each piece takes a part of the front; elevations are successively diminished by 25 meters from the long limit of the bracket to the short limit,—or, more exactly, until we see shots falling short. The fire of each piece is then turned to the right and to the left of its original direction, and conducted according to the same principles. If the distribution difference is 15, it will generally be sufficient to fire five series of shots,—one in the central position, two to the right and two to the left,—separated by two turns of the hand wheel.

Example,—a hostile battery, some of whose flashes are visible, is behind a crest and in front of a line of trees. The center of the sheaf (distribution difference 15 mils) is directed upon these flashes, and fire adjusted with time shrapnel. The crest is bracketed between 2500 and 2600, the line of trees between 2600 and 2700; the target is then between 2500 and 2700.

To oblige the personnel to take shelter, two *rafales* sweeping are fired at 2500 and 2600. The effects of this fire are carefully observed, in order, if possible, to determine more exactly the position of the hostile battery with respect to the crest or the trees. The captain then seeks, with shell, a 50 meter bracket on the line of trees. He might satisfy himself with a 100 meter bracket, and save a four-round salvo; but that might easily be the cause of expending a much greater number of projectiles later. It is unnecessary to seek a similar bracket on the crest, since in any event fire for effect is continued from the rear until shots are seen striking short.

If then the captain has bracketed the trees between 2600 and 2650, he commands in succession 2650, 2625, 2600, 2575, 2550, and continues until he clearly sees shots falling short. The series is then repeated four times, twice after a shift in direction by two turns of the hand wheel to the right, and twice after shifting by similar amounts to the left. The initial opening of the sheaf being 15 mils.

the ground is thus systematically beaten,—in breadth at intervals of about four mils, in depth at distances more or less closely spaced according to the slope of the ground.

If we suppose that 2550 is short, each piece fires five shots in each direction, or 25 in all; the battery fires 100 rounds, or the contents of one caisson. A considerable amount, it is true; but let us bear in mind the number of rounds that would be required to neutralize the same objective with time fire. Two *rafales* sweeping, at 2500 and 2600, would require 24 projectiles; and how many of these would be needed to insure the continued neutralization of the hostile battery? Is it not preferable to expend immediately 100 rounds, with the legitimate hope of silencing the battery, for many hours if not for good?

Batteries not far removed from their masks, and visible by flashes or smoke.—Such a target presents the same conditions as the preceding one, except that the farther limit of the bracket is not known. If then the conditions are such as to call for the reduction of a battery thus placed, and hence for the employment of the kind of fire above described,—the only kind, be it said, which leads to decisive results,—it becomes indispensable to fix this limit arbitrarily. The short limit is the covering crest.

The regulations prescribe seeking a 100 meter bracket on the crest, and taking the long limit of this bracket increased by 50 meters as the initial range for searching the bracket from rear to front, with range decrements of 25 meters. This procedure is based on the experience that artillery is rarely placed more than 200 meters from the covering crest, and that, on gradual slopes, a shot fired at the long range of the bracket plus 50 meters will strike at least 200 meters from the crest.

Against a hostile battery of this kind, the procedure will then be as follows:—obtaining a 100 meter bracket, or even a 200 meter bracket, on the covering crest; progressive fire or fire at successive ranges, starting from the short limit of the bracket (or the short limit increased by 100 meters, if the shots at this limit have been decidedly short). This done, we obtain with shell a 100 meter bracket on the covering crest, for example, 2500—2600, and fire for effect from rear to front by 25 meter decrements,—2650, 2625, 2600, etc., continuing until the shots are clearly short. This fire is repeated, changing the direction by two turns of the hand wheel. The method is automatic, requires little in the way of observation except noting when the shots begin to fall short, and ought to be employed with great rapidity, commands succeeding commands without interruption. It is scarcely necessary to say that the more clearly the hostile front is defined, the less will it be necessary to spread the sheaf, the fewer will be the azimuths to be employed, and the less will be the necessary ammunition expenditure.

Batteries on a forward slope.—A battery whose flashes are seen must be fairly close to the crest that masks it, or on a counterslope in rear. Whether it is in the one place or the other may generally be determined from observation of fire directed over the crest, and also from inspection of the map.

If the target is located on the counter slope we commence by determining the range of the intersection of the counter slope with the plane of sight tangent to the crest. If the flashes and smoke are seen, the target is not very far below this plane; we can then search systematically with shell the 200 meters of ground in front of the limit thus obtained.

We commence, as before, with searching shrapnel fire from front to rear. Since the target is on a forward slope, two volleys differing in range by 100 meters will not search a sufficient depth; it will be desirable to use three or four successive ranges varying by 100 meters. The effect is carefully observed, with the object of determining as exactly as possible the position of the hostile battery below the plane of defilade.

A 50 meter bracket is obtained with shell on the intersection of the plane of defilade with the counter slope; the farther limit of this bracket is the initial range of fire for effect; 400 meters instead of 200 may be taken as the depth of the suspected zone, but if the angle of fall is not too great the range decrements may be 50 meters instead of 25.

A battery concealed behind a mask of trees is in a situation analogous to the preceding. In this case one may be almost certain that it is but a very short distance below the plane of defilade; the depth of the suspected zone is taken as 200 meters, and the successive ranges vary by 25 meters.

Invisible batteries.—Batteries totally invisible from the position of artillery charged with attacking them may not be so from a lateral observation point. We have already had occasion to refer to the case of the French and German artillery on the 16th of August, 1870; the artillery of Bataille's division in particular would establish itself today in the same position as formerly, seeking defilade from the heights west of Vionville, but, invisible from this point, it would not be so from the Vierge signal station. The batteries of the 5th Prussian Cavalry Division in their turn would evidently take defilade against the positions clearly indicated by the terrain for the French batteries of the 2d and 6th Corps, but this would not prevent their being seen from an observation station north of the Vionville woods, in a region already held by the 3d Corps. In these cases the adjustment would evidently be more difficult, but it would still be possible, and one might then pass to one of the methods of fire described above.

These examples suffice to prove that defilade, whether for guns or howitzers, is an entirely relative matter. One can not defilade against the whole horizon, and the combat fronts of the armies of today are neither rectilinear nor fixed. A battery which is invulnerable for the moment, because invisible to the hostile artillery already in position, will not be so in a few hours, when additional hostile artillery comes into action in another locality.

This shows likewise that the best hidden batteries,—and this applies especially to howitzer batteries,—will not have the most to fear from the hostile batteries in their immediate front. Experience, moreover, has long proved that oblique fire is the most destructive. Finally, the day is near, if it is not already here, when by the aid of aeroplanes, artillery will be able to reach with its fire invisible targets, however situated.

Summing up, it may be said that the great majority of hostile batteries are susceptible of destruction, either of personnel and matériel both, or of personnel only. Only the batteries which are totally concealed can escape from our fire. However, such batteries, unless armed with howitzers, are, in general, incapable of firing upon our infantry on account of the dead angles in front of their positions; they are dangerous for us, but not for our infantry. This removes a great part of our interest in their immediate destruction.

The destruction of hostile artillery is not a hopeless task. We can and must attempt it, for it is our essential task in battle. It is only at this price that we can devote the majority of our batteries to the direct support of our infantry, whose success will then no longer be doubtful. If we can not destroy, then we shall be forced to limit ourselves to neutralizing.

3.—METHODS OF FIRE FOR NEUTRALIZATION.

Cases in which neutralization will suffice.—Neutralization is only an expedient employed when we can do no better. It is difficult to give a complete list of the circumstances under which neutralization is necessary, but a certain number may be pointed out.

During the reconnaissance which inaugurates the artillery combat, neutralization is employed until, the enemy's line no longer prolonging itself, we know what we desire to know,—the front occupied by the enemy. And if it happens that this front is too great for us, with the forces at our disposal, to devote even a single battery to fire for destruction, then we must content ourselves with neutralization. Not being able to harm the enemy, we restrict ourselves to preventing him from doing harm.

During the combat itself, while certain batteries,—necessarily few in number,—will proceed to destroy in succession the especially vulnerable targets, all the others will content themselves with neutralization; their sole aim, at least temporarily, will be to prevent the enemy from interfering with those batteries that are performing the essential task. After the artillery combat those hostile units so placed as to be protected from fire for destruction will be merely observed and neutralized.

In the last period of the attack, the batteries assigned to its indirect protection,—that is, to watch the position which may be occupied at the last moment by the enemy's guns, either to fire upon our advancing troops or support a counter attack,—have not to seek the destruction, but merely the neutralization, of their targets. It is a question of gaining minutes, and neutralization is sufficient. These batteries, assigned to guard against a possible but not a certain danger, are necessarily few in number; and as their zones of action may be very extended, they have double reason for limiting their efforts to neutralization.

Methods of fire.—The circumstances justifying fire for neutralization are varied, but the proper methods of fire are simple and easily defined if we keep clearly in mind the object to be attained. This object is plain:—to prevent hostile artillery from acting effectively, in order that certain friendly troops, artillery or infantry, may accomplish unimpeded the work assigned them. Two cases are to be distinguished: either the hostile artillery to be neutralized has already been fired upon, or its presence is merely feared.

In the first case the firing data are known, and neutralization consists in a slow continuous fire, executed within the limits of the accepted bracket and kept up so long as no symptom of activity manifests itself along the front observed; as soon as the enemy resumes activity, however, we pass to rapid fire. In the second case we must first obtain the necessary firing data; then at the critical moment of the principal action[7] we direct upon the suspected area a slow continuous fire, to hamper the possible occupation of the position by the hostile artillery; finally, at the least indication of attempted occupation of the position, time fire at successive ranges, with the greatest possible rapidity, is called for.

The slow continuous fire is executed by piece, each chief of section being informed as to the front and the depth to be attacked by him, and as to the rate of fire. This rate may be different for the different pieces, and may vary with the time; certain pieces may even be silent for a while. The rapid fire, almost always with time fuzes, is executed by salvos or volleys at successive ranges, since this method enables us to restrict the fire in depth to the limits of the bracket, which means economy in ammunition, and also to change the corrector as well as the range, which is important in neutralizing a hostile battery behind a crest.

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[7] When the first line of infantry approaches the hostile position, for example; or when a counter attack has been launched and we fear to see it soon supported by artillery.

NOTES ON THE PARALLAX METHOD.

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(Originally published as No. 3 in the series of Regimental Notes of the 4th Field Artillery.)

I.—INTRODUCTION.

The Drill Regulations for Field Artillery discuss generally the determination of the deflection for the directing (right) piece, and the deflection difference, and give the following equations:

1. (For directing piece) ---------------- D=a+n (p—t).
2. (For converging fire) --------------- DD=p—t.
3. (For distributed fire) ---------------- DD=p—t+f/4.
4. (For parallel fire) -------------------- DD=p.

Equations (1) and (2) being assumed, equations (3) and (4) follow. But the Drill Regulations do not deduce equation (2); and, basing equation (1) on equation (2), deduce the former only for an observing station on the line of guns, and give no explanation of the changes in the signs of *p* and *n* for varying positions of aiming point and observing station, nor of the desirability of limiting the observing station to a position not more than 400 or 500 yards from the directing gun. Also the statement is made that "if the observing station is not on the prolongation of the line of guns, but is in advance or rear of that line, the interval between observing station and right piece must be measured perpendicular to the line joining the right piece and the target."

This case is presented in Fig. 1. Following the rule,

$$n=BG'/20,$$

which value would give the proper (approximate) value *nt,* but would not give the proper value of *np;* for the latter,

$$n=B''G_1/20.$$

In both cases the correction of *p* for obliquity to the line G_1G_2 would be the same. The angle G_1pB' would be obtained instead of the angle G_1pB''; consequently attempts to use the rule result in considerable error when the obliquity of *p* is appreciable.

To use the parallax method with the facility essential to success requires a thorough knowledge of the underlying principles and almost constant practice in their application. The purpose of these notes is to inculcate these underlying principles so thoroughly that their application can be made without mental effort and independently of reasoning or memory; in fact, subconsciously.

II.—PARALLAX.

In Fig 2, let *p* represent any distant point, and G_1G_2 a platoon front (20 yards), to which the line G_1p is normal. Then the angle

G_1pG_2 (in mils) =

This angle G_1pG_2 (=p) is the *parallax* of *p* at G_1. A better term would be "normal parallax," since it is the parallax of *p* with respect to the normal front G_1G_2.

Let P be any point not on the normal G_1p, such that $G_1p=G_1p$. Then the parallax of P with respect to the front $G_1G_2=p \cos a$, since for small angles

$$P : p :: G_1G' (=G_1G_2 \cos a) : G_1G_2,$$

whence

$$P=p \cos a.$$

The angle *a* is termed the *obliquity* of point P with respect to front G_1G_2. The term "rectified parallax" will be used to indicate the parallax of any point with respect to a given point on a given front. The rectified parallax (P) is equal to the normal parallax (p) when the obliquity is zero, and becomes zero when the obliquity is 1600 mils on either side of the normal.

The rectified parallaxes for various ranges and obliquities are entered in tabular form on the back of the battery commander's ruler. They can also be determined mentally as follows:

First:—p=

Second:—Decrease *p* by the sum of the series of as many tenths as there are 400 mils of obliquity, thus:

Obliquity	400,	take	1—0.1=0.9p.
"	800,	"	1—0.1—0.2=0.7p.
"	1200,	"	1—0.1—0.2—0.3=0.4p.
"	1600,	"	1—0.1—0.2—0.3—0.4=0p.

III.—DETERMINATION OF DISTANT ANGLES BY PARALLAX.

The rectified parallax affords a ready means of determining the angle subtended by two lines passing through a distant point (e. g., a target or aiming point) provided the length of base intercepted by these two lines can be measured.

(a) In Fig 3 the line G_1T is assumed normal to the line BG_1; G_1T=2500 yards; BG_1=400 yards. Then the rectified parallax of T, which is in this case the same as the normal parallax, is 20/2.5=8; and by the proportion in II, *supra*,

$$\text{angle } G_1TB= \quad T= \quad 8=160.$$

If the parallax be accurately determined, angles can thus be calculated with sufficient practical accuracy up to about 400 mils, at which limit the error is 12 mils, due to the excess of the tangent over the chord. But any error in the determined parallax is multiplied by *n* in the result; hence the necessity of limiting the length of BG_1 to 400 or 500 yards.

(b) In Fig. 3, assume the line G_1P to make an angle of 800 mils with the normal to the front. Then

$$P= \quad 0.7=5.6$$

$$\text{Angle } G_1PB=\frac{400}{20}5.6=112 \text{ mils.}$$

A more accurate result is possible if an estimate of the mean obliquity along the line BG_1, and of the mean distance be made and used in the computations; e. g., the mean obliquity of P to the front BG_1 is about 850 and mean distance to P about 2650. Then

$$P= \quad 0.65=5,$$

which may be called the *mean rectified parallax;* and

$$\text{Angle } G_1PB=\frac{400}{20}5=100 \text{ mils.}$$

By trigonometrical calculation G_1PB=103 mils.

(c) From (a) and (b)

$G_1TB=nT$, and

$G_1PB=nP$.

IV.—DEDUCTION OF THE GENERAL FORMULA.

The unit of angular measurement is taken as the mil. Angles at B and G are measured counter-clockwise from P. B is at any point at which the angle PBT (=A) can be measured. G is any point at which the angle PGT (=D) is desired in terms of A and the angles BPG and BTG. T and P are respectively the mean rectified parallaxes of T and P with respect to the line BG. Also

n=

Then by III (c), BTG=nT and BPG=nP. T is considered as always in front of the line BG. If T be on BG or its prolongation, its parallax is zero, since its obliquity to the normal is 1600 (see II); and it is immaterial which side of BG is considered the front, since if the latter be changed the signs of both P and *n* change, and their product is algebraically and numerically the same. P may be either in front or rear of BG, or on its prolongation; in the latter case its parallax is zero. B may be either to the right or left of G.

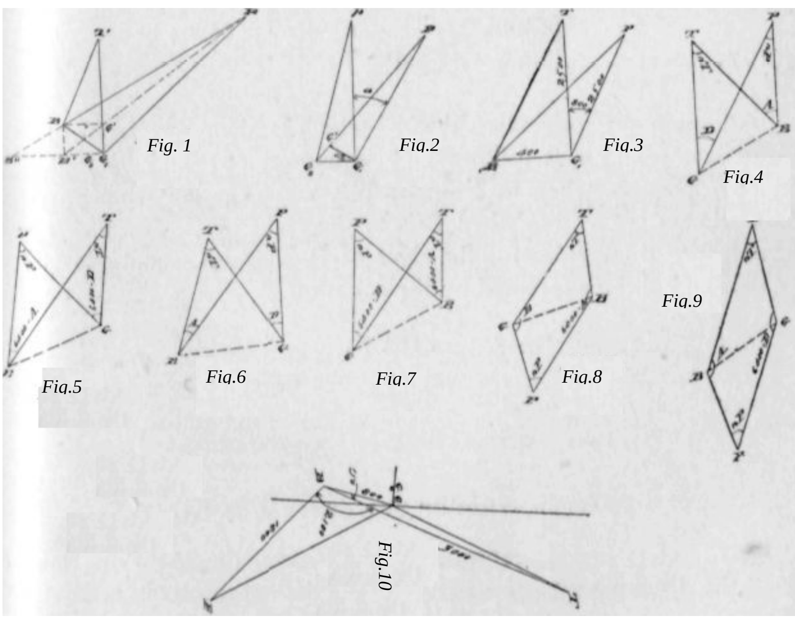

Fig. 1 *Fig.2* *Fig.3* *Fig.4* *Fig.5* *Fig.6* *Fig.7* *Fig.8* *Fig.9* *Fig.10*

Figs. 4 to 9 therefore represent all cases that can exist in which T and P have values other than zero. For the latter case see the paragraph following equation (11).

From Fig. 4

D+nT=A+nP; hence

(5) ------------ D=A+n (P—T).

From Fig. 5

(6400—D)+nP=(6400—A) +nT; hence

(6) ------------ D=A+n (P—T).

From Fig. 6

D+np=A+nT; hence

(7) ------------ D=A—n (P—T).

From Fig. 7

(6400—D)+nT=(6400—A)+nP; hence

(8) ------------ D=A—n (P—T).

From Fig. 8

D+(6400—A)+nP+nT=6400; hence

(9) ------------- D=A+n (—P—T).

From Fig. 9

(6400—D)+A+nP+nT=6400; hence

(10)-------------D=A—n (—P—T).

Adopting the convention that T, which is always in front of BG, is always positive, it follows from equations (5) to (10) that P is always positive when in front of BG, and negative when in rear; also that *n* is positive when B is to the right of G, and *vice versa*. Subject to these rules for the signs of P, T and *n*, equations (5) to (10) may all be expressed by the equation

(11) ---------D=A+n (P—T),

which is entirely general.

If P or T=0 the corresponding factor disappears.

V.—APPLICATION OF THE GENERAL FORMULA.

(a). Let B and G represent, respectively, the observing station and the directing gun of a battery, T and P, respectively, target and aiming point. Practically, the obliquity of T to the normal *to the* *front of the battery* will never exceed 400 mils; hence its obliquity in Cases 1 and 2, and in V(b), may be taken as zero. Three cases may arise:

1.—BG coincides approximately with the line of guns; P is within 400 mils of the normal through G to the line of guns.

This is the normal case given in the Drill Regulations. Equation (11) should give accurate results provided *n* does not exceed 20 or 25.

2.—Same as Case 1, except that P is not within 400 mils of the normal through G to the line of guns. P must be corrected for obliquity. If the obliquity is great and *n* large, the result will be more accurate if the mean rectified parallax of P along the line BG be used.

3.—*BG makes an appreciable angle with the line of guns. This is the general case. Obtain the mean rectified parallax of T and P along the line BG; determine D from equation* (II).

(b). *Convergence difference*.—Let B and G represent, respectively, the directing (right) gun of a battery and gun No. 2, T and P, respectively, the target and aiming point. Since B (Gun No. 1) is to the right of G (Gun No. 2), *n* is positive and equal to

= =1.

By equation (11), if P is in front

(12)............D=A+ (P—T);

if P is in rear,

(13)............D=A+ (—P—T).

Since A in this case is the deflection of Gun No. 1, the second term of equation (12) or (13) is the deflection for Gun No. 2, and so on, provided the guns are at normal intervals. That is, for converging fire,

(14)............DD=P—T,

in which P is positive when in front of the line of guns, negative mal DD may be corrected after the first salvo, but if the intervals when in rear. If the intervals are fairly regular but not quite nor-are very irregular or abnormal (e. g., guns of a battery widely separated to simulate several batteries) it is best to determine the deflection for each gun; thus:

D for directing gun being determined per V (a), let D_2, D_3, D_4 represent the deflections for Guns Nos. 2, 3, 4, respectively, and n_2, n_3, n_4 the distances in platoon fronts from Gun No. 1 to the other guns, respectively. Then

(15) ------------ $D_2=D+n_2$ (P—T).
$D_3=D+n_3$ (P—T).
$D_4=D+n_4$ (P—T).

This method may also be used by a battalion or higher commander to obtain the deflection of the directing gun for each of several batteries on the same line. But in either case if the observing station be appreciably off the line of guns it is better to determine D independently per V (a), for all guns more than 500 yards apart.

(c). *Distributed fire*.—F=front of target in mils. Therefore the section of target for each gun=F/4. If, then, the deflection difference for converging fire be increased by F/4, and the right gun be directed on the right section of the target, the sheaf of fire should cover the target; i. e., for distributed fire,

(16) ------------ DD=P—T+F/4.

(d). *Parallel fire*.—If the lines of fire of the guns are parallel to each other they are directed upon points a platoon front apart; i. e., F/4=T. Hence for parallel fire equation (16) becomes

(17) ------------ DD=P.

(e). *General example* (see Fig. 10).—

A=2100.
n=800/20=+40.
P=+7 (mean distance, estimated, 2000; mean obliquity to BG, estimated, 800).
T=+1.5 (mean distance, estimated, 2700; mean obliquity to BG, estimated, 1400).
D=2100+40 (7—1.5)=2100+220=2320.

By actual calculation D=2326.

To get deflection difference parallaxes must be taken with respect to the line of guns. Hence

P=—7 (distance from G_1, estimated, 2200; obliquity to G_1G_2, estimated, 740).
T=+8.5 (distance from G_1, estimated 2300; obliquity negligible).

For converging fire

DD=P—T=(—7—8.5)=—15.5.

Fractions of a mil have here been considered in order that the accuracy of the method might be demonstrated.

VI.—CONCLUSION.

In the field no trouble should be experienced in the determination of D and DD. Much practice is, however, indispensable to rapid and accurate work. It should be borne in mind that *the line along which the transformation is being made* determines the signs of P and *n*, and that the *front* with respect to this line is *toward the target*.

NOTES ON THE EMPLOYMENT OF SPECIAL DETAILS.

Prepared at the School of Fire, Fort Sill.

AGENTS.

Although in time of peace Agents of Communication are not permanently detailed, they should always be designated, instructed and employed as contemplated by Drill Regulations. In a battery all of the caisson corporals and at least one of the sergeants should be made available for this duty.

Agents from the batteries and battalions report to the next higher commander at the formation of the battalion or the regiment and remain at battalion or regimental headquarters until dismissed except when sent away on duty. It should never be necessary for the major or the colonel to *send* for the prescribed agents: it is the duty of subordinate commanders to detail them and to see to it that they report promptly and are suitably equipped for their duty. Even when there has been no battalion or regimental formation, a battalion or regimental commander supervising the drill or instruction of batteries may require agents at times and should, in such cases, send for them. In the field agents should mess and be quartered with headquarters.

Agents, in alphabetical or numerical order from right to left should ride immediately in rear of the musicians and orderlies, and in front of the non-commissioned staff so that they may be called readily. In calling for them their names should never be used, but they should be spoken of as, for example, "Agent, A Battery" or "Agent 2nd Battalion." The practice of calling for "All Agents" when the same message or order is to be sent to all batteries or both battalions will always save time because the order or message will have to be stated but once.

When an agent is required the word should be passed to the man designated by all who hear it. This will make it unnecessary to shout when calling for an agent. The agent required should move promptly at a trot, salute and report, for example, "C Battery Agent reports, Sir!" He will then be given a message and told where he is likely to find the person to whom it is addressed and instructed what to do in case the person designated cannot be found. He will be required to repeat the message before starting away and expected to report upon his return. If the message is a written one, it should be plainly addressed, and its urgency stated in writing. The agent should be instructed to bring back the initialed envelope as a return receipt.

While with headquarters agents are not subject to the orders of other officers; and all officers should be cautioned not to delay them by asking questions. In this respect they differ from scouts who are expected to give information to any officer who may properly call for it.

Agents are primarily for the purpose of carrying messages between headquarters and the organization from which they are detailed. In exceptional cases they may be used by headquarters as scouts or signal men.

SCOUTS.

Battery Scouts.

All the caisson corporals are instructed as scouts, and two of them are designated for this duty daily. For purposes of instruction all the caisson corporals available may be used at drill in addition to the two prescribed by drill regulations.

Scouts report to the Battery Commander at the formation for action, or at any prearranged signal, as prescribed for the Chief of the 5th Section.

They remain with the Battery Commander until they are dismissed, or until they are assigned some specific duty. Upon completion of any duty they should be required to return and again report.

In general, scouts are employed:

(a) To obtain information concerning the enemy and friendly troops.

(b) As route markers and guides.

(c) In reconnaissance to find and identify targets.

(d) To keep targets or sectors under observation.

(e) To assist in reconnoitering gun positions and to mark the position of one of the flank guns in the position selected.

(f) To carry messages.

(g) To act as members of an observation patrol on unprotected flanks.

(h) To act as horseholders.

To go more into detail, they are employed under these heads as follows:

(a) Battery scouts are seldom required to be used to obtain information concerning the enemy and friendly troops because these duties pertain to the functions of battalion, regimental and higher commanders; but in rare cases when batteries are acting alone, especially in advance and rear guard duty, such employment may be required; and they should then be used as prescribed for patrols by Field Service Regulations.

(b) They are used as route markers and guides when the Battery Commander precedes the battery for the purpose of making a reconnaissance or reporting to a higher commander. It should be generally understood amongst the officers of a command that no markers are required:

(1) When the march is to be continued along the main highway and there is no possibility of mistaking a minor road for the main highway.

(2) When the march is to be continued along a straight road or in any direction previously agreed upon without turning to the right or left and when there can be no reasonable doubt as to what is the straight road or proper direction. It should be understood that an officer is justified in keeping straight ahead unless a marker is seen.

Markers are especially required:

(1) At night.

(2) When any reasonable doubt as to the correct road could arise.

(3) In entering or leaving a city of any size. It is easier to lose the road in leaving a city than in entering it.

(4) Wherever there is a difficult piece of road, a bad ford or a suitable watering place for the command.

When a marker is left at a point, he should be informed:

(1) The route to be followed, and the gait desired by higher authority.

(2) The organization to be guided.

(3) The exact message to be delivered.

(4) Whether he is to rejoin his command when the message is delivered, or remain and guide the organization to the next marker.

It is important that an officer, having received information from a marker, should himself leave another marker at the same place in order to guide organizations in rear of his own.

(c) In reconnaissance, upon approaching the general locality of the position the Battery Commander should inform the scouts as to the general situation, what is known of the enemy or the targets and what his instructions or plans are. If the Battery Commander is reporting to a higher commander, the scouts should go with him and remain in a group mounted behind the crest until sent for. In sending for scouts they should be designated "1st Scout," "2nd Scout," etc., and not by name.

As soon as the Battery Commander has been assigned and identified a target, he should send for a scout and require him to keep the target under observation at all times unless he is assigned to other duty.

If the Battery Commander is not reporting to higher authority but is himself conducting a reconnaissance, he should direct his scouts to spread out over the available crest and look for targets. If a scout finds a target, he should signal to another scout to join him, point out the target found, and leave the second scout to observe in his place while he himself reports at once to his Battery Commander.

(d) After a target has once been identified by a Battery Commander he should require at least one of the men with him to keep it under observation continually, reporting change, disappearance, reappearance, movement or destruction. While the Chief of the 5th Section is busy setting up his instrument, the Battery Commander should require one scout to watch the target and point it out again to the Chief of the 5th Section when he is ready.

(e) By the time the Battery Commander is ready to designate gun positions it is assumed that the scouts with him have been told:

(1) The location of the enemy and friendly troops;
(2) the problem assigned the Battery Commander; and
(3) the target and its approximate range.

The scouts will then be prepared to assist him in finding a position for the guns:

(1) in which the necessary amount of defilade can be obtained;
(2) which will not encroach upon the ground assigned other batteries or other troops;

(3) from which aiming points can be seen if possible; and

(4) from which fire can be delivered upon the target or in the sector at the minimum assumed range without danger of obstruction from the height of the mask.

The gun position having been decided upon, the exact location of one of the flank guns is usually indicated by posting a scout at that location facing in the direction of fire with one arm extended in that direction and the other in the direction towards which the line of guns is to be prolonged. The gun indicated is usually the flank gun nearest the Battery Commander's station; but if the battery is acting in battalion, or if for any other reason the extent of the position is limited or there is possibility of encroaching on the ground assigned to other batteries or troops, it is advisable to post the scout at the position to be occupied by the flank gun which is to limit the position of the battery. In this case the battery should always be brought in from this flank in order that the gun in question may be unlimbered when it reaches the point marked by the scout. If it were brought in from the other flank, before the carriages straightened out the battery might easily extend past the scout and on to the ground occupied or assigned to other batteries or other troops. As soon as the executive officer* in command of the guns reaches him the scout should be prepared to give the following information or such of it as may be considered by the Battery Commander as appropriate to the occasion:

(1) The direction of fire.

(2) The location of one flank gun and the prolongation of the line.

(3) The location selected for the limbers.

(4) The aiming point selected by the Battery Commander; or, if none has been designated, the location of suitable ones. If no common aiming point is available, the Battery Commander's instructions as to reciprocal laying.

(5) In addition to the above, ordinarily all the firing data should be given in writing to the scout for transmission to the executive officer as soon as he arrives in the position;

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* The term "Executive Officer" as used in these notes means the senior officer or when no officer is present the senior non-commissioned officer actually present with the battery. He is responsible that the commands sent to the battery are promptly and accurately executed. His function ceases when the battery commander is so close to the battery that he can actually command it by word of mouth.

but the scout should not be required to keep in his mind or to transmit verbally anything more than is indicated by (1), (2), (3) and (4) of the above sub-heads.

(f) Messages carried by battery scouts are usually limited to those sent to the executive officer, to the limbers, and to the combat train.

Scouts used as messengers are guided by the same instructions and should be employed in a similar manner as prescribed for agents of communication.

By coöperation and "team-play" between the Battery Commander and the executive officer, the length and number of messages passing between them can be reduced to a minimum.

For example, before leaving the battery, the Battery Commander should furnish the executive officer and the other lieutenants with the battery, with all the information concerning the situation which he himself has received. Upon going forward from the battery on reconnaissance or to report to a higher commander it is feasible to have a general understanding with the executive officer that he will form and prepare for action and follow the route taken by the Battery Commander and, if possible, at a gait one degree slower than that taken by the Battery Commander. Upon reaching a point from which he can see the Battery Commander's station and the gun position as indicated by a scout, the executive officer can usually tell at a glance whether or not the position is ready for occupancy. If it is he should at once occupy it, depending upon the information previously received from the Battery Commander, the special information received from the scout and the method of occupation generally adopted in the battery. If it is evident that the position is not ready for occupancy, the executive should halt and wait for instructions. If the Battery Commander sees that for any reason it is not advisable to have the battery follow closely, if it is in sight he should sound his drill whistle and signal "Halt"; if it is not in sight, he should send appropriate instructions to the executive officer by a messenger scout. In any event, the method here suggested will always save time, and is for many reasons preferable to leaving the executive officer and the battery far in the rear waiting for instructions which are usually almost identical in every case. This method has the added advantage of giving the executive officer an interesting duty which requires initiative and judgment.

(g) A battery is generally a technical rather than a tactical unit; and a battery commander is responsible for the protection of his flanks only when he is acting alone without supports or when especially directed by higher authority to send men to an unprotected flank. Scouts are then sent out with instructions to act as an observation patrol and to give immediate warning by visual signals or messages of the approach of any body of the enemy and also of the arrival in position of any friendly troops which will protect the flank formerly unguarded.

(h) Musicians and mounted orderlies should ordinarily be employed as horseholders in preference to scouts, who are specially instructed men, intended to be used for the specific duties herein laid down. No scout should be used as a horseholder when a musician or mounted orderly is available; and no musician or mounted orderly should be used as a scout or messenger when a scout or an agent is available. No musician or mounted orderly should be permitted to decline to hold the horse of an enlisted man detailed on information or communication service, although a sense of military propriety will usually prevent the turning over of horses to the musicians or orderlies on duty with higher commanders.

Battalion and Regimental Scouts.

With obvious modifications the employment of battalion and regimental scouts is similar to that laid down for battery scouts; but their duties are more varied and general than those of battery scouts. They do not require the detailed knowledge of gun positions which battery scouts must have; but in their employment they are more often used to find the way through unknown country, to use and prepare maps, road, position and panorama sketches, and to reconnoiter and report upon roads, streams, fords, camp-sites, towns and artillery positions. They are frequently used as road markers as prescribed for battery scouts. They are not used as messengers to organizations when agents of communication from those organizations are present and available.

CHIEF OF THE FIFTH SECTION.

Co-operation between the Battery Commander and a well-instructed Chief of the 5th Section contributes greatly to the speedy and successful occupation of position and to the prompt and effective delivery of fire.

While the battery is in position no non-commissioned officer is closer to the Battery Commander or of more assistance to him than the Chief of the 5th Section, provided that he is the right sort of man, well instructed and *properly employed*.

The non-commissioned officer selected as Chief of the 5th Section should preferably be a young man with good character, eye-sight and judgment. A man who has had habits or any tendency toward absenteeism or whose eyes are old or weak should not be considered for the position. An ambitious man, eager for advancement and interested in his work, is naturally to be preferred.

The non-commissioned officer selected should receive thorough, painstaking instruction from the Battery Commander personally. Once instructed, his value and ability will increase rapidly through daily experience and the actual performance of his varied duties.

To be of the greatest assistance the Chief of the 5th Section should be employed in a uniform and rational manner, in order that he may be able to anticipate what is to be required of him, and that the Battery Commander and the man may each know what to expect from the other. If the Chief of the 5th Section is employed in an erratic manner, never knows what is to be required of him or receives vague directions, he can be of little value.

Chiefs of platoon should be instructed as to the method of employment adopted by the Battery Commander in order that when they are acting as battery commander they may obtain full value from the work of the Chief of the 5th Section, and also in order that the Chief of the 5th Section may be able intelligently to cooperate with them as well as with the Battery Commander.

The Chief of the 5th Section should be well instructed in the general duties as Chief of Section in the care of men, horses and matériel pertaining to his section in the battery. In addition he is charged with the special care of the instruments and equipment carried in one of the limbers of his section. The telephone corporal should be attached to the 5th Section, and has charge of the telephones and signal equipment, but is under the general supervision of the Chief of Section.

In addition to these general duties he should be instructed especially along the following lines:

(a) The construction, care, operation and adjustment of the Battery Commander's Telescope as laid down in the Handbook of the

3-inch Field Artillery Matériel, pages 123 to 130; the use, care and adjustment of field glasses, including the measurement of angles by means of glasses; the use of the Battery Commander's Ruler; and the keeping of neat and concise notes.

(b) The measurement of angles by means of the telescope, ruler, field glasses or hands.

The system of angle measurement adopted by the artillery service and its employment should be carefully explained. The relation of the value of one mil at any given range should be understood thoroughly.

All the methods of measuring the following angles should be explained and frequently employed:

(1) The angle between the aiming point and the target.

(2) The angle of site.

(3) The front of the target and the relative interval in mils between sections or portions of the target.

(4) The interval in mils to prominent points of reference for observing errors in deflection.

(5) The height in mils of prominent points of reference for observing errors in height of burst.

(c) The calculation of firing data including:

(1) The "P minus T" method as laid down in the Field Artillery Drill Regulations, paragraphs 419-433.

(2) The graphical (or parallel) method, by means of the measurement of an angle whose sides are parallel to the angle at G′ desired. At first this method will probably seem more difficult than the "P minus T" method on account of the feeling that, by the use of actual calculations on paper, something tangible is obtained, which, at the beginning seems to be lacking in the graphical method; but the frequent use of explanatory diagrams and practical examples, insisted upon until the method is clearly understood and its advantages appreciated, will, in most cases, result in a preference for it over the "P minus T" computation. It has the great advantage of precluding a cumulative error in the wrong direction.

(3) The necessary corrections to adjust the sheaf after the initial error in deflection and deflection difference has been observed.

(d) The Observation of the Target.—It is important that the Chief of the 5th Section appreciate the importance of keeping the target under observation at all times, noting changes, movement, disappearance, reappearance and obvious effect of fire.

(c) The Chief of the 5th Section should be instructed in the Observation of Fire as follows:

(1) Deflection.—Look for the first shot with the naked eye. Then with field glasses or telescope, if possible, measure the error in deflection, either on the scale in the field of view or by turning the telescope in azimuth. If impossible to measure the error in the first shot, measure that of the second and all subsequent shots until the deflection and the deflection difference are adjusted.

(2) Height of Burst.—Measure and be prepared to report accurately upon the height of burst of all observable shots, classifying bursts in 3-inch field artillery practice as follows: "Below (below target); "Graze" (actual percussion bursts in which no white smoke-ball can be seen); "Low" (0 to 1 mil high); "Normal" (2 to 4 mils high); "High" (4 to 6 mils high); "Very High" (above 6 mils high).

(3) Range.—Although the Battery Commander is alone responsible for the sensing of shots for range, the Chief of the 5th Section should be trained in such observation in order that, in emergencies, he may furnish reliable information. To this end he should be instructed:

(1) That, with respect to bursts of time shrapnel, it is impossible to sense shots

(a) that are not sufficiently correct in deflection to be on line with some portion of the target.

(b) that are more than 1 mil high.

(c) and that all such unobservable shots should be reported as "indeterminate" or "doubtful," and that nothing is more disastrous to proper adjustment than an attempt to sense such shots.

(2) That, in dry weather, or with particularly favorable slopes in front or in rear of the target, it is sometimes possible to form an opinion as to the range of otherwise unobservable shots on account of the dust kicked up by fragments, fuses or shrapnel bullets, but that all such observations should be recorded as "Fragments over" or "Fragments short."

(3) That, with respect to percussion bursts, it is also impossible to sense shots which are not sufficiently correct in deflection to be on line with some portion of the target, except that with exceptionally favorable slopes in front of the target a percussion burst may be sensed as short when the shot obviously falls in a portion of the terrain known to be in front of the target.

(4) That percussion bursts may otherwise only be sensed when smoke, dust or fragments are thrown up in front of the target by "shorts" or behind the target by "overs;" and that, due to the similarity often existing between the color of the target and the color of the percussion burst, they are usually more difficult to observe than time bursts.

(5) That, of observable time bursts

(a) Shots are short when the smoke-ball appears in front of the target or immediately drifts in front of it. (The danger of being deceived by the drifting of the smoke-ball due to wind blowing up or down the range should be explained.) "Shorts" are also indicated by the appearance before the target of the shadow cast by the ball of smoke, *when the sun is behind the observer*.

(b) Shots are over when the smoke-ball appears behind the target, and the target is silhouetted against the white smoke. Such an observation often discloses a target otherwise invisible.

(c) Salvos or volleys are "Bracketing" when shots in the same salvo or volley are observed as both "short" and "over." They indicate the range of the target *but usually too long a range for effective time fire*.

(6) That obvious effect on the target is indicated by the knocking down or blowing up of portions of it.

The Battery Commander should be accompanied by the Chief of the 5th Section at all times after leaving the battery for the purpose of reconnaissance or of reporting to a higher commander. To this end the Chief of the 5th Sction, equipped with the Battery Commander's Telescope, field glasses, Battery Commander's Ruler, notebook and pencils, should be instructed to report to the Battery Commander when the battery is subdivided for action, or at any prearranged signal, and to remain with him until a station is established or he is dismissed.*

When first approaching a crest the Chief of the 5th Section and the other battery details should halt behind it and remain mounted until sent for or assigned other duty. They are then ready to proceed promptly to another position, if necessary.

As soon as the Battery Commander has found or been asssigned his target or his sector of observation, he should at once call up the Chief of the 5th Section, point out the target or sector, designate an

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*Three blasts of the drill whistle have been found to be an excellent signal for summoning the Chief of the 5th Section and the other battery details.

aiming point, and indicate, at least in general, the position of the battery. If this information is not furnished the Chief of the 5th Section he should ask the battery commander for it. As soon as he is sent for the Chief of the 5th Section should dismount, turn his horse over to the nearest horseholder, and run forward with the instrument, taking advantage of all cover, and report to the battery commander.

Having received his instructions, the Chief of the 5th Section at once sets up his instrument, unless he is directed not to do so, selecting a position for it and setting it up at such a height that *full advantage of all available cover is taken.* He then rapidly gets the target under observation and keeps it at all times under observation, thus leaving the Battery Commander free to select and designate definitely the position of the battery. If he is instructed not to set up the instrument he should observe the target with his field glasses and make the required angle measurements with the ruler, field glasses or hand.

Having got the target under observation, the Chief of the 5th Section should be required without further instructions to perform the following duties, or such of them as time will permit:

(a) Measure and record the angle from the aiming point to the target.

(b) Measure and record the angle of site.

(c) Measure and record the front of the target in mils and the intervals between the sections or portions of it.

(d) Measure and record the interval from the target to any prominent marks in the terrain and the height in mils to any good reference points, thus establishing a graphical scale to which errors in deflection and height of burst may be referred.

(e) Calculate the deflection and deflection difference by any method prescribed by the battery commander.

(f) Make a panorama sketch of enemy's position.

(g) Determine the gun position from which the crest can be cleared at the given range and angle of site by taking from the Battery Commander's ruler the angle of departure in mils, and, with proper correction for angle of site, subtracting it from 300, setting it off on the Battery Commander's telescope and finding the point in the gun position where the line of sight of the telescope cuts the ground. Any gun position in rear of this point will clear the crest at the assumed range.

The above duties should be performed by the Chief of the 5th Section regardless of whether the Battery Commander is to make use of them or not. The more a Battery Commander can rely upon the Chief of the 5th Section to perform these duties accurately, the freer he is to concentrate his own mind on his own observation of the target, the transmission of commands to the battery, the observation of fire, the corrections to be made during adjustment and the prompt delivery of fire for effect.

During the delivery of fire the Chief of the 5th Section should observe the target at all times, and should record his sensing of each shot.

The Battery Commander should never delegate to any one else the all-important duty of sensing each shot for range, deflection and height of burst; but in order to provide for emergencies when the Battery Commander may be absent or disabled, the Chief of the 5th Section should be prepared to furnish information regarding previous fire or even temporarily assume direction of the fire himself.

The Chief of the 5th Section should at once report any obvious effect on the target.

When new targets appear or are assigned, the Chief of the 5th Section should be at once notified and required to obtain and record the same data in respect to them as were obtained for the initial target.

When the Battery Commander's station is to be closed or moved the Battery Commander should notify the Chief of the 5th Section promptly in order that there may be no unnecessary delay in packing the telescope or getting the horses up.

If the Battery Commander is disabled or relieved, the Chief of the 5th Section should be prepared to furnish his successor with all the information previously obtained or recorded.

FRENCH FIELD ARTILLERY DRILL REGULATIONS, 1910.

FIRING INSTRUCTION

Translated by LIEUTENANT COLONEL J. E. MCMAHON, GENERAL STAFF.

CHAPTER IV.

ARTICLE II.

MANAGEMENT OF THE TRAJECTORY IN THE PLANE OF FIRE.

170. In the course of an engagement the captain may be called upon to utilize the relations existing between the range, the angle of site and the corrector, which are as follows:

The trajectory depends upon the angle of site and the range. The trajectory can be changed by changing one or the other of these elements, and the same trajectory can be retained by changing both elements in an inverse sense by appropriate amounts.

A change in the angle of site has the same effect on the range as an equal change in the angle of departure. It is given by the range table.

The height of burst depends upon the angle of site and the corrector only.

A division of the corrector corresponds to a variation in the height of burst of one mil. To raise the height of burst, increase the corrector; to lower it, decrease the corrector.

If the angle of site is changed, the height of burst is changed, but not the burst interval; if the corrector is changed, both height of burst and burst interval are changed; if the angle of site and the corrector are changed in an inverse sense by equal amounts, the height of burst remains the same, but the burst interval varies.

The burst interval depends upon the range and the corrector only.

The burst interval is increased or decreased by increasing or decreasing the corrector. A change of 1 mil in the corrector corresponds to a change in range of about 25 yards at 3000 yards, and of about 50 yards at 1000 yards.

The point of burst is fixed in position only when the three elements which determine it remain constant, or when they are all three changed by the proper amounts.

The difference in range given in the range table for a given variation in the angle of departure does not hold true unless the ranges are measured in the same plane. If the ground slopes uniformly toward the battery firing, the true difference in range is less than that given in the range table; on ground that slopes in a contrary sense (ground behind a crest), the true difference of range is greater in proportion as the slope increases.

APPLICATIONS.

171. (a) If one of the elements of fire is incorrect, for example, the angle of site, the error can be corrected only by changing the other elements, the range and corrector.

The range found by adjustment therefore corresponds to the true range only when the angle of site used is correct.

(b) If it is desired to use the elements of adjusted fire found by a neighboring battery, the three elements must be furnished. If only the range and corrector are received and used, the burst interval obtained with these two elements will be correct, and the point of burst must be brought back to its proper height by a change in the angle of site.

(c) After the first adjusting salvo with time fire, using the normal corrector, it will be advisable to correct the height of burst, if it is evidently abnormal, by a change in the angle of site, for the observed error is an indication that the wrong angle of site has been used.

(d) If, during adjustment, the angle of site has been changed, the adjustment for range must be commenced anew.

(e) (This sub-paragraph furnishes data applicable only to the French matériel).

(f) If the enemy succeeds in reaching the dead space in front of a battery, he cannot be reached by ordinary means; a certain effect, however, may be produced by bursting the projectiles on a trajectory corresponding to the minimum range. To do this it suffices to raise the corrector progressively.

The effect that can be produced in this way, always inferior to that obtained with the real trajectory passing through the target, depends upon the trajectory resulting from the mimimum range and the angle of site used, and upon the profile of the ground passed over by the trajectory. Upon horizontal ground, with angle of site 0, range 1300 yards, the effects are appreciable even when the target is under the highest part of the trajectory. If the range is greater than 1300 yards and the points of burst are raised, the effect decreases rapidly and ceases to be appreciable when the target has advanced 200 or 300 yards under the dead space.

(g) A target scattered over a glacis sloping toward the battery can not be covered in all parts by time fire, unless the points of burst are moved in a plane parallel to the ground, which is accomplished practically by simultaneously increasing (decreasing) the range and the corrector.

The relation between the changes made in the two elements modified depends upon the slope of the glacis.

(h) Against a target hidden by a crest, it is always advisable to fire as against a deep target. To take into account the slope of the ground behind the crest, the increments in range are combined with decrements in the corrector setting. The steeper the slope, the less should the changes be made with the range and the more with the corrector.

(i) Against a target whose elements have the same range but different angles of site, a different angle of site should be used for each piece.

(j) Against a target whose elements are in the same plane of site but at different ranges, the range should be changed for each piece.

(k) Against a target whose elements are at different ranges and in different planes of site, at the opening of fire different angles of site should be used; when errors in range become apparent, a different range should be employed for each gun.

ARTICLE III.

PRINCIPLES GOVERNING OBSERVATION OF FIRE.

172. *Observation of errors in direction*.—To determine accurately the sense of direction errors the observer must be near the piece that has fired. Observation from a lateral position may cause considerable errors, especially when the shots are fired at ranges which materially differ from the true range.

173. *Observation of heights of burst*.—Height of burst is measured from the foot of the target, unless the latter is sheltered by entrenchments or is behind a crest. In these cases it is measured from the top of the covering crest.

A burst is said to be *very high* when its height is greater than twice the normal height; *high,* when it is greater than the normal; *low,* when it is less than the normal. A burst below the plane of site should be regarded as on impact. The height of a salvo is the mean of all the bursts in the salvo.

174. *Observation of errors in range*.—Adjustment for range is based upon determination of the sense of the points of impact of percussion projectiles or of the points of burst of projectiles burst in the air. It is, therefore, essential to observe with great care, and, on the other hand, to take no account of doubtful bursts.

If the smoke hides the target, the burst is *short;* if the target is silhouetted against the smoke, the burst is *over*. However, the range corresponding to a burst whose smoke has obscured the target, is not to be considered as short, unless the height of burst of this round is less than half the normal height.

A time burst observed as *over* always indicates a range too great, whatever be the height of burst.

When no smoke is visible, dust and debris knocked up by the impact of the projectile may furnish information.

If the ground on which the target is placed inclines towards the battery, the shot is *short* or *over,* according as the point of impact is seen below or above the target. A salvo is said to be *short* or *over,* as the majority of the shots observed are short or over. Shots "at the target" may be regarded as either short or over. A bracketing salvo is one that is made up of two shorts and two overs, provided all the parts of the target are at the same distance from the battery. A bracketing percussion salvo should be regarded as giving the most probable range of the target. A bracketing time salvo should be considered as indicating a range that is *over;* the range that gave the bracketing salvo is nearly the true range. In all cases account should be taken of the effect produced on the target by a salvo or round, provided this effect has been observed with certainty.

The observing officer, as soon as he has formed an opinion on the sense of a salvo, should note it as *over, short, bracketing* or *doubtful*. It is advisable, however, to allow time for the smoke to form. The decision should be especially prompt when high explosive shell is used, because the ball of black smoke upon which the observation has to be made, is extremely fugitive.

175. In certain cases (night firing, firing against balloons) great

difficulty would be experienced in determining the sense of errors in range by direct observation made from the vicinity of the battery. Recourse is then had to lateral observation. The direction having been adjusted and the observer having taken position, for example, to the right of the battery, all rounds observed to the right of the target will be *over*, all rounds seen to the left will be *short*. The greater the difficulty in adjusting the direction and the greater the distance from guns to target, the greater should be the distance from guns to observer.

For night firing, the direction of the guns and the alignment of the observation station on the target (or the aiming point) are accomplished by means of stakes carrying lanterns.* The pointing instruments are illuminated as indicated in Vol. II (No. 24). An observer placed near the directing gun verifies the direction, the captain at the observing station verifies the range and corrector setting. To adjust the height of burst, effort is made to pick out a datum line; the B. C. telescope can then be used if the micrometer be illuminated.

PRINCIPLES GOVERNING ADJUSTMENT.

176. Adjustment of fire comprises three operations; adjustment in direction, height of burst and range. In principle these three operations are carried on simultaneously.

177. *Adjustment in direction*.—The operation of adjusting for range is effected as follows: (1) Put the right of the sheaf on the right of the target; (2) Adapt it to the front to be covered; (3) Regulate it.

For this purpose the captain orders: (1) Increments or decrements in the deflection; (2) Modifications in the distribution difference; (3) Individual corrections.

When, after a correction has been made in a certain sense, it becomes necessary to make the same correction in an inverse sense, the captain reduces the second correction by one-half.

178. If doubt exists as to the exact adjustment in direction in the preparation of fire, or if the angle between the aiming point (or registration mark) and the target has not been accurately measured, a trial shot may be fired from the directing piece, after which the deflection is corrected by the observed error.

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* Under certain circumstances this will have to be done by daylight.

179. If the captain fails to see the bursts, he raises the corrector temporarily. When he meets with difficulties in adjusting the direction, he adjusts each piece separately (Par. 132). After the direction has been adjusted, he may use salvos or volley fire, 1 round.

180. *Adjustment of height of burst.*—The adjustment in height of burst has for object to determine the corrector setting that will give for the salvo a height of burst equal to the normal height for fire for effect, or 1 mil for adjustment with time fire. This is accomplished by changing the corrector in accordance with the mean height of the salvo last observed. As this mean height is estimated in mils, the captain decreases or increases the corrector by the number of mils necessary to give the height sought for.

If the mean height is 1 mil, one should get, in general, one percussion burst (or burst below the target) in four. It will not be necessary, therefore, in general, to change the corrector, if in an adjusting salvo one percussion burst or burst below the target is observed.

If the first salvo shows that a very large correction is necessary, this correction can be advantageously made by the angle of site and not by the corrector (see Par. 171-c).

When a salvo is all on impact, without having been preceded by a salvo bursting in air, the corrector should be raised by 4. When a salvo is made up of bursts on graze and in air, the former are considered as corresponding to a zero height. If, after a correction has been applied to the corrector, the salvo fired with the new corrector calls for an opposite correction, an intermediate correction is applied.

No attention should be paid to salvos in which the heights of burst have been very abnormal. These abnormal bursts are due to mistakes in fuse setting and laying or to errors in angle of site—all of which should be sought for in the battery.

When the 1 mil height of burst has been obtained in adjustment to pass to the normal height it is sufficient to increase the corrector by 2. When fire has been adjusted on a crest, it may be advisable not to raise the corrector (see Par. 171-h).

181. *Adjustment in range.*—Adjustment of range is effected by time or percussion fire. The adjustment by time fire, besides permitting the simultaneous adjustment of the height of burst, renders the observation of the shots independent of the configuration of the ground. Adjustment by percussion fire will be used to advantage

when fire for effect is to be with percussion projectiles, and when the range, nature of the ground, etc., leave no doubt as to the visibility of the points of fall. It sometimes becomes necessary at the end of a time fire adjustment, on account of the danger of hitting friendly troops that have come too close to the enemy, or when it is desired to obtain a narrow bracket against a limited target.

All adjustments in range consist in principle, in obtaining two ranges, one short, the other over, bracketing the target. Beginning the adjustment by firing *over* makes observation easier in certain cases; for example, when the target or the point upon which adjustment is made is indistinctly outlined against the background, or when the wind is such that the smoke from the bursts interferes with observation. Moreover, it is always advisable to begin with *overs*, if there is danger of hitting friendly troops. If the adjustment is begun by firing *short* and is effected on the objective itself, the chances are increased for obtaining effect at an earlier stage.

The captain, therefore, begins his fire for adjustment with a range greater or less than the range he has estimated or measured. Starting with the range thus selected, he proceeds by successive steps to obtain two ranges bracketing the target. The first bracket obtained is, in general, 400 yards. It may be reduced to 200 in certain cases when observation is sure and easy, or when indications as to the proper range have been supplied by preceding fire, by the fire of another battery or by a range-finder. The captain then narrows the limits of the first bracket as much as the circumstances will permit.

A range cannot be considered as the limit of a bracket unless it has been observed in at least two shots of the same salvo or in two salvos during adjustment. If the target is in motion or is susceptible of movement, the bracket is not considered as established unless the last range used corresponds to the limit toward which the target is moving.—or, in default of precise indications as to the limit towards which it is moving, to the short limit.

When, in the course of adjustment, a bracketing salvo (2 short and 2 long) is obtained, the range should be considered as adjusted if percussion fire is used; if time fire is employed, the range should be considered as *over*, but close to the target, and the length of bracket may then be reduced to 100 yards.

Adjustment of fire with high explosive shell is carried out after the general method indicated above. If high explosive shell fire is preceded by an adjustment with shrapnel, this adjustment is carried only to the 200-yard bracket, when it is continued with high explosive shell, starting with the long limit of the bracket.

182. In case only part of the target is visible, it will very often be advantageous to adjust by converging the fire of the four pieces on the visible portion of the objective, increasing the interval between shots as the case may require.

When the target is not visible, the object of the adjustment is to enclose it with a bracket by observing the fire with respect to some visible object or natural feature of the ground that has been located *with certainty* as being in front or behind the target; in certain cases the short limit of this bracket can alone be determined. The extent of the bracket to be searched in connection with these auxiliary reference points varies according to circumstances, but it never should be less than 100 yards.

If, on account of the condition under which observation is made, or of special circumstances arising during an engagement, only one limit of the bracket can be determined, this limit is taken as the basis of a fire for effect, the extent of which is reduced by determining in advance the width of the suspected zone, or, when possible, by observing the sense of certain low bursts or the effect of the fire upon the target.

183. *Verifying Salvo*.—A verifying salvo is one fired, after the adjustment is completed, by all the pieces that are to take part in the fire for effect. Its object is to verify the elements of the fire for effect, and, in fire for demolition, to make a closer adjustment for range, if need be.

The verifying salvo is fired with low time bursts or with percussion fire, according as the fire for effect is to be time or percussion and with the same range as is to be used in the fire for effect. It may be repeated when there have been important modifications in direction and height of burst. When firing against troops, a verifying salvo should not be used against a target at short range, not when the last adjusting salvo, fired at the short limit of the bracket has made it evident that the height of burst and the direction have been already regulated.

CHAPTER V.

MECHANISMS AND RULES FOR FIRE FOR EFFECT.

1. TIME FIRE.

184. At mean battle ranges (2500 meters), with a normal height of burst, a piece covers effectively a front of about 25 meters, if two shots be fired at the same range; if only one shot be fired, the front covered is about 20 meters.

The depth of the effective sheaf, under the same conditions, is about 150 meters.

A battery, therefore, using time fire without sweeping, covers a front of 100 meters so that no intervals are free from fire.

185. *Sweeping*.—If the front is greater than 100 meters and it is desired to cover it at all times without intervals free from fire, the captain orders *sweeping fire*. Sweeping moves the successive points of burst by intervals of about 5 mils; double sweeping moves them by 10 mils.

The number of projectiles to be prescribed in the command, "*Volley Fire*, *sweeping* (or *double sweeping*)" corresponds to the front to be covered by each piece divided by 5 or 10, and is limited only by the horizontal movement of the piece upon its axis (theoretically, 100 mils under the most favorable conditions). Double sweeping is employed when it is desired to diminish the density of fire over a given front, either because the target is not worth the consumption of a great quantity of ammunition in a very short space of time, or because single sweeping does not sufficiently separate the sheafs of adjacent projectiles, as is the case at short ranges.

186. The usual mechanisms employed in fire for effect are: (1) Fire at a single range; (2) Fire by salvos or volleys at successive ranges. (3) Zone fire.

All these mechanisms may be executed with or without single or double sweeping.

187. *Fire at a single range* is appropriate against a target of little depth against which it has been possible to obtain a 50-yard bracket within the available time. It is executed at the short limit of the bracket, if the target is standing up or kneeling in the open, and at the long limit if the target is lying down or behind cover.

188. *Fire by salvos or volleys at successive ranges* (*n* projectiles fired at each of the successive ranges ordered) is a very flexible

and economical mechanism, allowing at will changes in the rate of fire and permitting the captain to use the corrector appropriate to the conformation of the ground, and so observe each salvo or *rafale* as to narrow the limits of the fire. It may be used against targets of any depth, within the limits comprised between the short and long limits of a bracket that has been determined with certainty.

189. *Zone Fire* (2 rounds per piece, 3 if sweeping be used, fired at a single command and at four successive ranges) is the most rapid but rigid of all the different kinds of fire at successive ranges. It should be used only when it is essential to obtain a certain effect in the shortest possible time, either because the target is a fleeting one or because it is important that it be struck before getting into action. It is executed by starting from the lower limit of a 400-yard bracket determined as regards the target itself,[1] or of a 200-yard bracket (better still, a 100-yard bracket) obtained as regards the crest[2] or the mask concealing the target, in the case of an invisible target.

It should be noted that zone fire may be employed against a target of little depth, even when on a slope, provided that the adjustment has been made on the target itself.

190. *Fire ordered by the chief of section.*—In certain cases, when the nature of the target permits a fire more or less slow, the captain, after having adjusted his fire, may find it advantageous to turn over to the chiefs of section the details of the conduct of fire. The fire is then executed according to indications such as the following:

"Such a piece, against such a front, at such a range, one round in so many minutes (or so many rounds per minute)."

The captain devotes his whole attention to the objective and varies the rate of fire prescribed for the different pieces to conform to the changes noted in the form or the vulnerability of the target. Certain pieces may not fire at all.

II. PERCUSSION FIRE.

191. *Percussion fire with shrapnel.*—Percussion shrapnel is employed to destroy obstacles and matériel, or, in certain cases, against

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[1] In the case of a moving target approaching the battery, it is prudent to verify the short limit before ordering zone fire.

[2] In the case of an invisible target behind a crest, zone fire should not be employed unless it is presumed that the slope of the ground is very gentle or the objective is very near the crest (See Par. 171-h).

personnel. A battery can cover effectively a front of 25 meters, each piece being directed on the middle of the section which belongs to it. If the obstacle is wider than 25 meters, it must be attacked by successive sections.

Fire against an obstacle is executed by volleys of one round at the mean of the 50-yard bracket. The volley should give 2 or 3 overs for 1 shots observed. If this proportion is not obtained, the range is changed by 25 meters in the appropriate sense.

Against matériel, fire is executed by the pieces firing independently. After a series of 4 shots the range for each piece is changed by 25 meters, if necessary.

Against personnel, the mechanism employed is fire at a single range with or without sweeping, upon the mean of the 50-yard bracket, or fire by salvos or volleys at successive ranges, the increase in range—25 or 50 meters—depending upon the form of the ground upon which the target is situated.

192. *High explosive shell fire*.—High explosive shell is used to destroy obstacles or matériel, to reach personnel behind shelter, against localities or woods, or against cavalry. Against cavalry, high explosive shell is fired the same as shrapnel. Against the other objectives the mechanisms to be employed are:

(a) Against obstacles or matériel.—Fire at a single range; same rules as in Par. 191.

(b) Against sheltered personnel.—(Example: Infantry in a trench, personnel of shielded artillery).—Fire by salvos or volleys at successive ranges, preceded by adjustment on a narrow bracket.

1st Case: The objective is visible (infantry or artillery).—Endeavor to obtain a 50-meter bracket and fire at the mean and limits of this bracket.

2d Case: The objective is behind the crest (artillery).—Try for a hundred meter bracket on the crest. Proceed then by decreases in the range, beginning with the upper limit of the bracket increased by 50 meters,[1] and proceeding by steps of 25 meters until it is evident that the shots are surely short. Repeat in order to obtain the desired

[1] This rule is not absolute; it is based only on probability of hitting an artillery target located on gently sloping ground under the conditions that are usually met with.

density of fire,[1] changing the direction so as to obtain as uniform distribution as possible.

(c) Against localities and woods.—Try to obtain a narrow bracket on the edge, then fire in depth by volleys at successive ranges.

CHAPTER VI.

CONDUCT OF FIRE.

To shoot well does not consist only in knowing and following the technical rules. It is by applying them properly, with all the modifications attached to them, that we obtain from the battery the maximum useful effect as regards the situation and the objective. The most tangible and the least doubtful part of the useful effect is effect of fire; but it is not the only part. On the other hand, all objectives are not equally vulnerable, and are not dangerous in the same way. They should be attacked in different ways.

The following remarks on useful effect, and especially on effect of fire and the nature of objectives, are made with a view to guiding battery commanders in their conduct of fire.

ARTICLE I.

EFFECT OF FIRE.

194. The essential object of artillery in battle is the *destruction* of its adversary. If this destruction can not be accomplished, the effects produced in the attempt at destruction enable us at least to *neutralize* the enemy, i. e., to impose upon him a temporary and more or less complete cessation of activity. Moreover, the guns lend a *moral support* to friendly troops, and, by making a diversion, relieve them from the attention and attacks of the enemy.

195. The effects of neutralization, moral support and diversion result from the known powers of artillery. They are not less distinct because they can be produced by fire, whose actual effect may be little or nothing. They are to be taken into consideration to hasten or retard the opening of fire, to increase or decrease its intensity, and to suspend or resume the fire. The result sought for

[1] Fifty shells to the hectare, uniformly distributed, produce a mean effect of 33 per cent.

will be all the more surely obtained if based on an actual effect as great as possible.

The effect of a projectile fired against a given objective with the correct firing data is known;[1] but actual firing in battles is not executed under these conditions: the elements of fire are determined within limits more or less wide, and the vulnerability of the target changes (or may change) during the fire.

197. The determination of the firing data within narrow limits is impossible unless the conditions for observation of fire are favorable; it requires time; and, lastly, narrow limits are more subject to error than wide ones. On the other hand, it produces greater effect with less consumption of ammunition against an objective whose vulnerability does not vary with the time.

Keeping in mind the importance of the result, the duration of the opportunity offered and the conditions for observation, the battery commander will endeavor to obtain the desired effect either by a greater expenditure of ammunition fired more rapidly against a wider front, or by using less ammunition against a narrower front in a greater period of time.

198. *Relative influence of the elements of adjustment.*

(a) In range.—An error in one of the limits of the bracket may result in the absolute inefficacy of the fire.

(b) In height of burst (time fire).—When the height is kept between 2 and 4 mils, the effect varies but little. Outside these limits it decreases rapidly. A constant error of 3 mils in the estimation of height of burst by a battery commander

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[1] It may be deduced from the following experimental table, which is based on the result of a large number of cases of adjusted zone fire, executed by batteries of 4 guns against a 100-meter front.

MEAN NUMBER OF MEN PER 100 PUT OUT OF ACTION.

Ranges.	Infantry.				Shielded Artillery	
	Standing in single rank.	Lying down in single rank.			Fire normal to the front of the objective.	
		Without knapsack.	Knapsack on back	Knapsack in front of head.	Personnel.	
					In action behind shields.	
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
2000	45	19	15	6	20	20
2500	42	17	13	8	18	15
3000	33	16	8	11	15	11
3500	24	14	6	12	12	9
4000	21	13	6	12	11	8

amounts to a loss of about 3 caissons, from the point of view of fire effect.[1]

(c) In direction.—In fire for demolition of matériel, every projectile that is not absolutely adjusted in direction is lost. In fire against personnel, the adjustment in direction need not be so exact.

1st. With one gun considered by itself, consideration must be given to the width of the sheaf.

2nd. With all the guns of the battery firing, if the objective is very vulnerable, exact distribution will increase the effect; but the time taken to obtain this exact adjustment might be taken advantage of by the enemy to diminish his vulnerability.

199. The variation (real or possible) in the vulnerability of the objective during the continuance of the fire, introduces as an essential factor of effect the *appropriateness* of the kind of fire used, not only of the kind used in the adjustment, but also of that used with the salvos or successive *rafales*. Sometimes the objective is vulnerable for a short time only; for example, a reconnaissance party. At other times, the vulnerability, without disappearing entirely, will be greatly decreased; for example, artillery going into position. Lastly, the objective may preserve the same general vulnerability, but it is irregular; e. g., infantry in a trench and firing at intervals; shielded artillery when the guns are not visible (personnel not vulnerable when the artillery is not firing and a little more vulnerable when it is firing).

In all these cases it is evident that the same mechanisms and the same methods of fire are not appropriate.

200. The appropriateness of the method of fire is often confounded with the quickness necessary to make the fire effective.

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[1] Comparative table of the effect of fire obtained at 2500 meters with heights of burst differing by 3 mils.

Kind of Target.,	Heights of burst.	
	3 mils.	6 mils.
	Per cent.	*Per cent.*
Infantry standing in single rank	42	30
Infantry lying down in single rank	17	9
Personnel of shielded artillery in action	18	14

Unless the firing data are known, we can not dispense with adjustment, under penalty of firing short, over or too high, and consequently without effect. But the methodical endeavor to obtain a bracket has the disadvantage of warning the enemy, of losing the effect of surprise, and of delaying the moment when the fire can reach its greatest rapidity. Therefore, we should take advantage of every circumstance to simplify the operation of adjustment and to shorten its duration.

201. Measurement of ranges by the telemeter, calculation of the angle of site, registering the configuration of the ground by certain batteries that have already revealed their presence, the determination of the relative distance of two points, upon one of which fire has already been adjusted, etc., will sometimes reduce the adjustment to the firing of one verifying salvo. Every battery which has to attack fleeting targets, against which a methodical adjustment will be impossible, should be prepared to strike the enemy by utilizing devices similar to the above.

ARTICLE II.

THE DIFFERENT TARGETS MET WITH ON THE BATTLEFIELD. METHODS OF ATTACKING THEM.

202. The great majority of targets met with on the battlefield are found in one of the following categories:

(a) Obstacles to be destroyed,
(b) Localities,
(c) Woods,
(d) Staffs and reconnaissance parties,
(e) Observers, signalers, telephone details,
(f) Aerial objectives,
(g) Cavalry,
(h) Artillery,
(i) Infantry.

203. The great majority of *obstacles* can be destroyed by field artillery by the expenditure of a greater or less amount of ammunition. They should be attacked with percussion shrapnel or high-explosive shell. Against loop-holed walls, it is easier to reach the troops behind the walls with high-explosive shell. Earthworks can not be demolished by field artillery; fire directed against them is intended only for the defenders who are sheltered by them; shrapnel or shell fire is employed.

204. *Localities* are attacked with a view to inflicting losses on the troops supposed to be assembled therein, or to making them untenable by the destruction of buildings, to which is occasionally added the effect caused by setting them on fire. They are attacked with high-explosive shell or with low-bursting time fire.

The desired effect may be produced by the field gun; but the projectiles of the heavy field artillery, containing more explosive, will produce greater destruction on important localities—houses that are large and crowded together.

205. *Woods*.—If the edges are occupied, they are attacked with time-fire. The interior of a wood in which troops are hidden is attacked by percussion fire, using preferably high-explosive shell.

206. *Reconnaissance parties—Staffs*.—These form important objectives which are very vulnerable, but offer only a fleeting opportunity to attack them. Fire against them should be with time shrapnel covering a broad front, within wide limits and with the maximum rapidity.

207. *Headquarters detachments, observers, signalers, telephone details*.—These form important targets, of changing vulnerability, and remain in place for a considerable time. Fire against them should be within narrow limits as to front, and with gradually reduced limits in range; time-fire will be followed by high-explosive shell fire, if the observer is on an observation tower.

208. *Aerial objectives*.—These require generally the use of certain accessories,[1] the execution of certain preliminary work on the emplacement of the guns,[2] the organization of lateral observation stations placed as far apart as possible, and sure methods of communication between the observers and the officers at the battery. These objectives are classified mainly according to their degree of mobility.

1. *Captive balloons*.—Extremely vulnerable within the limits of range and of the fuze,[3] The captive balloon is a target more or less fixed in position, and is attacked by time-fire, with very high bursts[4] and burst-intervals of from 200 to 400 meters.

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[1] A special form of sight.—*Translator*.

[2] A circular ditch with a depth of .5 of a meter, to receive the spade and permit the use of angles of departure of 30°.

[3] The zone covered, up to an altitude of 1000 meters, extends from 2400 to 6000 meters, the limit of the fuze.

[4] 10 to 15 mils above the top of the balloon.

2. *Dirigibles*.—These are very vulnerable if not moving at great speed across the line of fire. Use time-fire with very high bursts, the two platoons starting with ranges widely different—from 2000 to 3000 meters apart and surely bracketing the target. In each platoon use volleys of one or two rounds at all the intermediate ranges, changing by 200 meters, the platoon starting at the long limit to decrease its ranges, the one beginning at the short limit to increase the ranges. When the balloon gets outside the bracket,[1] put it back again and continue firing until it drops or gets completely out of range. Fire rapidly and do not wait to have the shots observed: proceed by bold changes in range.

3. *Aeroplanes*.—Same general methods.

209. *Cavalry*.—Extremely vulnerable when halted and in close formations; cavalry targets protect themselves from artillery fire by their mobility and open order. If the cohesion of the hostile cavalry be destroyed and it be forced to deploy, the friendly cavalry may be regarded as already having obtained a distinct advantage. Very often this effect is increased by the infliction of certain losses and the fear of crossing certain zones—the effect produced being more powerful from the fact that it is produced on both men and animals.

These results correspond generally to the maximum that can be expected from the artillery. To secure them, the artillery must make all necessary arrangements to shift its fire rapidly. If the battery is not so located as to have the objective in plain view, open the sheaf and have each piece fire in depth when the cavalry enters the zone. If the battery has the target in full view, follow it in direction with all the guns, determine wide limits in range and commence firing with all the guns at the short or long limit of the bracket according as the target is approaching or moving off.

The opportunities for firing at cavalry will be fleeting and the fire of short duration. The greatest possible rapidity should be used, employing either time or percussion shrapnel or high-explosive shell.

When cavalry directs its attack against a battery, the latter will do

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[1] This fact is signaled by a lateral observer when for example, the projectiles of the platoon which was firing at the short ranges are over: or when the two platoons finally reach the same range. For example:

Platoon using the long range: 4200, 4000, 3800.
" " " short range: 3400, 3600, 3800.

Of their own initiative the platoon commanders order:

Platoon using the long limit: 4800, 4600, 4400.
" " " short limit: 2800, 3000, 3200.

well to establish a barrier of percussion shrapnel or shell in front of the hostile line.

210. *Artillery* offers targets of widely varying vulnerability. The greatest degree of vulnerability exists from the beginning of the reconnaissance until the completion of the occupation of position (up to the moment the hostile artillery is ready to open fire).

An effective fire upon the reconnaissance parties may cause serious delay in the occupation of position and deprive the artillery of its superior officers. An effective fire at the moment the position is being occupied may produce such losses and disorder as will make it difficult for the artillery to recover from them. The moment when it is retiring from the engagement is also a most critical one, if all the carriages move off together.

If artillery is in position and its guns are in plain view, it will not take an excessive expenditure of ammunition to destroy the matériel.[1] If the pieces are not visible, if they are too far away, or if the direction of the target is made known only by its flashes, or by the dust thrown up by the blast, fire for demolition will require too great an expenditure of ammunition, but even under these circumstances artillery is more or less vulnerable.

There are always to be found in the intervals between batteries, in front or in rear of the guns, higher officers, agents of communication, observers, etc., who are not completely sheltered and who are less so during the time the artillery is active. Moreover, the shields do not afford absolute protection to those who are sheltered behind them. Even time-fire produces a certain effect, which is greater when the battery is subjected to oblique fire, and lastly, high-explosive shell will reach the cannoneers wherever they are placed.

The only thing that will render an objective absolutely secure is to place it at a sufficient distance from the covering crest or mask, for the terrain cannot be searched indefinitely in depth. On the other hand, however, the placing of batteries at great distances front the mask causes a certain amount of difficulty and uncertainty in command.

It is necessary to form an opinion, based on indications of every kind that can be obtained, as to the depth of the zone that may be

[1] The number of projectiles required to hit one of the two carriages of a section varies with the range and the conditions of observation. On an average it requires 15 or 25 projectiles, according as the range is 2500 or 3500 meters. Naturally, fire for demolition is effective against the personnel.

reasonably considered as liable to be occupied by the enemy. In certain cases certainty will exist; in others only probabilities. From these probabilities we must deduce the number of projectiles necessary to produce a probable useful effect; we must then consider the necessity of producing this useful effect and come to a decision.

211. The above considerations determine the principles to be followed in directing fire against an artillery target.

If you have occupied the position first, look carefully for indications of reconnaissance parties and of the hostile batteries going into position. Take advantage of these operations to open fire, using time-fire, a long bracket, a wide front and the greatest rapidity possible. Resume the fire, if need be, narrowing its limits.

If not first in position, or if you have missed the opportunity of firing at the time the reconnaissance is being made or the position occupied, proceed as follows:

1st Case. *Artillery whose guns are visible*.

1. Attack the personnel that is exposed and produce a preliminary effect of confusion by time-fire, using a long bracket on wide front.

2. Increase the effect already produced by reaching the personnel even though sheltered. To do this, use high-explosive shell, reduce the limits of range as far as possible, and reduce the front covered to the actual width of the target. Fire a number of projectiles, as equally distributed as possible, proportionate to the surface resulting from the limits given in par. 192.

3. Complete the destruction of the personnel, while at the same time you undertake that of the matériel; for this purpose, deliver as accurate a fire as possible against all the guns in sight and continue it until the object is attained, unless another mission be given the battery, unless a scarcity of ammunition necessitates economy or unless the range is so great as to preclude a fire for demolition. In these different cases, designate a portion of the battery (a piece or platoon) to be always ready to open fire whenever the hostile battery renews its activity, and thus release the other portion of the battery. Fire for demolition may be executed with percussion shrapnel or high-explosive shell.

The three phases described above should succeed one another without any considerable delay.

2d Case. *Pieces not visible*.

The presence of the hostile artillery is revealed by its flashes or by the dust thrown up by the blast, or by some other indication.

Proceed as in 1 and 2 above, unless in the second phase you are forced to fix arbitrarily the long limit of the bracket, the short limit being determined by the range to the crest. For example, you may consider that the enemy rarely places his guns more than 200 meters from the crest or mask. When you cannot narrow the limits and are uncertain as to the results obtained, it is proper to wait for new indications. Watch for them with the greatest care in order to take full advantage. The battery will remain in observation as regards the objective, while you look carefully for the enemy's observers or the observation station of the battery commander. If they are discovered, try again to destroy them.

212. Fire for demolition, requiring the greatest precision in range and direction, demands considerable effort in observation of fire. It can be executed by a single observer only in case a single gun is used at a time. If the nature of the objective indicates that you will have to fire for demolition and the number of batteries at your disposal permits, it will be desirable to limit to a width of 100 meters the front to be covered by a single battery. If, however, the objective does not require fire for demolition, one battery will deliver enough time or percussion projectiles to make it unnecessary to use more than a single battery against an artillery target, no matter how dense it may be, which does not exceed 200 meters in width.

213. *Infantry*, like artillery, furnishes targets of ever varying vulnerability. But, while hostile artillery, once in position, constitutes a definite objective, the only important modifications being that it may pass from action to inaction by exposing or sheltering more or less its personnel, an infantry target changes its form, dimensions, density, and sometimes its position from one moment to another. An artillery target may sometimes be destroyed; you cannot practically destroy a body of infantry, the elements of which look out for themselves individually and can undergo fire almost without losses. Finally, it may be said that artillery is in limited quantity and that, by reason of the power of a single gun which is visible or is firing, it is always worthy of being attacked; while infantry is present in more or less indefinite numbers and is scattered nearly everywhere, but in insignificant fractions which on

account of their weakness do not invite attack, or by their multiplicity force those who desire to fire at them to disperse their fire.

It follows then that fire against infantry targets rarely produces great losses, but other results are to be looked for.

On the defensive (from the moment of the first appearance of the enemy until the time when our own infantry, by causing him to halt, changes him into a fixed target, sufficiently dense and vulnerable) force the attacking troops to deploy at great distances, to spread out their units, to look for covered routes of approach; make them hesitate to cross zones covered by fire or permit them to cross only at great cost.

On the offensive, keep the defender behind his shelter, prevent him from firing when it is important that he should fire, deprive him of the use of certain points of support, and interfere with the movements of the reserves.

211. Usually these results may be obtained by the use of a few projectiles at a time, fired at the right moment and renewed as often as the opportunity is offered, at the same time keeping in mind the amount of ammunition available, the intensity of the general engagement and the nearness of the assault.

At the height of the combat, and in proportion as the final stage becomes imminent, the batteries firing upon the infantry will become more and more numerous. But as long as the situation is not cleared up, in order not to disclose all the artillery available and to keep batteries in hand for an emergency, it will be advantageous to use against the infantry (as above against the artillery) only the necessary number of guns. One gun will always be able to cover, with the desired useful effect, all the front that the movement on its axle allows it to sweep. One battery may then be charged with the task of attacking infantry on a front of from 300 to 600 meters; the captain may concentrate the fire of several or of all his guns at one time on one part of this front, and at another on a different portion.

To sum up, on account of the great variety of particular cases, no broad rules for fire against infantry can be prescribed, as was done above in the case of artillery. The best guaranty for well-conducted fire is based on the characteristics of the captain; a good eye, coolness, sharp tactical sense, a profound knowledge of the resources of the matériel and great experience in command.

ARTILLERY SUPPORT TO THE INFANTRY ATTACK

A paper prepared at the Staff College, 1912.

BY MAJOR T. N. HORN, 4TH FIELD ARTILLERY.

Our Drill Regulations refer to three kinds of attack:

An advance against an occupied position;
An advance against marching troops (the rencontre);
The "holding" attack.

The last two varieties are merely incidental, the attack of a position being the one properly regarded as impressive; we will therefore consider that kind without entirely neglecting the other varieties.

The last Infantry Drill Regulations state:

"The best results are obtained by leaders when they know the capacity and traits of those whom they command." (Par. 364.)

"Regardless of the number of subordinates who are apparently supreme in their own restricted spheres, there is but one battle and but one supreme will to which all must conform." (Par. 373.)

"Clear and concise instructions are given as to the action to be taken in the combat by each part of the command. In this way the commander assigns tasks, fronts, objectives, sectors, areas, etc., in accordance with his plan." (Par. 381.)

"Artillery generally communicates with the firing line by means of its own staff officers or through an agent who accompanies some unit either in or near the front. The infantry keeps him informed as to the situation and affords him any reasonable assistance. When the infantry is dependent on the artillery for fire support, perfect co-operation through this representative is of great importance." (Par. 388.)

"Fire superiority is gained not only by the hits, but by the moral effect the artillery produces on the enemy." (Par. 420.)

"In attack, the artillery assists the forward movement of the infantry. It keeps down the fire of the hostile artillery and seeks to neutralize the hostile infantry by inflicting losses upon it, destroying its morale, driving it to cover and preventing it from using its weapons effectively." (Par. 421.)

"Troops should be accustomed to being fired over by friendly artillery and impressed with the fact that the artillery should continue firing upon the enemy until the last possible moment. The few casualties resulting from shrapnel bursting short are trifling compared with those that would result from the increasing effectiveness of the enemy's infantry fire were the friendly artillery to cease firing. Casualties inflicted by supporting artillery are not probable until the opposing infantry lines are less than 200 yards apart." (Par. 422.)

"When the distance between the hostile infantry lines becomes so short as to render further use of friendly artillery inadvisable, the commander of the infantry line, using a preconcerted signal (with the 4-foot red and white regimental flag) informs the artillery commander. The latter usually increases the range in order to impede the strengthening of the enemy's foremost lines." (Par. 423.)

"The firing line must ordinarily advance a long distance before it is justified in opening fire. It cannot combat the enemy's artillery, and it is at a disadvantage if it combats the defender's long range infantry fire. Hence it ignores both, by taking full advantage of cover and of the discipline of the troops, advances to the first firing position at the shortest range possible." (Par. 453.)

"Infantry passing through deployed artillery should interfere as little as possible with its fire and utilize intervals in the line. Mutual understanding should govern the movement." (Par. 456.)

From the 1911 Field Artillery Regulations the following paragraphs are culled:

"Communication must be maintained:

Between the superior commander and the artillery commander;

Between the field artillery and the infantry which it is immediately supporting;

Between the elements of the field artillery itself.

"(a) As a rule, the field artillery commander accompanies the commander of the troops during the earlier stages and receives the orders from such superior commander in person. As the engagement progresses, it may be necessary for the field artillery commander to establish his position at a point other than that selected as the position of the commander of the troops. In such cases the duty of maintaining communication between the superior commander and the field artillery commander devolves, in general, upon the Signal Corps. If, however, the Signal Corps is for any reason unable to supply such communication, the field artillery commander furnishes the personnel and material necessary to give this communication. In any case the field artillery commander is represented at headquarters of the superior commander by an agent designated from among the field artillery personnel for the purpose.

"(b) *** To insure effective co-operation, it is essential that the field artillery be kept informed as to the losses sustained by the infantry, the particular part of the hostile line from which the fire causing the greatest losses comes, the movements, and any change of plan of our infantry, also when it is necessary to begin, increase the rate of, or cease, the firing. An artillery reconnaissance officer, with artillery scouts, or artillery scouts alone, may be employed to establish the requisite means of communication, which may be by courier, signals, or telephone. The reconnaissance officer or scouts also report the effect of the field artillery fire and furnish such other technical data as they may be able to obtain. It may frequently be necessary for the infantry to furnish *additional* means of communication; especially is this necessary during the last moments of the assault when previously concerted signals for the cessation or shifting of field artillery fire must, as a rule, be given from the infantry firing line.

"(c) The communications between the various elements of the field artillery is maintained by the members of the headquarters detachments, and of the battery details."* (Par. 772.)

"Each headquarters is provided with suitable signal and telephone apparatus. A battery has three telephone operators, a battalion headquarters two, a regimental headquarters two. They must be prepared to act as signalmen as well as operators. Frequently higher commanders will find it convenient to post themselves near one or more of their subordinates, and the material and personnel thus freed for other use may be utilized in establishing communication with auxiliary observers, with ammunition batteries, or with reconnaissance officers or scouts accompanying the other arms." (Par. 789).

"No special apparatus or operators for signal or telephone communication are provided at brigade artillery headquarters. The means provided for regiments, battalions and batteries are, however,

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* Each battalion can lay about 8 miles of wire . . . insulated and buzzer.

ample for the connection of all the parts of the brigade." (Par. 793.)

"In the preparatory stage artillery has for its objective those parts of the enemy's forces which at the time most oppose the action of our infantry. Until our infantry comes within effective small arms fire, the principal target will, therefore, be the hostile artillery. As the progressive advance of our infantry brings them within effective rifle fire, more attention must be paid to the hostile infantry. Obstacles, such as walls and abatis, which impede the advance of our infantry should, if possible, be destroyed by artillery fire." (Par. 864).

"The 'counter batteries' acting from masked positions, must dominate the enemy's artillery with the greatest possible rapidity; the infantry, or 'breaching,' batteries, on account of their more varied role, take less defilade than the counter batteries, and open upon the hostile infantry and other obstacles. This title designation of batteries is not permanent and may very with the progress of the engagement." (Par. 865).

"The artillery preparation for the infantry attack is, in general, carried on simultaneously with the infantry advance. If, however, the enemy has fully occupied his position, or the attack is able to form, under cover, close to the hostile position and thus has only a short distance to progress, the preparation may take place both before and during the attack." (Par. 866).

"Before opening fire with any unit of artillery upon any objective, care must be taken to have at hand another unit ready to open upon any of the enemy's artillery which may attempt to prevent the first unit from accomplishing its mission by forcing it to cease firing. In order to have batteries available for this counter attacking, 'economy of forces' must be practiced; no greater force must be used at *first* than is absolutely necessary." (Par. 867).

"In the decisive attack, a special preparation is necessary. The most rapid fire and intense concentration of fire of all the available artillery is brought to bear upon the objective against which the infantry is to advance. During this special preparation, the counter batteries continue or resume their fire on the hostile artillery. Some of the infantry batteries may be sent forward to closer positions as the attack progresses, but it is to be remembered that during such changes of positions the fire of these batteries is lost to the assailant at a most critical time and such changes of position should be avoided if possible; the range and the ease of the manipulation of the fire of field artillery enable it to dispense with maneuvers which in the last analysis are prejudicial to the infantry which it is charged with supporting." (Par. 868.)

"When the third phase of the attack is reached, accompanying batteries will be designated from the infantry batteries whose mission will be to reach the captured position as soon as possible after the infantry in order to pursue with their fire the retreating enemy, and to aid in repulsing any offensive return; they should cover with their fire the advance of troops which may be pushing on in pursuit and break down all efforts of the enemy to *reform* and renew the fight." (Par. 870.)

"In case of reverse, artillery directs upon the enemy's attacking troops every gun which can be brought to bear, in order to destroy the morale of the enemy and to assist the repulsed troops in the renewed effort which may lead to victory. If the repulsed troops continue to be forced back, the artillery must cover their withdrawal, resisting the advance of the enemy, if necessary, until annihilated." (Par. 871.)

"The term 'accompanying battery' should not be too narrowly interpreted, as they will do so more by their fire than by physical movement." (Par. 802.)

GENERAL PRINCIPLES.

In addition to the designations for batteries referred to, there are "batteries of preparation," "batteries of the counter attack," charged especially with the observation of the flanks, "reinforcing batteries," and "decoy" batteries. These last are placed in action usually with guns at wide intervals (say 100 yards), to open fire rather unreservedly and lead the enemy to believe himself opposed by a large force, and to disclose positions previously undiscovered.

As visibility draws fire, this is often employed as a part of the decoy.

Artillery of advance guards may often find opportunities and occasions to act in this capacity, while the main body and most of the guns are still some distance to the rear.

The reserve of artillery is *ammunition*, but it takes much road space, and is preferably placed in rear of the infantry during a march.

The amount of artillery ammunition required to kill a given number of men takes up ten times the road space occupied by an equivalent amount of small arm ammunition. However, a battalion of infantry, at critical moments, can deliver 15,000 bullets in one minute while a *battery* firing shrapnel is delivering 40,000. At anything over 1500 yards the percentage of effective bullets for the shrapnel is much the higher.

Our 3-inch gun is individually exceedingly accurate. At 2000 yards its error is but 12 yards in range and 2 yards laterally; at 4000 yards these figures are 17 and 4, respectively.

The *smoke-producing matrix* of the shrapnel may also be made an important factor in the assault; only those who have witnessed artillery firing practice can appreciate the reality of this smoke veil. In an experiment, 500 rounds covered a front of 125 yards with smoke for 30 minutes—a very liberal allowance for an assaulting period.

During an unaided advance against intrenchments the attacker loses about 5 men to the defender's 1, and to place the hostile lines on somewhat equal terms therefore, the defender's lines must be kept under a fire that will *certainly* drive him to cover, *probably* shake his morale and *possibly* cause losses. This can sometimes be effected by oblique infantry or machine gun fire from a flank, but the most efficient aid comes from supporting artillery; it keeps him crouching in the trench or bobbing up to deliver unaimed shots, till the attacker can get at him with the bayonet. On a steep slope, this support may continue until but 50 yards separate the lines. The security of the trench against shrapnel might be increased by making a profile of high relief, but the difficulties of its concealment would then practically aid the attacker.

When the troops are not closely engaged, a rate of fire of 10 rounds per minute is sufficient to keep down the fire of an intrenched line 100 yards long. This estimate is deduced as follows: Taking the effective spread of the shrapnel bullets at 20 yards (a minimum) each rifleman has two chances per minute of being hit if he puts up his head to fire. After each projectile bursts over him, he will have 30 seconds to make up his mind, get up, pick up his target, and fire. If the rate of the artillery were absolutely regular, the rifleman would soon get accustomed to firing between bursts. But if, while maintaining the average steady rate, the rate per minute and distribution be judiciously varied, the rifleman will never know when a shell is coming and will be nervous about getting up.

Artillery supporting an infantry attack usually does not make many hits, but to measure its importance in this way is quite unjust and shows ignorance of its true function. It should be measured by the ability of the troops it supports to continuously advance, by the losses it saves to its own troops, and not by their creation among the enemy. Casualties vary greatly. On one occasion, in Manchuria, 1000 rounds (over 200,000 bullets) were fired with a result of one man wounded; on another occasion the same belligerent fired 48 shrapnel with a result of 40 killed and 128 wounded.

Enlightening knowledge on the part of each arm as to the power, action and limitation of the other, has greatly decreased the old complaints, either that the artillery was more concerned with positions and technical data than with the infantry, or that the infantry went rushing ahead to win the combat alone or demanded annihilating effects the artillery could not deliver.

Officers who hope to lead troops have not properly prepared themselves for battle until they know instinctively how to act when they are face to face with the enemy. In this preparation, expert knowledge of terrain and skill in giving orders will be found of prime importance, but a supreme commander can *best* co-ordinate his branches only by possessing knowledge of them all.

The properties of Field Artillery are concentrated power, rapidity of fire, long range, and ability to act from concealed positions.

Its limitations are ability to act only by fire, vulnerability to percussion fire, and to shrapnel fire when in route formation or in the act of occupying a position, difficulty of concealment when surprised, and little defense against flank or rear attacks.

Until an artilleryman becomes familiar with the capacity of his arms and ammunition, he is using guess work instead of intelligent direction, for he must adapt his tactics to the weapon.

The field artillery have established a "School of Fire" at Fort Sill, and Colonels, Lieutenant-Colonels, Majors and Captains are being detailed there for short courses of instruction. It would be well to add Field Officers of Infantry to the details. The contemplated transfer of the School of Musketry to Fort Sill is a step in the right direction.

A division is the smallest body of troops having artillery permanently assigned to it. The division commander controls his artillery through his senior artillery commander, gives him general instructions as to locality to be occupied, objectives to be covered, or tasks to be performed, and holds him responsible for results secured. An officer charged with the accomplishment of a special mission, or one commanding an important sector of a battlefield, should, in general, have command of artillery designated to co-operate in the tasks assigned to him. When it is necessary to *detach* bodies of artillery from their regular organization for this purpose, it should be done by order of a superior commander only, who will make it clear to all concerned with whom the command of the detached artillery lies. When once detached, they are not returned to their proper organizations without similar authority. In emergencies, however, artillery finding itself in a given sector, without definite instructions, should at once report itself to the commander of that sector.

Unity of direction is favored by keeping batteries, especially within the battalion, fairly close together when several battalions are engaged. The commander may be within 1½ miles of his guns and yet control them efficiently by telephone. Confession of inability to do this indicates lack of capacity or of drill. Concentration of guns means control by one commander over many units.

This unity of direction does not remove or restrict the obligation imposed upon all officers to meet sudden and unexpected emergencies of action when time does not admit of reference to higher authority, and it is really weakened by every arrangement which limits the power of ready response.

A General, particularly in crises, should not find it necessary to undo any of the fabric constructed.

Field Artillery, the same as Infantry, avoids firing at objectives of small importance, and practices economy of ammunition. It does not expend ammunition against ravines, roads, woods, villages, etc., except in cases where it is positively known that they are occupied by an enemy who, if left undisturbed, would produce a material effect upon the combat, and searching areas is prohibited unless this rule is followed.

Registering fire is resorted to when an enemy may be expected to appear near some prominent object clearly visible, and is used to determine data and discover accidents of the ground. It places the guns observing the registered zone in the attitude of hunters, lying in wait for game. Regulations limit this kind of firing to occasions when our artillery has already revealed its presence to the enemy.

Our 3-inch gun can sweep, without shifting trail, a frontage of $\frac{1}{8}$ of the range; therefore a 4-gun battery *could* cover at 4000 yards a front of 500. But the amount of bullet delivery depends upon rapidity, and that upon the ammunition supply; 358 rounds per gun is pretty good for the first line. Ammunition being the reserve, it follows that its supply is a matter of control by the higher commander—this is an additional reason for "unity of direction."

Holding attacks *occupy* and *threaten*, while concealing their weakness in depth. Under such circumstances artillery does not keep up continuous fire, but resorts chiefly to intermittent violent outbursts; the defender is thus taught that a force is lying in wait opposite him ready to rush forward and he is compelled to make dispositions to meet the threat.

Reconnaissance, which is as varied as war itself, precedes every attack, and artillery officers should be attached to troops far in advance to gain early information of terrain and enemy. The field artillery regulations are full of general rules for guidance.

Advance guard artillery has some of these functions, for, although its use varies with advance guard mission, it should occupy no position from which it cannot withdraw without bringing on a general engagement, and it may frequently be obliged to develop and hold under observation the forces of the enemy, in addition to removing resistance to the advance guard's progress.

Reconnaissance of objective or of the effect of fire may be done in two ways:

1. Gallop up to a view, observe for an instant and rapidly return. This requires that a glance be sufficient.
2. Choose near the guns an observation station giving extended view, a high point such as tree, house, haystack, tower, etc., etc. Use field glasses and deliberately watch. According to the distance from guns a communicating wire is laid or agents posted to quickly transmit useful information.

A French officer experienced in maneuver reconnaissance says:

"The reconnaissance should not be pushed too far to the front for the officer escapes from the chief whom he is supposed to aid; he ought not to be asked to reconnoiter positions, as his duty is to contribute to details for positions already selected. A map may be used, but working without one possesses certain advantages as the terrain is more carefully studied, and all its landmarks better fixed in the mind. Even though the map is useful, we will have to learn to get along without it, for the number of officers having them in war will be very limited."

Quoting from a Russian Colonel:

"In the war with Japan, in all the reconnaissance which I made, as well in the defensive as in the offensive, I did not succeed a single time in distinguishing with my splendid prism glass the enemy's position, or in picking up any indication from which it would have been possible to judge where the enemy was; if it had not been for the information from the patrols and from the scouts, one might have believed that the terrain in front was completely deserted."

Observers and scouts must know three things well: *observe, recognize, report*. This is not an easy matter even for officers; it is not sufficiently emphasized in regulations that a knowledge of *formations*, of the methods of attack, of what battlefield movements really mean, of strength estimates, and of compass point descriptions are of important value during actual combat.

Determination of North by compass, sun and watch, and at night, should be taught and the military vocabulary enlarged; in other words, unless an observer can intelligently state just what he has seen and where he saw it, his report is of limited value.

GUN POSITIONS.

With rare exceptions, guns must proceed to a position before opening fire, their limbers safely disposed and station assigned for the battery reserve, and for observation of fire. A general's dictation as to this should be no more specific than necessary for the accomplishment of anticipated tasks, and the supporting artillery group commander is the one to select the actual positions for the guns.

As the area within which field artillery must take position is determined by the tactical situation, and it is not usually free to select its own position irrespective of the general attack, it makes the best use of the terrain that it can. Best positions are those from which the most effective fire can be delivered for the longest time.

If the occupation of the position will be visible to the enemy, it is preferable to have the horses draw the guns boldly to the positions from which they can immediately open fire without any manhandling whatever; otherwise it is always preferable to unlimber under cover. Absolute defilade is possible only when taken from the highest point that the enemy's *observers* might occupy, and at least 15 feet is necessary to conceal the flash.

Although the safest artillery positions are usually not less than 400 yards in rear of ordinary crests, and dead spaces created in front of such crests are regularly taken care of by guns placed in flank positions permitting cross-fire, skilful changes in corrector and angle of site may reduce these dead spaces to very small zones, for shrapnel bursts may be brought backward almost to the tops of the masks.

In positions more or less exposed, gun-pits may be thrown up and the caissons left under cover elsewhere, the projectiles being laid on the earth in a hollowed-out receptacle in the pits. Hand fuze setters are supplied to every gun, and in such cases they would be used.

From indirect position, where well concealed, artillery depends little on human emotions and its fire should be pretty accurate. It is frequently maintained that direct fire adds to accuracy, but this is very doubtful. The drill ground mechanical operation of the firings and the individual control and direction in indirect fire are two factors that, *per se,* should always make for greater accuracy; but, say what you may, observation and information are the two factors most determinate of results.

When it is necessary to bring guns into action *quickly* for the support of other troops, the principal consideration is to get fire support at once and delay for ideal conditions of security is then unpardonable.

After a reconnaissance officer has marked gun positions and the routes to them he should examine approaches and provide security by posting scouts, then study the tactical situation. He inquires as to neighboring troops, the name and location of their commanders; communication is established with the neighbor and his intentions and instructions learned so that the artillery may act without hesitation or distressing error.

In case this reconnaissance officer does not furnish the higher commander with firing data, the latter should reach the position in advance of his batteries and make some decision as to the method and distribution of fire.

By intelligently dispersing units the effect of the enemy's fire is diminished, and his difficulties of adjustment increased. Moreover, good organization of communication service can secure concentration of effort even though units be widely separated. From a front of 2500 yards, artillery can concentrate fire without exceeding 3000 yards range from any point of the line; and on a front of 5000 yards, the extreme range may be under 3500.

Some officers believe artillery dispersion increases difficulty of command.

Fire for adjustment precedes fire for effect and as troops expose themselves only a short time to artillery fire, it is necessary that the process of adjustment be shortened. It is a mistake for batteries going into action to seek only the prompt opening of fire as the means of shortening the seeming delay inseparable from all taking up of battery positions. This has two periods: 1st. From the unlimbering of the guns to the first shot. 2d. From the first shot up to the time when the firing is effective. This second is critical in all cases because the enemy then knows your position, consequently not so much the first period but the second must be shortened; it is wiser, therefore, to reject everything that tends to shorten the first period at the expense of the second.

Field artillery must meet an infinite variety of problems and therefore great flexibility of fire is called for: for instance, in firing verifying salvos during adjustment, they may be fired at a range known to be erroneous if we have a sure correction factor, and thus the enemy is kept in ignorance, as no warning is given to the anticipated target.

Although changing positions is objectionable, a need of moral support might arise, and there is something in the idea, especially with untrained troops; yet it should be exercised very discreetly and not as a matter of course. Reconnaissance having this in view, however, should *never* be neglected, both front and rear.

The gaits to be used in changing depend on the situation. If great excitement exists, the movement should be begun habitually at a walk so as to steady the personnel and the animals, and eliminate confusion.

CO-OPERATION.

United action of different arms is only possible where command is exercised in the *highest degree*, with a view of co-ordinating the instruments of combat.

The union of the different arms rest upon ourselves, in our instruction and in our military education, as well as on the offensive spirit and the desire to win; these are the factors which create comradeship of combat, the union of arms in battle.

During recent foreign maneuvers the infantry always waited for the active support of artillery before undertaking any serious attack. This slow progress and slow co-operation was precisely what the corps commander wished to get. It was noticed that separate columns kept up communication very nicely on the march but that they lost it as soon as they deployed for action.

This should not be; the principal link in the chain of support is a close and constant connection which communicates to the artillery the necessities of the troops to be supported.

For instance, should an infantry colonel find himself obliged to meet a suddenly uncovered enemy, or in similar embarrassing situation, the information of the obstacle or the need of support should at once be communicated to the nearest artillery representative. A small hasty sketch with marked location of the obstacle will some times greatly assist in obtaining quick fire support, and wasteful delay due to routine transmission of requests to headquarters in rear, thence elsewhere, thence forward again to the artillery are really inexcusable, unless it is without question the quickest method of transmission.

The joint action of the artillery and infantry is based upon operation orders, wherein the commander, assisted by his senior artillery commander orders that, say, the 1st Infantry brigade will attack So and So supported by the *nth* battalion of artillery. This does not cover the whole conduct of the attack; hostile artillery from other localities may oppose, and the senior artilleryman, as fire commander, may have to protect the attack by turning other artillery on the opposition. But so far as the joint action of the 1st infantry brigade and its supporting artillery is concerned, this order enables the two commanders to concert their measures. Before the attack commences, the brigade commander and the artillery commander confer personally or by staff officers.

The artillery is informed of the line of advance selected and the method of attack; the infantry learns what support can be rendered, what successive positions the artillery may occupy, whether guns can be sent forward in close support, and where the observing stations will be, etc. Strenuous efforts should be made for constant telephone communication between the two commanders. Failing this communication by orderly or signal corps must surely be established.

The artillery officer accompanying the infantry will not, as a rule, be in the firing line, but he needs to be where he can see it and what it does. As the infantry brigadier usually selects a station affording good view, the advanced artillery officer will generally be with or near him. He communicates with his chief by the surest and quickest means available.

In general there are two grades of co-operation; that between higher commanders, called by some the "senior" co-operation, and that between local commanders who are acting as leaders in some limited sphere of action, styled the "union in the rank."

The essential object of this latter is to avoid interruption in the co-operation during unforeseen delays, and it promotes ready response in an emergency where roles depend upon rapidly developing events. In such cases the unit leaders should keep their seniors informed of the events of which they are witness, and either call for new tasks to perform, or exercise their own initiative and report the fact.

ACTION OF SUPPORTING ARTILLERY.

The serious obstacle afforded by an unshaken defense has been noted, and therefore the necessity of *some* artillery preparation. Coming now to any infantry attack begun, say at 1500 yards range, it would appear that, taking into account all considerations, it is preferable to risk artillery too soon rather than undertake important work with insufficient means.

The number of batteries taking part is determined not so much by the number of hostile guns revealed as by the front they occupy. Artillery must constantly feel the pulse of the battle, closely follow its infantry's movements and prepare to at once so regulate its fire that the infantry can bring its full strength against a desired objective. Guionic states that every movement which might be perceived by the enemy should be supported by fire, and this is called the union of movement and fire. Unaided infantry, unless specially favored by concealment, cannot advance.

When an infantry attack is obliged to pass over open and unprotected space, the guns may be called upon to mask the movement by smoke from explosions of shrapnel, or to neutralize the enemy by shrapnel fire. This idea of smoke masking is particularly valuable and desirable during attempted removals of artificial obstacles by our engineers, or other troops, sent forward for that specific purpose.

The infantry develop the *obstacles,* and when an infantry commander cannot distinguish them either by his patrols or by sight, he can usually expect little from artillery. Once the infantry has pointed out an obstacle whose overthrow will cause the downfall of others, however, the artillery choose their target and open fire. If the infantry does not continue to advance, either the fire has proved ineffective or the target chosen was not the immediate obstacle.

Attacking troops do not all advance simultaneously, some are firing while others are moving. When any part tries to advance along a particular line or selected avenue of approach, the artillery fire should be directed upon that part of the enemy's position which commands that line or has the approach under observation.

Now, before artillery can engage a given target, it must be located; if the defender's line is well defined, this is simple. But the defender employs small detached firing lines in short trenches fitted to the ground. These are carefully concealed and the men in them will not open fire until the attacking troops arrive within 1000 yards, or thereabouts. Even on a slope open to the view of the artillery supporting the attack, these trenches may be impossible of location; in fact, their existence may not become known until the check given to our infantry is seen or reported.

Counter batteries usually fight masked, their struggle will be long and severe, rarely decisive, and intermittently renewed. So-called "silenced" artillery must be kept under observation; it is dangerous.

The question of how to best deal with targets is principally a matter of observation of fire—if guns are visible or located, the probable position of the limbers or the caissons may be deduced. It is often supposed that artillerymen cannot locate hostile guns firing from hidden positions. This is more apparent than real, for if their shots fall anywhere near skilfully trained men, the furrows will show direction and the range may be obtained by picking up and examining a shrapnel head containing the time fuze setting. A simple allowance for the position of our own guns gives us the enemy's range.

Special attention must be given to points of the enemy's line which afford a good view of the battlefield and preparations made to smother them if any staffs appear there.

Ranging usually produces no definite result unless the shots are observed by aerial or flank observer advantageously posted, and as infantry intrenchments possess little depth, fire against them must be carefully adjusted. This fire should be slow or cease when the enemy is concealed or inactive, but of great intensity when he exposes himself.

Cross fire, even to the extent of the artillery from neighboring divisions, always gives excellent results.

If greatly inferior, a defender does not enjoy seeing his batteries overcome in an unequal struggle, and he will show guns only when forced to do so by the appearance in his immediate front of objectives which must be met by effective fire, i. e., the infantry of the attack.

As an attack progresses supporting artillery may have to push forward guns and observers to positions from which individual targets may be more readily discovered, even if they have to advance under fire. In closed country this will be absolutely essential.

If fire is proving fully effective at 3000 yards, there is little to gain, and perhaps much to lose, ordinarily, by changing the position to 2000 yards; but the battery or battalion commander must see his target without getting at an undue distance away; moreover, at the decisive stage of the combat, many of the gunners themselves may be required to see it in direct fire. This artillery advance may take considerable time. Maneuvers mislead us in the unnatural rapidity adopted in order to get the maximum number of situations out of the limited time; during combat, advancing is usually slow, and if the artillery can get forward half a mile in an hour they are likely to be advancing faster than the infantry.

In case an artillery advance by daylight is entirely impracticable, the decisive attack would be postponed a day in order to enable the artillery to advance by night and take up position from which their supporting fire may be more effective. In fact, battles of a single day have grown more rare. When an attack pushes on, however, there is no excuse for artillery who fail to support their infantry because they cannot see their target; they should advance until they are able to. If the infantry can get forward, so can the artillery, even if they have to get their guns forward by hand. If they cannot conveniently use their picket ropes, they must push their guns and caissons in front of them; their shields will protect them,—these cannot be penetrated by bullets at 100 yards. If the infantry can get over hedges and ditches and through crops, so can the artillery, although it will take much more time.

It is desired to lay stress on this point, because there still exists some professional prejudice which requires uprooting. One is that artillery should never go near enough to the enemy to be jeopardized; another is that artillery can do nothing without a horse in it.

It is not unkind to remark that there are officers who, if they knew their teams would be lost to them and casualties result if they advanced to help their infantry, would be content to remain behind and shoot less effectively, with the belief that they had done their full duty. If as a consequence, the infantry were repulsed, these officers would still believe that they had done all that should be required of them. This is not the true artillery spirit: they are there to give aid and must do so at whatever cost to themselves.

ARTILLERY IN CLOSE SUPPORT.

One of the European powers details "infantry batteries" at the rate of about one per regiment to advance in support of the infantry; these batteries send forward sections in close support if necessary in extreme cases the whole of the infantry batteries may be up in the infantry firing line just before the final assault. Other nations still adhere to the idea of a main position, or rather positions, for the artillery, and a few guns in close support. These guns cause encouragement to the infantry by their presence, although this is not the reason for sending them forward. It is to be able to take on targets which suddenly appear more quickly than is possible from the main position and to afford intimate support in the complicated phases of the fight at close quarters, including local counter attacks.

For instance, if the infantry suddenly find themselves opposed by an enemy behind a wall it might take the main body of the artillery some time to range on it, while advanced guns can get at it at once.

A hostile gun posted behind cover so as to bring oblique fire to bear upon an attack may be undetected by guns in the main position and therefore safe from them, but not from the guns that are boldly advanced.

It is in intricate broken country that these guns are most useful and will best be able to push forward. Any gunner who expects that on service he will always have a clear range in his front is likely to be disappointed. The infantry are not so particular as to where they fight, and wherever the infantry go, if they require help, the artillery must be on hand to give it. In open woodland the task seems simple. In wooded country, having few clearings, the artillery are really severely handicapped.

The effect of shrapnel fire on troops sheltered by trees is good up to 100 yards from the edge. In firing from wooded positions, it will hardly be possible to keep guns in line, the batteries will be more or less extended and the protection of shields resorted to, the gun being run up by hand, especially where the woods are thick. To *fight* wooded positions the howitzer fire and high-explosive shell are much the best.

In open country, the possibilities of uninterrupted advance are greatly lessened.

It has already been mentioned that the batteries must push forward when they can no longer clearly distinguish targets opposed to their infantry; this does not mean to advance an entire battalion because the infantry are checked by one machine gun which cannot be located. Such a duty is better performed by the advanced sections. These constitute a means of *economizing* artillery by using small detachments in engaging small targets, moreover their handiness and insignificance may often enable them to get forward where large bodies advancing would draw fire from every battery within range and result in incommensurate loss.

It would be unsound to advocate the employment of sections advanced in close support as a standard method to be adopted under all conditions; the only persons who can decide whether their use would be advantageous and their need imperative, are the artillery commander and the infantry commander at the spot.

The tactics of advanced artillery are naturally determined by the terrain. They will of course endeavor to keep on the flanks of the infantry in order to divert the fire from them instead of attracting it; also that they may bring oblique fire to bear on targets in front. They use both concealed and open positions, naturally endeavoring to occupy them without losing their horses, even if this entails running guns up a quarter of a mile by hand. Cover in the advance is utilized, but they must be prepared to make a dash across the open when it is lacking.

When the enemy's troops are already hotly and closely engaged, it will take his officers some little time to see the comparatively distant target, and still more time to bring an effective fire to bear on it. A section galloping at 15 miles an hour will cover half a mile in about 2 minutes and has an excellent chance of getting across unscathed. An officer or non-commissioned officer leading such a section must have a good eye for terrain, or he may suddenly be halted by some obstacle under the enemy's fire; reconnaissance should precede the movement and ground scouts be used.

So far as close support is concerned, the mountain gun is a little weak in *power* in comparison with the 3-inch field gun, still it has its superior advantages. The shrapnel weights in pounds are as 15 to 12½, the bullets as 252 to 234—terminal velocities, say, as 1000 to 800.

Let us examine into the angles of departure and fall. They compare thus:

	Angle of Departure.		Angle of Fall.	
	Field Gun.	Mountain Gun.	Field Gun.	Mountain Gun.
Range:				
1500------	2º—00′	5º—11′	2º—38′	5º—52′
2000------	2º—56′	7º—16′	4º—07′	8º—18′
2500------	4º—00′	9º—36′	5º—48′	11º—10′

Now, a terminal velocity of 420 is necessary for the bullet to kill.

It is evident how a mountain gun is secure on steep reverse slopes and can sweep those which a 3-inch gun cannot touch.

But its principal advantage is its handiness, the field gun requires 6 feet width to get through, whereas the whole of the mountain equipment can be passed through any aperture of 3 feet. A mountain gun can be readily carried up to the top of a building or railroad embankment, while a similar attempt with the 3-inch gun is left to the imagination. Mountain artillery can be ferried across a stream in small boats or landed with infantry in disembarkation, the guns then being transported by hand. However, the greatest advantage lies in the closeness of its possible support. If field guns have to be run forward across country by hand, it is a slow and difficult process; mountain artillery can find cover where field guns would be exposed; they can advance through the trees of a farm, woods and ravines; they can go through cornfields without showing it, along the bottoms of ditches and the beds of streams. They get cover in very slight hollows of the ground and in rear of low hedges; a mountain gun and its mule require no more defilade than a tall man, while the field gun requires at least 8 feet to come into action horsed.

A mountain gun is more difficult to stop than a field gun, in spite of its separation into loads, because each load can be carried forward if the mule is hit, and even if the mules cannot get forward this gun is much easier to advance over obstacles by hand than its larger brothers. As Kipling has said, in his poem of the Mountain Gunner:

"They sends us along where the roads are, but mostly we goes where they ain't:
We'd climb up the side of a sign board, and trust to the stick o' the paint."

It is doubtful that this weapon will be introduced in our service as a part of the regular division organization, except in some particular case of operation in mountainous terrain, for the gun affords about half the power of the larger sizes, for the same expenditure of men and animals; but when this sort of artillery is available, it will certainly prove of value as above indicated.

Real night attacks are improbable, but not impossible. In such cases artillery fire must be assisted by searchlight beams thrown upon the trenches. Firing with data collected during daylight will be easy enough, but observation of the effect is possible only when illumination is used. Illuminating lights must be on the flanks and away from observers, as nothing is more futile than attempting to look along a searchlight beam. Direct light is dazzling to the defender and crossed beams will enable the infantry to advance very close before being definitely located. However, this will complicate the exact moment of removal of the supporting fire, for the beams must be removed from the slopes at exactly the same time.

So-called "harassing night fire" is two-edged, and therefore of doubtful value.

LIMITATIONS OF SUPPORT.

In connection with a large and much extended force, the supporting guns will nearly always occupy interior positions where the deployed troops protect them locally. Should the general deployment be to the flank of the line of march, however, or the force be small, the guns are frequently located on flank in such places as require local small arm protection. This artillery guard is misnamed "a support."

There are no fixed rules as to the support commander's methods of carrying out these duties, but the arrangements will be similar to those of outpost groups guarding approaches and dangerous cover in proximity; the support commander must rely on the artillery for information as to dispositions and needs. It is generally best to hold the bulk of the troops on the flanks and in rear of the guns some hundreds of yards so as to cover possible hostile advance. During the march, convoy escort principles should govern irrespective of the artillery commander's rank.

When the assault is about to be pushed home, the supporting guns must change their range and burst to the rear of the intrenchments, or smother the cross-firing positions of the hostile line. Frontal support here, then, ceases for a time. The moment of necessity for this rests with the terrain, and as co-ordinated time is here of the *greatest* importance, the system arranged, whether flag, disc, telephone, or wireless telegraph, should be sure and instantaneous. Although there are objections to signals apparent to all it has been suggested that rocket signals are surest and quickest unless the number of guns is small or the guns themselves not widely dispersed. Certainly if wire or "wireless" transmission is depended upon, the artillery observers must be so advantageously placed that a display of disc or flag from the firing line can neither be misunderstood nor lost to view.

In order to give some idea of the critical distance at which the guns should be requested to stop or change their fire, the following experiment is offered.

At Fort Riley a regiment fired 140 shrapnel at 2000 yards along ground sloping uniformly at a designated line of intrenchments. Three rows of silhouettes were placed at 100, 200, and 300 yards distance in front of them to represent *attacking* infantry. Result: 300-yard line, no hits; 200-yard line, no hits; 100-yard line, 3 hits only. Figures in intrenchments riddled.

Batteries that have expended ammunition should not, for that reason, retire; they shelter personnel while awaiting replenishment.

It has been noted how observation limits effect. The observation telescope and prismatic glasses of the field artillery are most excellent and have greatly increased the gun-power efficiency; however, in a battle, more or less haze usually exists, and it is well known that strong glasses are handicapped by such conditions. Advanced observers and the infantry, therefore, must largely determine the effectiveness of the support, and strict attention on the part of the infantry is essential, that they lose no opportunity given them to advance.

At the beginning of fire, it is best to watch with unaided eye the position of the smoke burst, and its location with respect to target noted. Observations of range errors are most important, and observers are best located on windward flanks. Ravines and hollows near the target must be located, for false deductions are natural from the observation of smoke arising from them and so thinned out as to present an appearance of targets silhouetted against such smoke. Moreover, a strong wind may carry the smoke burst some distance to the flank before it rises to plain view. To avoid this the lay of the ground must be appreciated and taken into consideration.

For observers, knowledge of contour sketching is essential. Our artillery regulations lay emphasis upon the "panorama" sketch and rightly prescribe that the position of the observer must always be shown, but in how many cases will that exact point be occupied by the user? Such sketches have very limited value in comparison with a contoured representation, readable and understandable anywhere.

Aerial observation will no doubt greatly decrease the present limitations of our gunfire. A height of 1500 feet is accepted as that necessary to secure safety from the field guns regularly used; therefore, the observer must look from that altitude. We have designed a special gun for attacking aerial machines, but the ordinary field artillery tactics against them include the formation of a "shrapnel bouquet" into which they fly. A smoke trail following the projectile aids in the ranging process.

This means of observation will no doubt prove most valuable, yet it is well known that the flat projection of the earth's surface presents an entirely different picture from the view presented along the horizon, and for this reason, crests and ridges will escape the aerial observer and it may be difficult to interpret some of his reports.

ACTION OF PROTECTING ARTILLERY.

Although some authorities advocate an assignment of "supporting" and "protecting" artillery at the beginning of an engagement, it is not considered desirable to make a rigid distinction between them, for an artillery commander must generally select his target according to the exigencies of the combat.

The term "protecting" is applied to those guns which engage the batteries firing on our infantry from places *other* than the sector of assault. These constitute fixed targets and are therefore engaged to the best advantage from concealed positions. If "knocking-out" fire is impossible, as will usually be the case, it will be desirable to concentrate the protecting artillery on the enemy's batteries in turn; this means good fire control by the artillery chief and requires that the batteries shall not shift their positions any more than is absolutely necessary because of the interruption to the fire. Howitzers are the best for engaging the enemy's artillery, for their shrapnel can get at the personnel behind the shields. It is a distinct improvement that our field artillery drill regulations now provide that one of the four battalions with a division shall be 3.8 inch or 4.7 inch howitzers—the larger caliber is *much* the more efficient. Herein we see also a natural provision to meet the shifting phase of the probably interminable contest that has begun between Projectile and Intrenchment. The 3-inch gun cannot affect an intrenchment much, even with the high-explosive shrapnel, or root out the hidden riflemen. An angle of fall of 28º is said to be necessary to destroy overhead cover, and a howitzer high-explosive shell is four times as effective as those from the 3-inch field gun.

There seems to be no limit to the digging that may be resorted to, but there *is* a limit to the mobile weapon. Here step in the heavier calibers, preferably those of the siege train.

Howitzers have not only the power and the trajectory to do the work needed, but they can come into action in almost any sort of a cut or hollow at ranges up to 7000 yards, effectively. In the attack of a strongly entrenched position, they are essential and they can destroy field guns.

The provision of three heavy-caliber battalions with the auxiliary division of the field army is thus seen to be a wise organization; it permits of a good, strong blow at the beginning of a decisive battle which can produce wholesome results at once, thereby simplifying the work of the smaller calibers.

CONCLUDING REMARKS.

It would seem that the disposition of artillery authorities is to build up on the action of their arms a preconceived notion of how the battle shall go, and they readily fall into the error of forming set notions as to command, fire, objective, support and terrain, quite neglecting the fact that the infantry, not the artillery, has in hand the determination of the objectives and the direction of the fight. Some writers seem to confuse the terms "tactical objective" and "assigned target," forgetting that they are related, but not synonymous.

Now, war never turns out exactly as we expect it, and the most intelligent and adaptable artillery enjoys a great advantage over that which is only accustomed to work in one way, and is tied down by hard-and-fast rules of procedure.

Examination of the actualities of combat shows that it is not a question of using one or the other of the two arms in accordance with a preconceived idea, and that it is impossible to foresee the division of the labors as long as the forces and the intentions of the enemy are undetermined. We have to apply to the artillery the same as to the infantry, the principles of the economies of forces with the object of throwing a superiority of fire at some decisive point, therefore a scattering of forces into a series of very small detachments under different commanders should cause more or less of weakness.

The French ideas are largely built upon their own firing practice and terrain, and we follow them rather more closely than prudence should dictate; the Germans have excellent ideas that the French discard, while the British are weighing the theories of both nations in a calculating balance.

The artillery, like the infantry, is under the orders of the General Officer commanding, the Chief of that unit to which it belongs whether this is an organic unit, such as the division or army, or a temporary tactical unit, such as an advance, flank, or rear guard, or a special detachment with determinate mission. When it is to engage, the general officer commanding assigns to it its approximate position and its mission. If this mission is to support a certain attack, the artillery is not *de*tached, it is *at*tached to the force under the orders of the infantry commander charged with this attack; it acts in connection with him, operating against the points indicated to it by him, and maintaining communication with him by every possible means.

The group which has established this connection at the opening of the engagement would keep it during the entire time of the action, whatever may be the number of groups engaged in the action by subsequent reinforcement.

Whether these groups are supporting the same, or different, attacks, or whether they are in observation in the combat zone, the *commander of the artillery* retains command of the engaged groups in such a way as to make felt everywhere the guiding will of the general officer commanding, of whom he is the direct representative, and his chief labor will be to co-ordinate the efforts of all the guns toward the same end—VICTORY.

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Lieutenant Marchand's "Experiences as a Reconnaissance Officer."

General Langlois' "Co-operation of the Three Arms in the Combat."

Colonel Lalubin's "To What Extent Can the Infantry Depend upon the Artillery for Support."

NIGHT TARGET PRACTICE FOR FIELD ARTILLERY.

BY CAPTAIN CLARENCE DEEMS, JR., 1ST F. A.

Targets used in time of peace, for the purpose of training our troops to meet war conditions, should necessarily be of such a nature as to simulate as nearly as practicable the actual battlefield difficulties, and thus develop that fire control and fire direction essential to successful fire effect. Night attacks will frequently promise a large measure of success for the offensive. The field artillery must be prepared to coöperate to the fullest extent in such movements. To give assistance of value at such a time it is essential that we have an opportunity to perfect ourselves by having practice under night service conditions; or at least that we may fire upon the same kind of targets as will be assigned to us then.

What will be the appearance after dark of the disputed area between two armies which face each other? In these days when electricity aids us in so many commercial enterprises, we may expect it to be as fully employed on the battlefield, and at night both the attack and defense may be expected to be supplied with many portable searchlights, mounted on trucks, which will be moved from place to place as needed. The beams of these lights will be constantly playing over the ground between the opposing armies, each of which will endeavor by their use to discover any threatening movement on the part of the other. As we look across at the enemy's position we shall probably see nothing except the moving beams of his searchlights, and those sectors illuminated by our own searchlights. If the enemy exercises due care in the manipulation of his lights, they will not disclose the disposition of his own troops, but illuminate only those sectors across which an attack upon him may be launched.

The effect of the beam of a searchlight directed at a person is almost to blind him temporarily by the dazzling light, and in consequence to prevent his observing other things at that time, and, even a short time after the beam has been diverted, to render his eyes useless in such a dim light as there is out of doors upon a starry night. In that manner the searchlights will so aid the defense that they will become important targets for the offense to select and destroy.

Acting on the offensive, in the night attack our own lights can be used but little (probably in very limited sectors) for fear of disclosing the advance of our troops, and it is to be expected that, except for particularly favorable weather conditions, the searchlights could aid the attack to but a slight degree, by reason of their relatively small size and their consequent short effective illuminating range.

When the artillery is warned that the night infantry assault is about to begin, it will have for its targets (1) only those points upon which it has registered its fire in the day time, when observation of fire has been good; and (2) the searchlights of the enemy in active operation. As to the first target, unless our lights are strong enough to illuminate it, we could not discover whether or not the point was being occupied at night until the enemy actually began firing at our own men, which might commence at so short a range as to preclude the possibility of our artillery firing at all. Fear of disclosing the advance of our own troops very probably would prevent our using our lights at all for illumination until the fire action of the enemy commenced upon the discovery of our attack. Concerning the second target—the searchlights of the enemy—they will probably be present in numbers, menacing the success of our attack by disclosing our advance, and so blinding our men that they will become confused, lose proper contact, and even fail to see the right point upon which to deliver their final blow in the storm of fire that they have drawn upon themselves.

The fact that these searchlights are a proper target for artillery should be sufficient reason why night practice at a searchlight target should form at least one battery problem yearly. In battle, shrapnel should be most effective against them. A direct hit upon the light would smash it, and very probably injure individuals near it; the shrapnel bullets and fragments would kill or wound the manning detail, shatter the lenses, break the carbons and their holders and cut connections, while the large fragments or the shrapnel case itself upon striking them would hopelessly jam the working parts.

In battle the searchlights of the defense would, by their portability, have a great advantage, for they might be used in several nearby places the same night, thus making the matter of estimation of range an exceedingly difficult problem. In this kind of fire an auxiliary observer would be of great assistance—in fact, a necessity—and he would be connected with the B. C. by telephone, as lantern or torch signals would be difficult to isolate as such and would possibly become confused with other lights.

To practise night firing properly a target should be arranged to represent a search light, but so constructed as to reduce the expense to a minimum. Calcium carbide is both cheap and easy to obtain. It is possible to make a very simple generator of the can type which will furnish an abundance of gas. This can should be made of steel of sufficient strength to resist the penetrating or denting effect of the shrapnel bullets. The light should be that from a large acetylene burner, projected by a rear parabolic mirror and a front lens. The box containing the gas tip, mirror and lens should be made of steel of sufficient strength to resist shrapnel bullets also. It should have a horizontal plate or shelf of steel just above the lens to prevent the latter from being smashed by a shrapnel bullet, which will have considerable angle of fall, and thus be caught upon the upper surface of the plate. A similar plate just below the lens would prevent richochets from doing damage also.

This whole box should be placed upon a platform, and the latter mounted upon a vertical pivot, so that the beam of light could be swept from side to side in fair representation of the manner in which a searchlight is actually operated. The range party could attach sash cord to opposite points of the movable platform, and with two ropes easily operate the target, sweeping its beam over a sector of 180° if desired.

A simple rubber hose would be the only connection required between the generator and the light.

The advantage of this target would be that only a direct hit would so injure it as to prevent its further use. This would be extremely unlikely, as the light could be contained in a box twelve or fifteen inches in diameter, the platform need be but little larger, and the generator could be just as small, and, in addition, the latter might have a small parapet of sand bags built about it for its further protection.

Several silhouettes to represent the manning detail should be properly arranged about the searchlight target.

Where electricity is available, it should be used in a small searchlight, which could be constructed as a target similar to the above.

If it becomes necessary for the artillery to destroy the enemy's searchlights and drive the manning details away from them in order to assist in our attack, then it becomes necessary for us to have frequent practice to secure that end. Such practice will develop expedients particularly applicable to that class of fire. If the gunner finds the beam of light too dazzling to aim at directly, when electric searchlights are used he could try placing a piece of paper at the rear sight, and, obtaining the shadow of the front sight cast upon the paper supported at the rear sight, he could aim in direct fire. If the searchlight is swinging, he could locate the narrowest part of the beam at the source while it is pointing away from him, and thus avoid its blinding effect caused by trying to aim upon it when pointed directly at him.

It would seem that results to be obtained from this kind of firing would be sufficiently valuable to warrant the construction of such targets as have been suggested, and having one battery problem in might firing at searchlights in each yearly series.

ITALIAN FIELD GUNS.

Translated from *Deutsches Offizierblatt*. No. 32, 1912, by Major A. E. Piorkowski.

The field artillery of the active Italian Army consists of 193 batteries of 6 guns each; 93 of these are still armed with the 75 A (75 millimeter steel) gun. This gun, dating from the year 1901, made in Italy, had a spring spur gun carriage. The rest of the batteries have a Krupp gun, recoiling on the carriage, Mod. 1906, which took the place of the 8.7 cm. bronze gun Mod. 1881.

Keeping the antiquated 75 A gun beside the modern Krupp rapid firer, was considered from the beginning as a merely temporary arrangement. The intention was, before abolishing the 75 A guns, which had only served a short time, to find out if they could not with comparatively small expense be converted into acceptable rapid fire guns. A Committee organized by the Inspector of Artillery, General Mangiagalli, towards the end of 1906, was of the opinion that such conversion would be possible and financially recommendable. In 1907 plans for the conversion were ready, but the question took a different turn when the War Ministry conceived the idea to give the whole 75 A outfit without change to the mobile militia. This idea was later dropped again, because it was understood as a mistake to give to insufficiently trained troops an antiquated material. Offers from the "Rheinische Metallwaaren- und Maschinenfabrik" in Germany and from the "Compagnie des Forges de Châtillon-Commentry" in France, to study the conversion of the 75 A material, were the cause of the proposal at the end of June, 1908, for a competition for this conversion under the condition that the ammunition of the Krupp 7.5 cm. gun Mod. 1906 could be used. The fate of the proposal has never become known.

In summer 1908 the Italian Administration finally accepted an offer from the firm of Schneider le Creuzot to adapt the 75 A gun so that it could be fitted in a Schneider gun-recoil carriage. Such a gun entered into tests partly in comparison with a field gun 1906 from autumn, 1909, until February, 1910. From a report to the Chamber of Deputies in March, 1911, it became known that the 75 A gun made of Terni steel was in no way up to the requirements of a modern quick-firing weapon. Its bore and powder chamber, after only 1300 rounds fired in series of rapid fire, were so worn out that the gun had become unserviceable by lack of accuracy: while the Krupp gun Mod. 1906 after 1664 rounds remained in perfect condition, nothing indicating a decrease of accuracy. The trials also showed that the difference in cost between replacing or converting the material was so small that the saving would have been out of proportion with the disadvantages arising from a converted gun.

On the strength of such experience the army administration decided, according to War Minister Spingardi (in the Chamber of Deputies on May 24th, 1910), to replace the 75 A gun by a new model. The fundamental condition for the construction of the new material was that ammunition and carriages should be like those of the material Mod. 1906. It would have been easy to conform the entire field material, without exception, to that of Mod. 1906, which had shown well at the several tests and fits well with all the Italian requirements; but the Administration did not go so far, saying they would first examine the technical progress made in other places since the adoption of Mod. 1906. It is quite probable that this decision was influenced by the opposition made by the Nationalists against adopting the Mod. 1906, which had, for the most part, come from a foreign country, Germany.

As early as June, 1908, while the studies for converting the 75 A material were still going on, the firm of Châtillon-Commentry had offered a gun constructed by Lieutenant-Colonel Deport, one of their officials. The Administration consented to its presentation, to be commenced in June, 1909. But several delays occurred, caused by the factory, and the gun only arrived in September, 1910. Its characteristic features were a gun carriage whose flasks could be spread, and thereby offered a large vertical and lateral aiming field. Shortly before this, in July, 1910, Schneider le Creuzot, through the Italian firm of Armstrong-Ansoldo, had offered a field gun built on the principle of counter-recoil; and this gun also was admitted to the competitive trials. Both factories had given assurances that in case their gun was adopted, by arrangements with Italian private factories even such parts of the guns as could not be made in Italian Government work shops would be made in Italy. This promise evidently was influential in the decision of the Ministry to test the guns of both makers.

In autumn and winter, 1910 to 1911, firing and driving tests took place at the proving ground of Cirie near Turin. The result showed that both models, in spite of their several merits, were not suited for the Italian field artillery. On proposition of the Committee, the War Minister ordered a battery of each for further more elaborate experiments, and one gun of each for an endurance test. The Deport Model was required to lessen its weight and change its elevating gear so that direct aiming at distances of over 3,000 meters was made possible; Schneider's counter-recoil apparatus was rejected and replaced by a Schneider gun-recoil carriage.

In order to give a free hand to the Government in definite selection of the gun and conclusion of contracts, the Chamber and Senate voted in June, 1911, the necessary appropriations for the replacement of the 75 A material, which were estimated by the Government at 50,000,000 lire.

In the course of the summer Krupp also consented to participate in the battery trials with his latest model based on the Italian Model of 1906.

Beside the Inspectors of Artillery who were competent for the testing of the material, a special testing board was organized, consisting of General Radicati di Marmorito, as Chairman, and three Colonels of Artillery.

The trials began in November, 1911, on the proving ground of Cirie and embraced mainly efficiency of the material, driving qualities, evolutions in draft, accuracy, and firing under conditions of war. To study the value of the guns under conditions different from those on the proving ground, the trials were extended from Turin to the south of Naples. They concluded with endurance firing in January on the plain of Eboli, east of Salerno. Each gun had to fire 500 rounds against a number of targets at various ranges from 1500 to 6000 meters.

Details regarding the behavior of the guns at the various trials have not been made public. It became known that the Schneider gun was so inferior to the others that its selection was never seriously considered. As to the other two competitors, Krupp's gun had the advantage of lesser weight than the Deport gun. Krupp's gun, unlimbered, weighed 960 kilos, while Deport's, although its shield was comparatively thin, weighed unlimbered 1100 kilos. The handling of the Deport gun is complicated, and compared with

Krupp's it differed considerably from the service gun of 1906. Also it seems that the Deport breech mechanism was not fully satisfactory.

A short time after the end of the trials, the Chairman of the Committee, General Radicati di Marmorito, died, and so the definite decision was delayed. It was said then that Radicati favored the Krupp gun.

After his death, however, it seems that the principles as originally fixed had suffered a change: the chief requirement of a least possible weight had become less important, while the novelty in the Deport gun, its great aiming field, had gained partisans. Moreover, the firm of Châtillon-Commentry had in the meantime succeeded in uniting nineteen Italian manufacturers in a syndicate ready to purchase Deport's patents, to manufacture the material at home.

Facing this situation, by which the competition of foreign works appeared avoidable, the War Ministry finally, at the end of March, decided in favor of a gun with Deport carriage.

The syndicate of domestic manufacturers notified the administration that the whole material would be delivered by July, 1913.

The question of making the guns themselves was causing special difficulties. Those tested during the trials had been forged in French Government workshops, which can not, of course, furnish for Italy. Italian industry is without experience in manufacturing steel for modern rapid-fire field guns, as is evident from the endurance test above mentioned of the 75 A gun. Nevertheless, Italian industry was given the order to produce the guns. The forgings are again to be made in the Terni works, whence the steel came for the 75 A guns, the machining to be done in the Vickers-Terni works or by Armstrong-Pozzuoli. In this way the new material will have guns which have not been tested at all.

The breech mechanism, it is said, will be of the Italian Agostini design.

The Italian public applauded the decision of its Government and the enterprise of its industry. But there are also opinions—and particularly from experts—full of grave criticism.

The military paper "Esercito Italiano" published the decision, adding: "We take the liberty even now to remark, that in this way our artillery will have two models, surely not a success for our high technical experts."

It is evident that the difference between the two kinds of guns will result in all sorts of difficulties in instruction and tactical use, which cannot follow the same principles; and also in the exchange of spare parts and reserve pieces on the field of battle.

Also there is an opinion expressed that the large aiming field has only conditional value, especially if accompanied by increased weight as with the Deport gun, and with complications and difficulties in handling. Finally it is to be feared that domestic industry, according to present experience, will be unable to produce in so short a time a material satisfying all requirements, and that further delays in the change of the field artillery are to be apprehended.

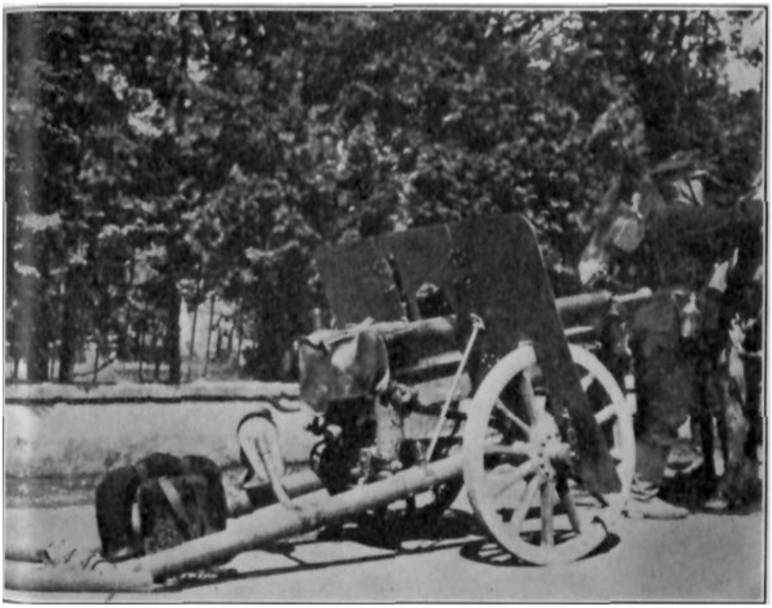
The distribution of the work over nineteen different establishments is in itself a difficulty, and in fact nothing has been heard as yet that the manufacture has commenced. Even the contract between the Italian Government and the syndicate is said to be still incomplete.

In the meantime the Italian Government has awarded Krupp a contract for 12 complete field batteries, including caissons, etc., which are of the same construction as produced by Krupp for the competitive trials with Châtillon-Commentry and Schneider in Italy.

THE NEWEST TYPE OF JAPANESE MOUNTAIN GUN.

Information concerning this gun is still incomplete, as under the Japanese regulations all important changes in matériel are held as confidential for five years from the date of introduction.

The gun was made at Osaka, and issued for trial to the School of Instruction for Field and Mountain Artillery some two years ago. After exhaustive trials it was issued to the service in December, 1911. Its introduction will necessitate a new edition of



the Artillery Training Manual. It is said that the gun is still far from satisfactory, and that the caliber, now the same as that of the field gun, will have to be reduced. It appears that with the present caliber it has been impossible to effect a satisfactory compromise between a load light enough for a pack pony and the requisite stability and strength. Eighty guns and carriages of this type have been completed, and nine more are under construction; probably no more will be made.

The gun proper is of steel, caliber 75 mm., length 1 meter, twist of rifling one turn in 25.2 calibers. The breech mechanism, of the swinging block type, is not connected with the gun proper, but with a support (*takuga*) which intervenes between the gun and the cradle (*yoga*). The glycerin buffer and its attachments are beneath the gun. The maximum elevation is 25 degrees, maximum depression 10 degrees, maximum traverse 6 degrees on each side of the normal, length of recoil on the cradle 1 meter.

The height of the wheels is 1 meter, track the same, and width of tire 4 cm. Hardened steel shields are provided, 3 to 3.5 mm. thick, which may be attached to the axle; these are proof against rifle fire at 400 or 500 meters, but do not protect the recoil buffer. The height of the axis of the piece is 70 cm. Provision is made for draft as well as pack transport, using no limber.

The gun is served by one noncommissioned officer and six cannoneers, who are not armed with rifles. The battery has six guns. Fixed ammunition is used, with the same projectiles as the field gun; the charge of smokeless powder is between 1-3 and 1-2 kg. Projectiles are carried fuzed; a point combination fuze (Model "41st Meiji"), with a tin cover, is used. The maximum range is 6500 meters.

The line of sight is not independent. The sight is panoramic, and there is a separate clinometer for setting off range in indirect laying. An extension bar is provided, by means of which the sight may be raised so as to look over the shield instead of through the sighting port.

Telephones and signal flags form part of the battery equipment, as well as an Italian form of the Gautier telemeter.

For pack transport, the piece forms six loads, averaging 100 kg. weight:

1. Gun.
2. Support (*takuga*), with breech mechanism.
3. Cradle (*yoga*), with buffer.
4. Trail and carrier bars.
5. Wheels and axle.
6. Shield, shafts, store-boxes, etc.

The support is in one piece; the gun is placed upon it and secured by cap-squares (B, Fig. 1). The bottom is flat, and has flanges at the

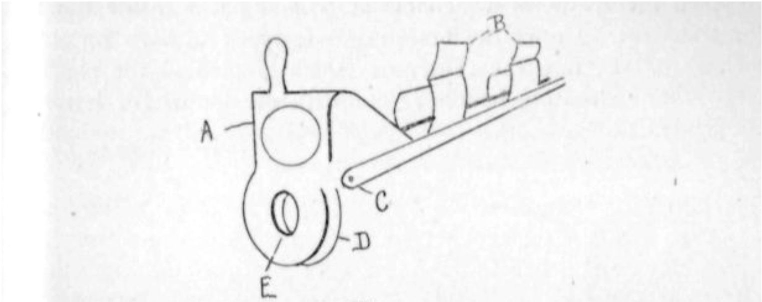


Fig. 1

sides which fit over ribs on the cradle. At the rear is a lug D; a projection on the buffer cylinder passes through this at E, and is secured by a large nut. The breech block works in a carrier ring which is pivoted on the right side of the support; it has two threaded and two slotted sectors. The extractor is of the usual type. There is a safety button on the rear face of the carrier ring; when this is turned up the gun can not be fired.

The cradle (Fig. 2) contains the buffer, over which are assembled first three counter-recoil springs, then an outer case, and finally three more springs. The piston rod is secured at the

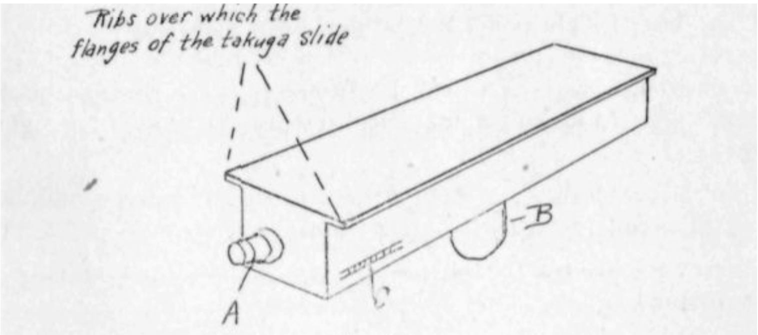


Fig. 2

front end of the cradle; the projection A serves to secure the cylinder to the lug under the breech. On the bottom of the cradle is a projection B which fits into a socket in the axletree. The sight socket is attached to the left rear of the cradle; on the right is a scale C to register the length of recoil.

The trail (Fig. 3) is of steel tube, forked to allow the breech to be depressed between the forks. The end piece, to which is attached the spade, is detachable at B, and packs inside the fork for transport. Under the breech and fastened to both forks is a rocking bar C, into the center of which is pivoted the elevating screw. The elevating

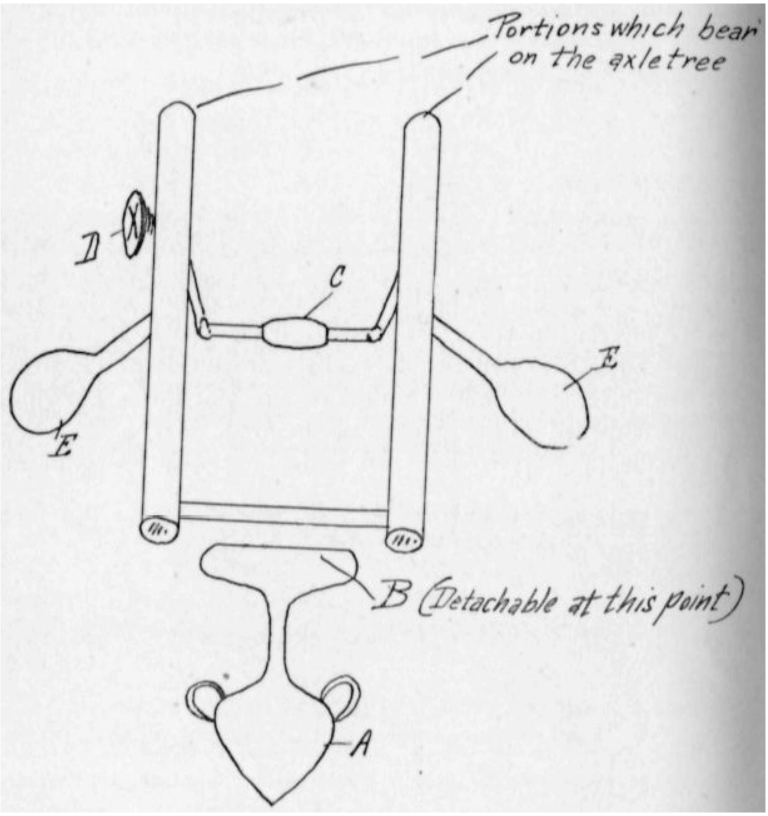


Fig. 3

handle D is on the outside of the left fork. Cannoneers' seats E are attached to the outside of each fork, and fold over for transport. Attachments for the shafts are formed on the forks.

The axle tree is provided with a socket for the cradle pivot, and bearing surfaces for the ends of the trail forks.

There are two forms of pack-saddle, the trail load and the shield requiring a special form. The saddle panels are stuffed with rice husks, and are adjustable to fit different sizes of ponies.

AUSTRIAN OBSERVATION LADDER AND BRIDGE EQUIPMENT.

The equipment of the Austrian field battery includes an observation ladder and a portable bridge, all packed on one store wagon. The following descriptions are translated from official publications, by Lieutenant Harvey H. Fletcher, 12th Infantry.

OBSERVATION LADDER.

To erect the ladder. (Figs. 1-3.)

Two men are required. Taking hold of the lowest rungs of the inner ladders, they raise them until opposite the next to the top ones of the middle ladders, and set the locking plates, after which they similarly raise the middle ladders. One man then ascends, clasps the locking springs for the top ladders, and fastens the table spring under the table leaf. The footrest and seat drop into place automatically. After this man has left the ladder, the sliding feet are adjusted to the inequalities of the ground. Stability against the wind is obtained by storm guys, which extend from pegs driven into the ground to hooks on the top ladders, to which they are attached by rings. Base plates prevent the feet from sinking into wet ground.

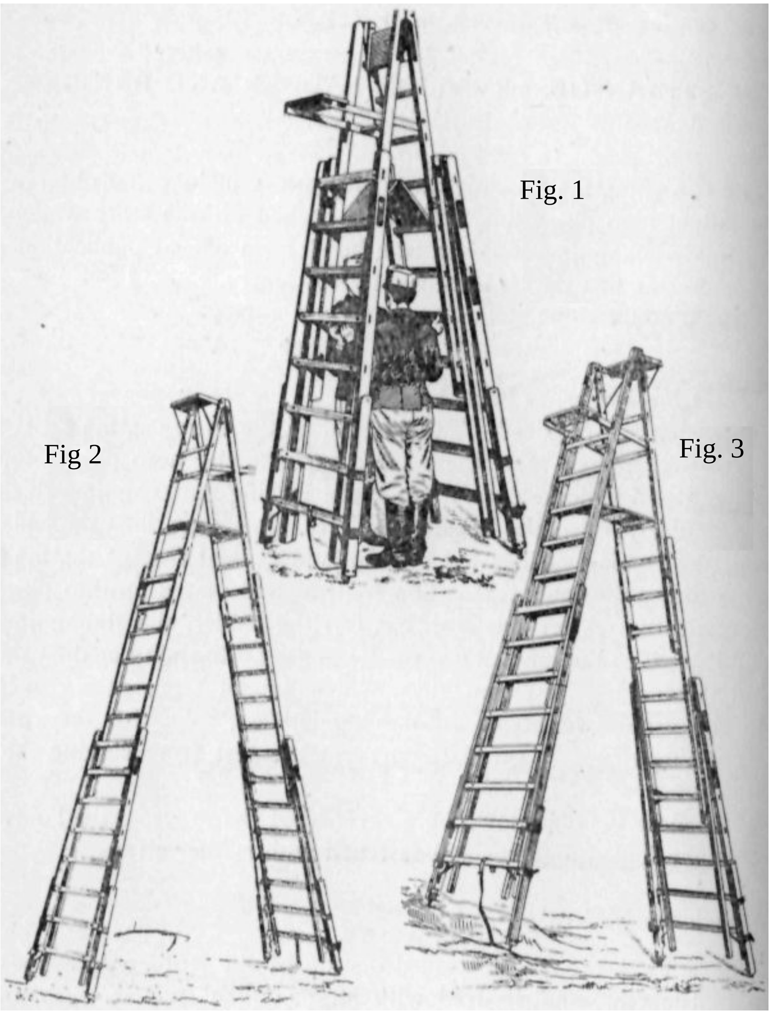
The ladder is taken down by a reversal of the process; the ladder beams are folded together and fastened with leather straps.

To pack the ladder.

The ladders proper are placed on top of the store wagon body, top to the rear, and secured with straps. The smaller parts are carried in a drawer fitted in the right front of the wagon body.

PORTABLE BRIDGE.

This bridge will bear all field artillery carriages, heavy field howitzers included, in section column. Cannoneers are dismounted in crossing. It may be constructed in three ways: normal bridge,



span 3.6 meters; short bridge, span 1.8 meters; and long bridge, span 5.4 meters.

Constructing the bridge.

Choose a crossing place with firm level banks, as equal in height as possible and with easy approaches. Mark with the railing rope the earth to be removed, and with carbines (temporarily) the distance between centers of the abutment sills. Level up the ground under the sills. The bridge is set up by the cannoneers.

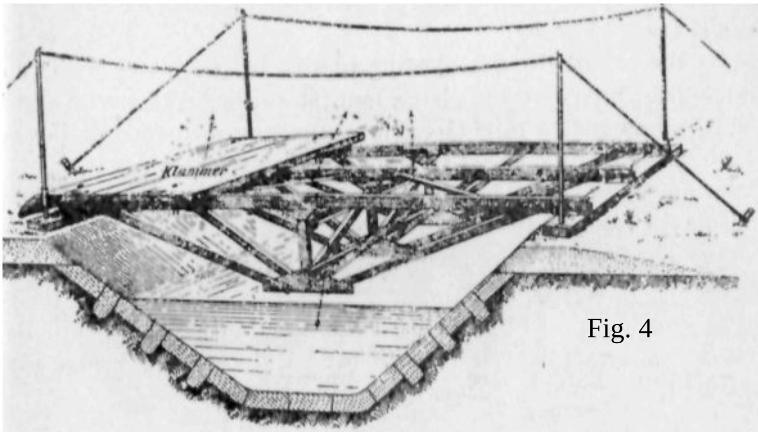


Fig. 4

(a) *Normal bridge* (Fig. 4.)—Lay the abutment sills horizontal and solid, testing with a level. Place the ends of the trusses in the shoes of the abutment sills, and, when both ends are in place, key them. If necessary, the banks are cut away for the under braces of the trusses, or the sills elevated. Drive the railing pegs.

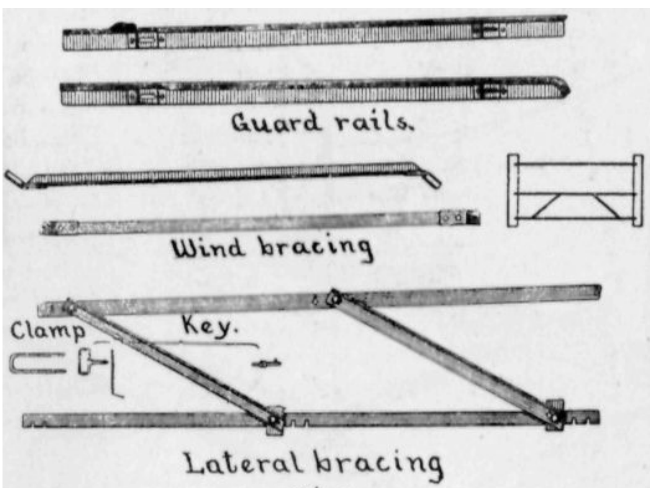


Fig. 5

To attach the lateral bracing truss (Fig. 5) loosen the wedges; place the lower chord in position between the connecting plates of the longitudinal trusses, attaching it by the notches at the ends and middle; key the upper rods to the vertical struts of the truss; tighten the wedges.

The wind braces are fastened between the trusses in such a manner that the resulting quadrilateral has its narrow side on the middle truss (Fig. 5).

Lay the bridge deck, consisting of two bridge plates with ramps and four ordinary bridge plates, and pin to the trusses with clamps. Lay the four guard rails along the sides, rounded ends at the ends of the bridge, and connect to the floor plates with keys.

Set up the railing rods and hang the railing ropes on them; tie the ends of the ropes to the pegs.

Throw earth on the roadway, and, if time permits, bank it under the ramps.

(b) *Short bridge* (Fig. 6-7)—Parts required: 2 abutment sills; 3 beams A; two bridge plates with ramps; 1 ordinary bridge plate; 2 guard rails; railings. Construct as in figure.

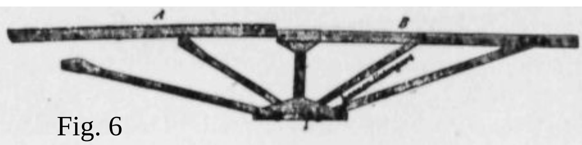


Fig. 6

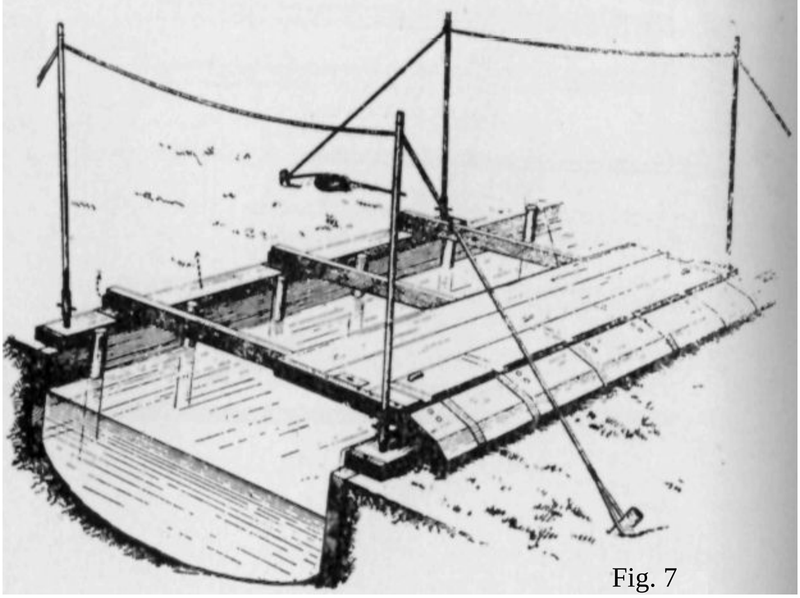


Fig. 7

(c) *Long bridge* (Fig. 8)—This bridge requires the equipment of two batteries. From one battery take the entire bridge. From the other take: 3 parts B of the truss (entire truss except beam A); 1 lateral bracing truss; 3 ordinary bridge plates; 2 guard rails; clamps and keys.

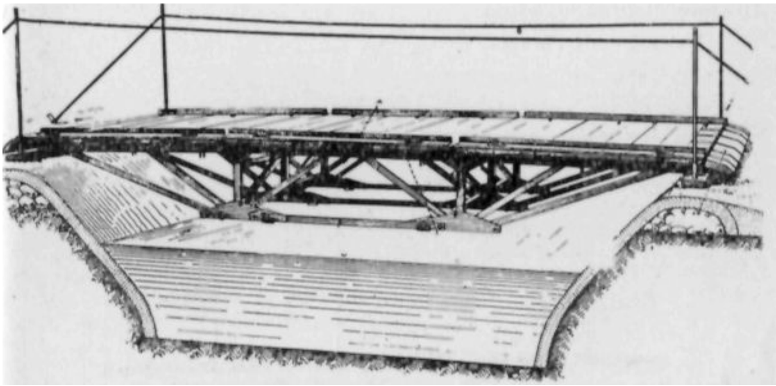


Fig. 8

Each truss is lengthened by joining each part B of the second bridge to a truss of the first. This is done by joining the upper beams of the two trusses together, the inner short underbrace of the second truss to the middle upper beam, and the inner long under braces of both trusses to the opposite connecting plates.

The bridge is constructed in the same manner as the normal bridge, two lateral bracing trusses being used. The wind braces are put in as in the figure (Fig. 9).

To construct the bridge, using only one bank.

Raise one or two trusses vertically on end (Fig. 10). Anchor the bottom ends, and place the loops on the ends of the railing ropes over the top ends. Lower the top ends to the opposite bank. The builders then cross on this improvised bridge, using the ropes as railings; the opposite sills and remaining trusses are drawn over after them.

Packing the bridge.

The figure (Fig. 11) shows the rear elevation of the store wagon. The compartments are packed as follows:

1. 3 trusses.
2. 4 floor plates, ordinary.
3. 4 floor plates with ramps.
4. 2 abutment sills.
5. Drawer with guard rails and wind braces.
6. Drawer with smaller bridge parts.
7. Lateral bracing truss.
8. 3 truss beams, extra.

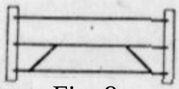


Fig. 9

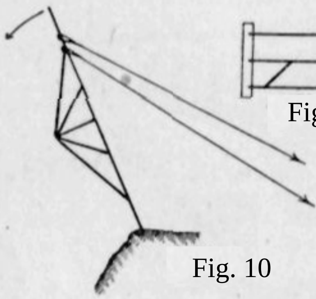


Fig. 10

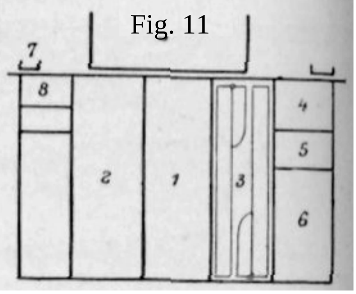


Fig. 11

CURRENT LITERATURE.

All the books and periodicals referred to below are on file in the War College Library. Officers desiring to consult them should address The Secretary, War College Division, General Staff.

CONTENTS OF PERIODICALS.

JOURNAL OF THE ROYAL ARTILLERY. (Royal Artillery Institution. Woolwich, England.)

September, 1912.

A Visit to Some Battlefields in Northern Virginia.—Capt. F. R. Sedgwick, R. A.

An account of a trip by six English and Canadian officers to a number of the Virginia battlefields. The writer had very evidently made a careful study of the battles before visiting the fields, and knew precisely what he was looking for. That he looked intelligently is evident from his closing remark, that "the whole trip was one of the most enjoyable and certainly the most instructive holidays which has ever fallen to my lot."

A Miniature Artillery Range.—Major H. T. Belcher, R. A.

Description, with diagrams, of the apparatus in use at the Roval Military Academy for indoor simulated firing. The installation is very complete and elaborate and should give very realistic results; nevertheless it can all be easily constructed by any carpenter, and the materials cost little or nothing. It seems doubtful, however, whether any better results are to be obtained from such an elaborate installation than from a simple one.

Trajectories and Cambered Planes.—Lieut. H. L. F. Dimmock, R. G. A.

The writer very ingeniously works out an analogy between the path of a projectile in air and the path of a particle of air acted upon by an aeroplane wing; and proposes both practical and theoretical work along the lines thus suggested, with a view of determining the most efficient wing shapes.

Organization and Training of Territorial Field Artillery.—Lieut. Col. A. M. Balfour, R. F. A. (T.).

Continuation of the discussion started by Col. Talbot in the May number (see FIELD ARTILLERY JOURNAL for June and September). The writer disagrees with Col. Talbot on most points.

The Battle of Kin Chou.—Translation from *Mitteilungen über Gegenstände des Artillerie- und Geniewesens*, May, 1912.

Aeroplanes and Dirigibles for Observation of Fire.—Translation from *Spectateur Militaire*, Feb. 1, 1912.

Kriegstechnische Zeitschrift.—Précis of contents, No. 4, 1912.

Jahrbücher für die deutsche Armee und Marine.—Précis of contents, July, 1912.

October, 1912.

Napoleon's Campaign in Poland.—Major F. D. Logan, R. F. A.

The first instalment of a critical study of the campaign of 1806-7.

Review of Chapters VI and VII, Series C. Dickson MSS. Edited by Major J. H. Leslie, R. A.—Prof. Charles Oman.

A highly appreciative review of the latest instalment of Major Leslie's edition of the papers of Col. Dickson, Wellington's chief of artillery in the Peninsula. These chapters deal with part of the year 1813, covering the Vittoria campaign, the battles of the Pyrenees, and the siege of San Sebastian.

The Possibilities of Half Batteries.—Capt. H. W. Wynter, R. F. A.

A discussion of the advantages that might be obtained through a reorganization of the British six-gun batteries, subdividing into two semi-independent half batteries something on the lines of the Dutch system, instead of three entirely subordinate platoons.

Aerial Warfare.—Major H. T. Hawkins, late R. A.

Speculations as to the strategic and tactical use of air-craft. This paper is interesting in that it devotes serious attention to the matter of actual hostilities in the air between fleets of air-craft.—a subject that is curiously neglected by enthusiastic aviators, who often fail to consider that the enemy will not wait quietly on the ground for our air-craft to reconnoiter them and annihilate them with bombs.

Some Aids to Training in Territorial Batteries.—Lieut. Col. G. R. Talbot, R. F. A. (T.).

Description of the apparatus used by the writer for indoor practice in conduct of fire. The board for indicating bursts seems less practical than the American system; but some hints are given for constructing tripod or standard contrivances for training gunners in handling laying instruments which might be useful to our militia officers.

Fire Control and Identification of Ships.—Lieut. Col. C. R. Buckle, R. G. A.

Propositions for a system of communication in a coast fortress.

Adjustable Range and Elevation Scale for Howitzers.—Capt. J. W. K. Disney, R. G. A.

Description and drawing of a device for determining range settings for seacoast howitzers, permitting the battery commander to think in yards instead of degrees, and change from one powder charge to another without difficulty.

The 28-*cm. Krupp Howitzer*.

Description of this gun (see FIELD ARTILLERY JOURNAL for March, 1912), originally published in *Löbell's Jahresberichte*, reproduced in French in the *Internationale Revue*, thence translated into Spanish for the *Memorial de Artilleria*, and now translated from the Spanish.

Draft Animals in the African Field Artillery.

Translation from *Revue d'Artillerie*, February, 1912 (see FIELD ARTILLERY JOURNAL for June).

4.8″ *Guns and Howitzers for Casemates*.

Description of Cockerill guns, translated from *Revue de l'Armee Belge*.

Kriegstechnische Zeitschrift.

Précis of contents, No. 5, 1912.

November, 1912.

Introduction of the Tangent Scale in the Royal Artillery.—Col. Sir H. W. Barlow, Bart., R. A.

A curious investigation into early English artillery laying instruments.

Napoleon's Campaign in Poland.—Major F. D. Logan, R. F. A.

Continuation of study commenced in October number.

Interior Ballistics with M. D. Cordite.—Captain R. K. Hezlet, R. A., A. O. D.

An investigation, by Ingalls' method, of the relative advantages of the tube, strip and cord forms for cordite grains. The writer concludes that for efficiency and economy the forms should be rated in the order named.

Quick Firing Schneider Field and Siege Howitzers.
Schneider Long Range Quick Firing Siege Guns.

Translations from *Revue d'Artillerie*, March and May, 1912.

Tactical Employment of Heavy Artillery.

Précis and translation, from *Jahribücher für die deutsche Armee und Marine*, August, 1912, of a review of Captain Friedrich's book under the above title (see FIELD ARTILLERY JOURNAL for June, 1912).

Kriegstechnische Zeitschrift.

Précis of contents, No. 6, 1912.

Tactical Use of Field Artillery.

Translation from Russian *Artillery Journal*.

REVUE D'ARTILLERIE.—(Librairie Berger-Levrault. Rue des Beaux-Arts 5, Paris.)

July, 1912.

The Burst Ellipse.—P. Charbonnier.

A theoretical discussion of the errors of fuzes.

Initial Velocity in Field Guns.—Lieut. Col. Sautereau du Part.

The writer discusses at considerable length the factors entering into the efficiency of shrapnel fire; and concludes that initial velocity has comparatively little to do with it. He recommends the reduction of initial velocity from 530 m.s., the present figure with the French field gun, to about 460, urging that the gun may then be lightened without sacrificing efficiency.

Contribution to the History of Artillery.—Major C. Romain.

Conclusion of the paper under this title in the June number (see FIELD ARTILLERY JOURNAL for September.

Essay on Artillery Fire.—Captain E. Pagezy.

Conclusion of the papers published in the January and June numbers (see FIELD ARTILLERY JOURNAL for March and September). The writer suggests various methods of calculating deflections when the battery commander has to be a considerable distance from his guns, and describes a very simple instrument for facilitating such calculations. This is simply a circular slide rule made out of an ordinary cardboard pillbox, the graduations being laid off on strips of paper and glued on around the rims of box and cover.

Safety in Aeroplanes.—Major P. Lucas-Girardville.

Conclusion of paper in June issue (see FIELD ARTILLERY JOURNAL for September).

August, 1912.

German Artillery Firing Practice.

Translation of the article entitled *Notes on Firing Practice*, 1911, in *Artilleristische Monatshefte* for November, 1911 (see FIELD ARTILLERY JOURNAL for December).

The Scott Sight for Aeroplanes.—Captain Peloux.

Extended descriptions, with photographs and diagrams, of Lieut. Scott's bomb-dropping apparatus.

Kites for Observation.—Major C. Romain.

History of the military kite, and its use in the French Army.

Notes on the French Artillery Matériel in 1870.—Gen. G. Herment.

Interesting remarks on the ammunition and firing methods of the French in the Franco-Prussian War.

Reorganisation of the Dutch Field Artillery.—Lieut. Schildermann.

Continuation of the paper begun in the June number (see FIELD ARTILLERY JOURNAL for September) describing the firing methods of the new three-gun firing batteries.

ARTILLERISTISCHE MONATSHEFTE.—(A. Bath, Mohrenstrasse 19, Berlin.)

September, 1912.

Progress of the French Field Artillery.—General Rohne.

An appreciative review of the work of General Percin as inspector of field artillery.

Measurement of Atmospheric Resistance for High Velocities.—K. Becker and C. Cranz.

The first of a series of papers describing experiments with rifle bullets, made with a view to determining atmospheric resistance at various high velocities, and thus testing some of the fundamental assumptions of ballistic calculations.

New Experiments in Atmospheric Resistance.—O. v. Eberhard.

A brief announcement, to be followed later by more complete details, of experiments made by the writer under the auspices of the Krupps, with artillery projectiles. In making these the writer was in constant communication with the authors of the preceding paper, and collaborating with them. As a result of his experiments he is led to believe that the usual assumption, that functions tabulated for one projectile may be used for another by introducing a proper coefficient of reduction, is inadmissible. He proposes a basis for a new method of making ballistic calculations, to avoid this source of error.

Combat Principles of the Russian Artillery.—Captain Bracht.

An extended review, based upon official publications, of the Russian artillery organization and tactics.

Artillery Matériel at the Turin Exposition, 1911.

Illustrated descriptions of the guns (French and Italian) exhibited at Turin.

October, 1912.

The Present Status of Ballistics.—Colonel E. Vallier.

A sketch of the origin, progress and present position of the study of exterior ballistics.

The Recent Changes in the Field Artillery Drill Regulations.—General Rohne.

The recent amendments chiefly affect the vital chapter on Combat. General Rohne expresses his approval of most of them:—insistence upon close coordination of infantry and artillery; the requirement that the commander of any force shall assign specific duties to his artillery, and that infantry and artillery commanders must then arrange for harmonious action, whether or not the artillery has been expressly placed under the orders of the infantry commander; omission of the old 300 m. limit for firing over friendly infantry, and leaving the whole matter to the judgment of the officers concerned. He dissents, however, from the idea of habitually attempting the actual destruction or permanent silencing of hostile guns, and from the practice, thereby necessitated, of assigning only a narrow front to a battery. He prefers the French idea, of ordinarily giving a battery a broad front to observe, and requiring only neutralization of artillery on that front.

The Training of Reserve Officers in Field Artillery Regiments.

The writer points out certain difficulties in training reserve officers in their own batteries, and outlines a method of instruction by which all the reserve officers of a regiment or even of a larger unit may be trained under one instructor.

The New German Firing Regulations.—Lieut. Col. Hidikata.

Reply to comments in the February number upon Col. Hidikata's paper in the October number, 1911 (see FIELD ARTILLERY JOURNAL for December, 1911, and June, 1912).

Notes on the Russian Field Artillery: the Tactical Use of Howitzers.—W. N. Genischta.

A translation from the Russian *Artillery Journal*, giving an account of the Russian views on howitzer batteries,—marching, reconnaissance, occupation of position, change of position, fire tactics, and ammunition service.

New Krupp Mountain Guns.

Descriptions, with photographs, of three types of 75 mm. mountain guns, and a 10 cm. mountain howitzer.

French Horse Artillery Gun.

This paper gives, on the authority of *Les Archives Militaires*, the characteristics required of guns submitted for test, and the general program of the tests held at Bourges last February. The resullts of these tests have not yet been published, and the French horse artillery is still using the old guns.

Gunsights and Rangefinders.—Captain Gotzhein.

A proposed system of rangefinding for coast artillery, based upon the known height of ship targets, and a special form of gunsight for use therewith.

Simple Method for Adjusting Short Base Rangefinders.—Dr. C. v. Hofe.

Description of a method of adjusting two rangefinders by sighting upon each other.

The Artillery of the Air.—Gen. Rohne.

Comment upon the competitions for the Michelin prizes for accuracy in dropping bombs from aeroplanes, in which the American Lieutenant Scott showed unexpected accuracy and won both prizes, 75,000 francs in all. General Rohne, while calling attention to this accuracy, warns against building too great hopes upon it, more especially as nothing like the same results were obtained later at Joachimthal. He points out that it was, so to speak, target range and not service accuracy; and also that simply hitting with even a large bomb does not necessarily mean great destruction, since striking velocity has much to do with shell effect, and this is always low in dropping bombs from moderate heights. He suggests, however, that bomb-dropping might have its maximum tactical importance in a pursuit, where the physical damage done would be of less importance than the moral effect.

Reply to "Miscellaneous Remarks on Field Artillery."—Lieutenant Engel.

Lieutenant Engel states that he proposes to reply at some length to the paper under the above title in the August number (see FIELD ARTILLERY JOURNAL for September). In the meantime, however, he joins issue with the previous writer on the assertion of the latter that the officers on duty at target ranges often hamper the officers in charge of firing, by raising technical objections to their plans in order to save work in setting targets.

November, 1912.

Measurement of Atmospheric Resistance for High Velocities.—K. Becker and C. Cranz.

The second in the series of papers commenced in the September number (see *supra*). A method of determining velocities by photography is described in considerable detail.

Notes on Firing Practice, 1912.

First instalment of the regular annual review of the summer's practice. As a result of his observations the writer makes a number of suggestions.

He considers that the time required for preparing and opening fire is often too great. To remedy this, he proposes greater simplicity and brevity in orders to the battery commanders; relaxation of the rule that batteries should open fire simultaneously; and certain simplifications in battery procedure, such as having all guns habitually laid parallel upon some object in the proper general direction as soon as they reach position, and then opening fire by the command *add* or *subtract*.

Much space is given to a discussion of the designation of targets. The writer favors using concealed targets, indicated by marks known only to the officer in charge of practice, or even no targets at all; the battery commanders then to get orders to fire, for example, upon "artillery behind crest, from 40 to 75 mils to the left of the church, tower." The writer's view is that service practice is for general instruction, and that effect upon the target is a side issue; in this connection he suggests that detailed range reports, etc., are a detriment rather than an advantage.

The paper ends with some detailed suggestions for practice in regimental and brigade firing when only a few batteries are together, using a platoon to represent each battery.

Krupp Naval Guns for Use against Air Craft.

Descriptions and illustrations of new models of gun mountings.

Artillery Notes from Nauticus, 1912.—General Rohne.

Notes on the progress of naval artillery during the past year.

Apparatus for Gunnery Instruction.—Lieut. C. v. Keller.

Description of a set of small dummy laying instruments, used for instruction of cannoneers; the dummies are laid out on a table, and all the operations of preparation of fire carried out.

Contribution to the Theory of Recoil Carriages.—M. Pilgram.

A mathematical discussion of the effect of the weight of the recuperator springs upon the action of the recoiling parts of the carriage.

An Artillery Protractor.

Description of a celluloid protractor, graduated in mils, constructed by an instructor at the German School of Fire, for determining deflections on the map. Instruments of this kind, home-made, have been found useful by many officers in this country, especially in armory instruction of militia batteries.

MISCELLANEOUS ARTICLES.

MATÉRIEL.

Wastage of Artillery Matériel in War.

Figures on gun replacements by the Russians in Manchuria, with suggestion that present gun reserves may be found too small in view of the complication and delicacy of modern guns.

Schweizerische Zeitschrift für Artillerie und Genie, August, 1912, p. 306.

The Austrian Mountain Artillery.

Description of the Austrian mountain artillery matériel.

Schweizerische Zeitschrift für Artillerie und Genie, July and August, 1912.

Italian Heavy Field Artillery.

Numerical data on the Italian 149 mm. howitzer.

Bulletin de la Presse et de la Bibliographie Militaires, August 31, 1912, p. 188.

Bridge Equipage for Artillery.

The Austrian artillery has recently adopted light bridge equipment, for crossing ravines or small streams. It consists of steel supports and wooden deck; each battery carries material for 3.6 meters of bridge; a bridge of this length has been set up in five minutes and dismantled in one and a half. A full description of this equipment, with diagrams, is published in this issue of the FIELD ARTILLERY JOURNAL.

Deutsches Offizierblatt, Sept. 5, 1912, p. 863.

French Heavy Field Howitzers.

Details concerning the Rimailho howitzer.

Deutsches Offizierblatt, Sept. 19, 1912.

Periscope Mast.

The Fontana Mast Company has patented a mast formed of telescoping tubes, containing a special form of periscope. The device can thus be used for preparing and observing fire either from the ground or from the masthead.

Artilleristische Monatshefte, November, 1912, p. P-58.

AVIATION.

Italian Aviation in Tripoli.

A graphic description by Lieutenant Rossi, of his experience when reconnoitering and dropping a bomb into an Arab camp. His passenger was wounded and his machine damaged by rifle fire at a height of 2000 feet.

Journal des Sciences Militaires, September, 1912, p. 226.

Dropping Bombs.

At the competition for the Michelin prizes (Chalons. August 10-11), both were won by the American Lieutenant Scott. The bombs were spherical, 15 cm. in diameter and 7.1 kg. in weight. For the 50,000 francs prize the target was a circle 20 m. in diameter, and the height of the aeroplane 200 m.; for the 25,000 francs, the target was a rectangle 120 × 40 m., and the height of the aeroplane 800 m. Lieutenant Scott made 12 hits out of 15 on the former target, and 8 out of 15 on the latter.

Revue d'Artillerie, July, 1912, p. 293.

Artillery Fire upon Air Craft.

Brief of the new German regulations.

Archives Militaires, June, 1912, p. 174.

Air Craft in the Italo-Turkish War.

A general review of the operations of the air craft in Tripoli.

Militär Wochenblatt, October 5, 1912, p. 2944.

ORGANIZATION.

Austrian Mountain Artillery.

A reorganization and large increase in the Austrian mountain artillery is under consideration. There now exist seven regiments; the present proposition calls for nine more, so that one can be assigned to each of the sixteen Army Corps.

Schweizerische Zeitschrift für Artillerie und Genie, August, 1912, p. 320.

TRAINING.

Japanese Field Artillery Drill Regulations.

An extended review of the new (1911) edition of the Japanese Drill Regulations.

Rivista di Artigleria e Genio, June, 1912, p. 429.

Combined Field Firing.

Paper by a general officer, strongly advocating combined field firing by infantry and artillery as essential to the proper training of both arms.

Army Review, October, 1912, p. 484.

Field Exercises of Artillery Regiments and Brigades.

A detailed discussion of methods of planning and conducting field exercises of considerable bodies of artillery, with a number of concrete examples thoroughly worked out.

Vierteljahrshefte für Truppenführung und Heereskunde, No. 4, 1912, p. 611.

Firing upon Wrong Target.

An article by General Percin, mentioning numerous cases where artillery has fired upon friendly troops or upon empty spaces, and urging that umpires at maneuvers should check up firing data, and determine whether or not the proper coordination of the arms exists.

La France Militaire, August 21, 1912, p. 1.

Russian Field Artillery Drill Regulations.

Continuation of translation commenced in No. 8.

Mitteilungen über Gegenstände des Artillerie- und Geniewesens, No. 9, 1912, p. 997.

TACTICS.

Open and Covered Positions.

A paper by an English battery commander, pointing out the disadvantages of covered positions. The writer also suggests the habitual assignment of infantry officers as "tactical" umpires to artillery units in maneuvers, to report upon the amount of support given by the guns to the infantry.

Army Review, October, 1912, p. 508.

Artillery Cooperation.

Suggestions of methods of handling artillery officers' patrols, for reconnaissance and communication.

Army Review, October, 1912, p. 516.

Cooperation of the Arms.

French translation of a long article by Lieut. Col. Hoppenstedt, of the German Army, originally published serially in the *Militär Wochenblatt.* The writer reviews in some detail the present French theory and practice, and compares them with the German.

Internationale Revue, Supplement 163, October, 1912, p. 353.

Combination of Field Artillery with Other Arms in Battle.

An excellent brief paper on the subject, inspired by General Percin's "Picardy Maneuvers." It is discussed at some length in the editorial department of the same magazine.

Infantry Journal, October, 1912, p. 161.

BOOKS.

Das Oesterreichisch-ungarische Geschützmaterial.—Lieut. Col. Albert Langer. Vienna: Seidel & Son, 1912.

A very complete description, in two small volumes, of all the Austrian artillery matériel, illustrated by numerous large and detailed plates, in separate binding.

Les Archives Militaires (Quarterly).—Librairie Berger-Levrault, Paris.

A recent and very welcome addition to our exchange list is this new quarterly review. Two numbers have now been issued, and it seems to have passed the experimental stage and to have become well established.

Its plan is new and original:—it proposes to give in each issue a comprehensive survey of all important military news of the world for the three months. Its field includes organization, equipment, tactics, military history, and, in a word, everything necessary to keep one posted as to the progress of military affairs throughout the world. The form is that of an encyclopedia,—separate papers on each particular subject, all arranged in alphabetical order. Each issue also includes a well-arranged bibliographic section.

ANNUAL MEETING, FIELD ARTILLERY ASSOCIATION

The annual meeting of the Association convened, pursuant to notice, at 11 a. m., December 10, 1912. Present, in person or by proxy, 196, being a majority of the active members of the Association.

The Secretary and Treasurer submitted verbal reports, which were accepted.

Brig. Gen. M. M. Macomb, U. S. Army, Lieut. Col. H. H. Rogers, 1st F. A., N. G. N. Y., and Maj. George C. Lambert, 1st F. A., Minn. N. G., were elected members of the Executive Council, to fill vacancies.

There being no further business to come before it, the meeting adjourned *sine die*.

FIELD ARTILLERY DIRECTORY.

REGULAR ARMY.

1*st Regiment* (*Light*).—Col. David J. Rumbough: H. Q. and 2d Bn, Schofield Barracks, H. T.; 1st Bn, Manila.

2*d Regiment* (*Mountain*).—Col. E. A. Millar: H. Q. and 2d Bn, Vancouver Barracks, Wash.; 1st Bn, Manila.

3*d Regiment* (*Light*).—Col. Charles G. Treat: H. Q. and 1st Bn, Fort Sam Houston, Texas; 2d Bn, Fort Myer, Va.

4*th Regiment* (*Mountain*).—Col. Alexander B. Dyer: Fort Russell, Wyoming.

5*th Regiment* (*Light*).—Col. Granger Adams: Fort Sill, Oklahoma.

6*th Regiment* (*Horse*).—Col. Eli D. Hoyle: Fort Riley, Kansas.

MILITIA.

1*st Inspection District*.—Lieut. Thomas D. Sloan, Inspector, Boston, Mass.

Massachusetts.—1st Bn. Maj. Charles F. Sargent: H. Q. and Btry C, Lawrence; Btry A. Boston; Btry B, Worcester.

Rhode Island.—Btry A, Capt. Ralph S. Hamilton: Providence.

Connecticut.—Btry A, Capt. Luther E. Gilmore: Branford.

2*d Inspection District*.—Capt. Upton Birnie, Jr., and Lieut. Harry Pfeil, Inspectors, New York City.

New York.—1st Regiment. Col. ————: H. Q. and 2d Bn, New York City; Btry A, Syracuse.

2d Regiment, Col. George A. Wingate: H. Q., Btries A and B, New York City; Btry C. Binghamton.

New Jersey.—Battery A, Capt. Harry L. Harrison: East Orange. Btry B, Capt. Samuel G. Barnard: Camden.

3*d Inspection District*.—Capt. Oliver L. Spaulding, Jr., Inspector, Washington, D. C.

Pennsylvania.—Btry B. Capt. William T. Rees: Pittsburgh. Btry C, Capt. Charles H. Cox: Phoenixville.

District of Columbia.—1st Btry, Capt. J. H. Shannon: Washington.

Virginia.—1st Bn. Maj. T. M. Wortham: H. Q. and Btry A, Richmond; Btry B, Norfolk; Btry C. Portsmouth.

4*th Inspection District*.—Lieut. E. P. King, Jr., Inspector, Atlanta, Ga.

Georgia.—Btry A, Capt. R. J. Davant: Savannah. Btry B, Capt. J. E. Eubanks: Atlanta.

Alabama.—1st Bn, Maj. L. S. Dorrance: H. Q. and Btry D, Birmingham; Btry B, Montgomery.

Mississippi.—Btry E. Capt. Dennis E. Hossley: Vicksburg.

Louisiana.—Washington Artillery, Maj. Allison Owen: H. Q., Btries A. B and C, New Orleans.

5*th Inspection District*.—Lieut. John C. Maul. Inspector, Columbus, Ohio.

Ohio.—1st Bn. Maj. Harold M. Bush: H. Q., and Btry C, Columbus; Btry A, Cleveland; Btry B, Toledo.

Michigan.—Btry A, Capt. C. B. McCormick: Lansing. Btry B, Capt. ————: Lansing.

Indiana.—1st Bn. Maj. Frank E. Stevenson: H. Q., and Btry C, Rockville; Btry A, Indianapolis; Btry B. Fort Wayne.

6*th Inspection District*.—Capt. Charles C. Pulis, Inspector, St. Paul, Minn.

Minnesota.—1st Bn, Maj. George C. Lambert: H. Q. Btries A and C, St. Paul; Btry B, Minneapolis.

Wisconsin.—Btry A, Capt. P. C. Westfahl: Milwaukee.

Illinois.—1st Bn. Maj. Ashbel V. Smith: H. Q., and Btry C, Waukegan; Btry A, Danville; Btry B. Chicago.

7*th Inspection District*.—Lieut. Frederick M. Barrows, Inspector, Kansas City, Missouri.

Missouri.—Btry A. Lieut. Eugene O. Sanguinet: St. Louis. Btry B, Capt. ———— : Kansas City.

Kansas.—Btry A, Capt. W. A. Pattison: Topeka.

Texas.—Btry A, Capt. F. A. Logan: Dallas.

8*th Inspection District*.—Maj. O. W. B. Farr, Inspector, Denver, Colo.

Colorado.—1st Bn, Maj. J. B. Goodman, Jr.: H. Q. Btries A and B, Denver.

Utah.—1st Btry, Capt. W. C. Webb: Salt Lake City.

New Mexico.—Btry A. Capt. M. S. Murray: Roswell.

9*th Inspection District*.—Capt. Joseph F. Barnes, Inspector, San Francisco, Cal.

Oregon.—Btry A, Capt. Hiram U. Welch: Portland.

California.—Btry A, Capt. Reuben A. Ford: Los Angeles. Btry B, Capt. Ralph J. Faneuf, Oakland.

Unassigned.

New Hampshire.—Btry A, Capt. Edwin L. Towle: Manchester.