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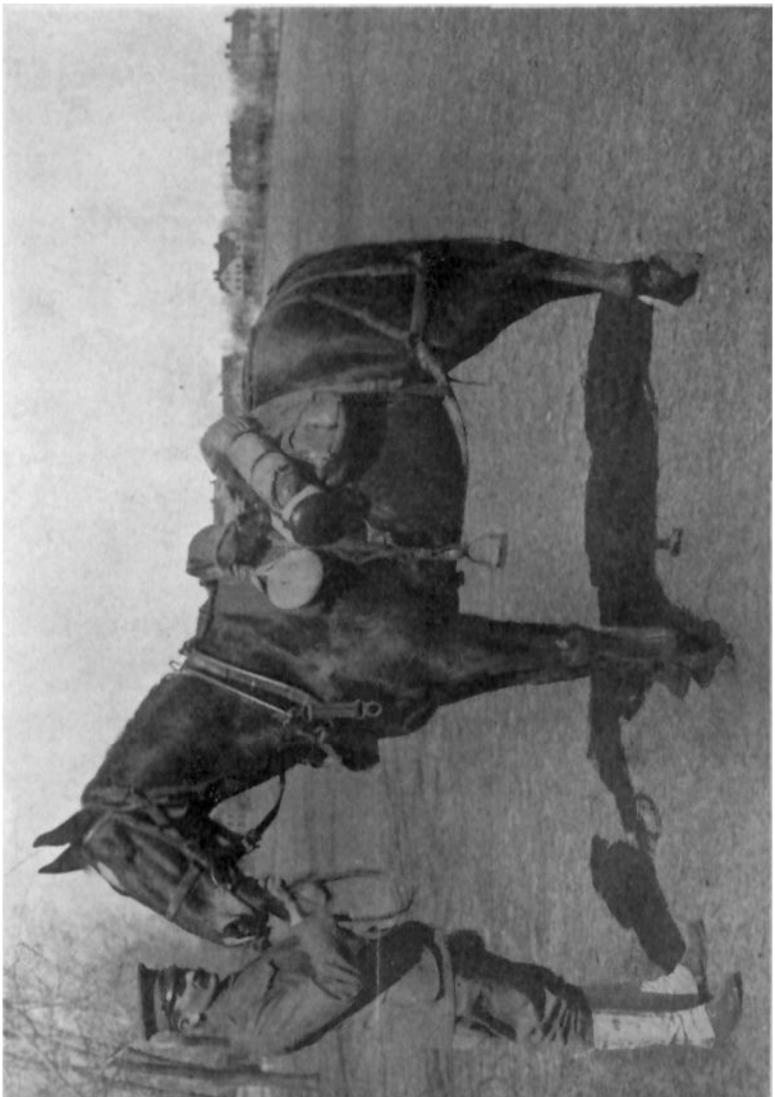

The Field Artillery Journal

Vol. III **JANUARY-MARCH, 1913** **No. 1**

FIRE FOR EFFECT.

BY CAPTAIN FRANCOIS ADOLPHE TRÉGUIER.

Translated from the French by Lieut. Col. Ernest Hinds, 5th F. A.

INTRODUCTION.

The proving-ground firings conducted at the time of the adoption of the 75-mm. gun gave results which were surprising as regards effect of fire. With ranges varying by 100 meters, the percentage of hits obtained was such that the target was surely put out of action regardless of its position in the beaten zone. Consequently, it was no longer necessary to adjust the fire with great precision; it sufficed to enclose the target in a wide bracket and to beat this zone as quickly as possible using ranges varying by 100 meters from range to range; whence the *progressive fire,* which at that time was considered to be the normal fire for effect.

But it was soon seen that, taking into consideration the visibility and the vulnerability of the objectives, those tests had been made under conditions which differed too greatly from those of actual service. Lines of standing figures clearly visible could no longer be considered as fairly representing infantry in battle, any more than batteries whose personnel was entirely unprotected could represent modern artillery. Further experiments were then carried out under conditions more nearly approximating those of the battle-field and the percentages of hits obtained were notably smaller.

Moreover, masked fire gradually came into use, and it began to be charged against progressive fire that beyond the crest, as the ranges increased the points of burst were farther and farther from the ground and, consequently, the shrapnel sheaf became more and more ineffective.

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Finally, the opponents of progressive fire called attention to the impossibility of observing the different salvos, and also to the fact that in many cases the expenditure of ammunition was too great. So this kind of fire soon lost its former vogue and some officers even went so far as to demand its complete suppression.

Without going so far, the Provisional Regulations of September 8th, 1910, have nevertheless confirmed the tendency toward a less extensive use of progressive fire, by prescribing that, far from being, as was formerly the case, the kind of fire for effect to be used in nearly all cases, "it should be employed only when it is essential to obtain a certain effect in the shortest possible time, either because the target is important and liable to disappear at once, or because it must be struck before it can get into action."

Doubtless, the cases where a certain effect must be obtained as soon as possible will still be numerous in war, and consequently occasions requiring the use of progressive fire will be frequent. But outside of those cases specially designated, progressive fire is being replaced by fire by salvos or by rafales of echelon fire,* "a very flexible method, economical, permitting the rate of fire to be regulated at will, allowing the captain to adapt his corrector to the configuration of the ground and to observe each salvo or rafale in such a manner as to enable him to narrow the limits of his bracket."

This phrase of the Regulations leaves to the battery commander the greatest initiative; but, on the other hand, it implies that the obligation rests upon him of being able to determine in each particular case the kind of echelon fire which seems best suited to the situation.

In this fire the ranges may vary 100, 50, or even 25 meters; the change in the corrector varies with this variation in range. These two elements—the variations in range and the changes in corrector—vary with the form of the terrain on which the target is found. These differences in the topography sometimes cause considerable variations in the distance beyond the crest of the points of fall and in the effectiveness of the shrapnel sheaf. Therefore, it is indispensable that the battery commander should have thoroughly studied beforehand all of these factors as well as the probable theoretical effect that may be obtained from each kind of echelon fire.

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* For the sake of brevity, *Tir Echelonne* will throughout this article be translated *Echelon Fire,* i. e., fire for effect in which the ranges are increased or decreased in arithmetical progression. For example, 2850, 2875, 2900, etc.; or 2700, 2600, 2500, 2400, etc.; or, 3000, 3050, 3100, etc.—*Translator*.

The board of officers which formulated the new Field Artillery Drill Regulations was undoubtedly correct in saying in its very able report, explaining and justifying the changes made, that "the useful effect of a battery is not always measured by the actual effect of its projectiles, and factors independent of the technique sometimes intervene in the conduct of fire. The effect itself depends upon the vulnerability of the objectives, and the latter, varying with the range, form and mobility of the objectives, requires that the means of reaching them be modified accordingly. Finally, there are as many particular cases of fire as there are targets."

So, let us not foolishly lay down fixed rules for fire for effect; for in order to be able, from a thorough knowledge of the subject, to select that particular kind of fire which is best suited to the conditions of the case, the battery commander must have made that previous study that we have just indicated.

The great latitude of initiative properly left to him by the Regulations does not authorize him to adopt by mere chance or at his own caprice sometimes one kind of fire, sometimes another. The right to the use of initiative is by no means the right to use it ignorantly. It is, therefore, the manifest duty of every officer to study most carefully this question of fire for effect, a question of the utmost importance since, in a word, it sums up the entire action of the artillery.

At target practice, the principal thing taught is fire for adjustment. The lack of ammunition rarely permits us to execute fire for effect. Of course, the battery commander is sometimes asked what kind of fire for effect he would use in following up his fire for adjustment, but owing to the fact that this is only fictitious fire and, also, because of the frequent necessity of hurrying the practice somewhat, the question of fire for effect is often not sufficiently clearly brought out. It is to be feared that the officer who has not given thorough study to this question may uselessly throw away a large part of his ammunition.

The object of this paper is merely to facilitate this preliminary study of fire for effect, to cause officers to think over some ideas which, perhaps, may be new to a certain number of them, and whose discussion may enable them to determine from a more thorough knowledge of the subject, the kind of fire for effect which appears to be most appropriate to the situation.

SUBDIVISIONS OF THE SUBJECT.

This paper comprises the study:

1st. Of the comparison of the probable theoretical effects of the different kinds of fire for effect;

2d. Of time fire against artillery located in rear of covering crests.

3d. Of fire with explosive shell against artillery which is masked and against artillery which is visible;

4th. Of fire against a target situated on ground sloping down towards the battery;

5th. Of fire against obstacles.

CHAPTER I.

COMPARISON OF THE PROBABLE THEORETICAL EFFECTS OF THE DIFFERENT KINDS OF FIRE FOR EFFECT.

ARTICLE I.

Definition of Probable Theoretical Effect.

If, with a given elevation, we fire a very great number of percussion shots, we will obtain as many different trajectories whose points of fall will be grouped about a certain mean point O. The trajectory having its point of fall at this point is called the mean trajectory.

If the above firing is executed with time fuzes, the effect obtained upon a target in the open is a maximum when this target is exactly at the mean point of fall, O. If we represent this maximum effect by 1, the effect that will be obtained upon the target placed at various distances from the point O will be approximately represented by the figures of the following scale:[1]

.15	.50	1	.75	.50	.30	.18	.10
100	50	0	50	100	150	200	250

If instead of a great number of shots we fire a small number only, as in a firing for effect, it is very evident that we will not necessarily obtain upon the target the effect indicated by the scale.

A priori, we are in absolute ignorance as to what this effect may be; but, as we know that if the firing were sufficiently prolonged we would obtain this relative effect, we are justified in saying that in

[1]Result of experiments made at Pontarlier. See Colonel Fayolle's Course of Artillery (War College).

the fire of a small number of shots the chances are greatest that we shall obtain this effect; in other words, it is the *probable effect*.

ARTICLE II.

Possible Situation of a Target within a Bracket.

The mean height of burst in fire for adjustment being one mil, the mean interval of burst E'C (fig. 1) or E'_1L is about 27 meters for mean ranges. Consequently, the target which has been located beyond the short burst and this side of the long burst can be only in the zone $E'E'_1$, that is to say at most at about 25 meters short of the short limit C, and at about 30 meters short of the long limit L.

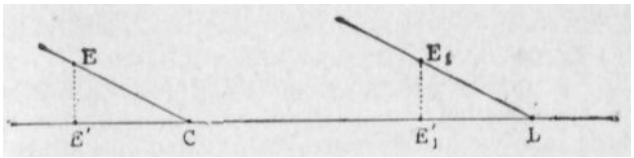


Fig. 1.

It should be noted, moreover, that when the target is in one of these extreme positions the chances, on account of dispersion, are greatly against the four shots of the salvo being all short or all long, a fact which indicates the particular position of the target.

As we are nearly always ignorant of the location of the target with respect to the limits of the bracket, we will suppose that this target occupies the different positions which it may have within the bracket, and by means of the dispersion scale shown above we may compare the probable effects obtained by the different kinds of fire.

We shall make this comparison only for firing in which there are no changes to be made in the corrector; firings in which changes in the corrector are required will be considered in a later chapter. Also, when we compare the probable effect of two firings, we shall always consider that each of them has been executed with the same number of projectiles, or, if this is not possible, we will calculate the probable effects as proportional to the number of projectiles fired.

Thus, for example, we shall, a little later on, compare echelon fire where the ranges vary by 100 meters, using the two elevations

2600, 2700; and another in which the ranges differ by 50 meters, using the three elevations 2600, 2650 and 2700. We shall consider the first as executed with three salvos for each elevation and the second with two salvos for each elevation. If we represent by E the probable effect at 2600 in the first case, it will be represented by 2/3 E in the second firing.

ARTICLE III.

Echelon Fire over a 100 *meter bracket* (2600-2700).

The echelon fire may be executed in several ways:

1st. Firing A: the ranges differ by 100 meters, using the two limiting ranges 2600 and 2700.

2d. Firing B: the ranges differ by 50 meters, using the elevations 2600, 2650 and 2700.

3d. Firing C: the ranges vary by 50 meters using the two elevations 2600 and 2650 only.

The target may be at the ranges 2575, 2600, 2650, 2670.

Let us suppose, for example, that it is at the range 2650.

Firing A: Probable effect at 2600 (3 salvos): 0.75
2700 (3 salvos): 0.50
Total: 1.25

Firing B: Probable effect at 2600 (2 salvos):2/3 of 0.75=0.50
2650 (2 salvos):2/3 of 1.00=0.66
2700 (2 salvos):2/3 of 0.50=0.33
Total: 1.49

Firing C: Probable effect at 2600 (3 salvos): 0.75
2650 (3 salvos): 1.00
Total 1.75

If we make similar calculations for the various possible positions of the target, we will obtain the following comparative table:

	Possible position of the target				Mean probable effect.
	2575	2600	2650	2670	
Firing A --------	0.75	1.15	1.25	1.35	1.12
Firing B --------	0.72	1.10	1.49	1.50	1.20
Firing C --------	1.07	1.50	1.75	1.55	1.37

This table shows, other things being equal:

1st. That echelon fire in which the ranges differ by 100 meters has a smaller mean probable effect than one in which the ranges differ by 50 meters.

2d. That firing B which is generally employed when echelon fire with ranges varying by 50 meters is used to cover a 100 meter bracket, has always a smaller probable effect than that of Firing C, even in the case in which the target is as close as possible to the long limit of the bracket.

ARTICLE IV.

Echelon fire over a 200 *meter bracket* (2600-2800).

The firing may be executed as follows:

Firing A: Ranges differ by 100 meters, 2600, 2700, 2800.

Firing B: Ranges differ by 50 meters, 2600, 2650, 2700, 2750.

By calculating the probable effects of each of these firings for the different possible positions of the target, we obtain the following table:

	Possible position of the target						Mean
	2575	2600	2650	2700	2750	2770	probable effect.
Firing A ---------	1.00	1.53	1.66	2.20	2.06	2.14	1.76
Firing B ---------	1.07	1.65	2.40	2.75	2.55	2.23	2.11

The table shows once more that the probable effect of fire where the ranges vary by 100 meters is always smaller than that in which the ranges differ by 50 meters, whatever may be the position of the target with respect to the limits of the bracket.

Must we conclude from this that when we are to use echelon fire over a 200 meter bracket, firing with 100 meter echelons is prohibited and firing with 50 meter echelons must always be used? Certainly not. The battery commander may have in any particular case reasons for preferring the 100 meter echelon. But if, *a priori,* he has no such reason, since the firing with 50 meter echelons has a greater probable effect, that is to say, has greater chances of giving more effect than firing with 100 meter echelons, it would be best to adopt the first method.

ARTICLE V.

Echelon fire over a 400 *meter bracket* (2400-2800).

A target is behind a mask. We have found that 2400 is short with respect to the mask and 2800 over with respect to the target.

Let us suppose that on the account of the difficulties of determining the 200 meter bracket, the battery commander decides to employ, not progressive fire, because he wishes to try to observe his salvos, but an echelon fire covering a 400 meter bracket.

Over so large a bracket the ranges will vary by 100 meters and not by 50. The firing, using 50 meter echelons, would be much too long and, moreover, with the same number of projectiles it would give a probable effect very slightly greater than that using 100 meter echelons.

We have calculated the probable effects obtained on the one hand by firing with 100 meter echelons at the ranges 2400, 2500, 2600, 2700, 2800, two salvos at each range, and on the other hand by firing with 50 meter echelons at the ranges 2400, 2450, 2500, 2550, 2600, 2650, 2700, 2750, 2800, firing one salvo at each range.

With an expenditure of four more projectiles in the first firing, we obtain for the possible positions of the target the probable effects shown in the following table:

	Possible position of the target.									Mean probable
	2400	2450	2500	2550	2600	2650	2700	2750	2770	effect.
100 m. echelons	1.15	1.25	1.65	1.55	1.83	1.63	1.83	1.65	1.61	1.57
50 m. echelons	0.82	1.20	1.45	1.60	1.70	1.74	1.74	1.66	1.54	1.49

which shows that for almost all positions of the target, the firing with 100 meter echelons, if only four more projectiles be used, will have a greater probable effect than that in which the echelons used are 50 meters, without considering the advantage of the greater rapidity of fire.

ARTICLE VI.

Progressive Fire.

Progressive fire, as formerly executed, beginning at the short limit diminished by 100 meters, is no longer used. In future we must be content to include the target within a 400-meter bracket and always open fire at the short limit of this bracket.

The report of the Drill Regulations Board has given excellent reasons for the suppression of the former means of executing progressive fire, but the comparison of the probable effects obtained by the old method and by the present practice is interesting, and brings out the justification for the suppression of the former.

Let us suppose that the bracket 2400-2800 has been found. The target may therefore be in the zone 2375-2770.

Formerly, we should have continued the fire for adjustment until

the 200-meter bracket had been determined and the target would have been located (proceeding by ranges of even hundreds) either between 2400 and 2600 or between 2600 and 2800.

1st case: *The target is within the 2400-2600 bracket*.

By calculating the probable effects of the old method of progressive fire (2300, 2400, 2500, 2600) and by the present method (2400, 2500, 2600, 2700) we obtain, considering the possible positions of the target, the following table:

	Possible positions of the target.						Mean probable
	2375	2400	2450	2500	2550	2570	effect.
Old method ----------	1.37	1.65	1.55	1.83	1.65	1.61	1.61
New method ---------	0.75	1.15	1.25	1.65	1.55	1.61	1.33

2nd Case: *The target is within the 2600-2800 bracket*.

By making the same calculations for the old method (2500, 2600, 2700, 2800) and for the present method (2400, 2500, 2600, 2700), we obtain the following table:

	Possible position of the target.						Mean probable
	2575	2600	2650	2700	2750	2770	effect.
Old method ----------	1.37	1.65	1.55	1.83	1.65	1.61	1.61
New method --------	1.61	1.83	1.65	1.68	1.15	0.91	1.47

These two tables show that the probable effect of the present progressive fire is equal to or greater than that of the old progressive fire whenever the target is situated between 2550 and 2650; that is to say, in the central portion of the bracket, where the chances are greatest that it actually will be found. It is only when the target is outside of this central portion of the bracket that the probable effect of the present progressive fire is slightly less.

In any case, the mean effects 1.61 and 1.40 $\left(=\frac{1.33+1.47}{2}\right)$ differ but little. And if, on the other hand, we consider that the 400-meter bracket is obtained more easily and more quickly than the 200-meter bracket, and consequently the present progressive fire is launched sooner than the old one was, and will thus take away from the enemy his freedom of action, we can only give unreserved approval to the method for progressive fire laid down in the new Regulations.

It will frequently happen that for a target which must be struck in the shortest possible time we may have found the 200-meter bracket, for example, 2600-2800, from previous firings or from a registration of the ground. If progressive fire is indicated, there should be no hesitation in ordering it, beginning, according to circumstances, with the range 2500 or 2600. The inconvenience arises

from the fact that the zone of ground beaten is double that which encloses the target.

It would be easy to cover by progressive fire the 200-meter bracket only. It would suffice to have the progressive fire with 50-meter echelons for the 200-meter bracket, just as we have progressive fire with 100-meter echelons for the 400-meter bracket.

In the case under consideration, the captain would command: "Progressive fire at 50—range 2600," and the firing would be executed using the four ranges; 2600, 2650, 2700 and 2750. Two cannoneers only, the firer and the fuze setter, would have to attend to the command in order to make the successive additions of 50 or 100. Moreover, errors would be all the less likely to be made because the chief of section announces the range to them.

CHAPTER II.

TIME FIRE AGAINST ARTILLERY BEHIND A CREST.

Fire against hostile artillery behind a crest may be executed with time shrapnel or explosive shell. The slope of the ground in rear of the crest has a very important bearing upon the effect of the sheaf of the shrapnel and the explosive shell. It is very essential for us to know the influence of this slope if we desire to avoid waste of ammunition.

ARTICLE I.

Variation, with the slope, of the distance of the points of fall from the crest.

Let R be the range of the crest C (Fig. 2). If we now give to this range an increment ΔR the trajectory will pierce the horizontal plane through C at the point A for which CA equals ΔR, but it will pierce the slope at D.

Let us calculate the distance CD.

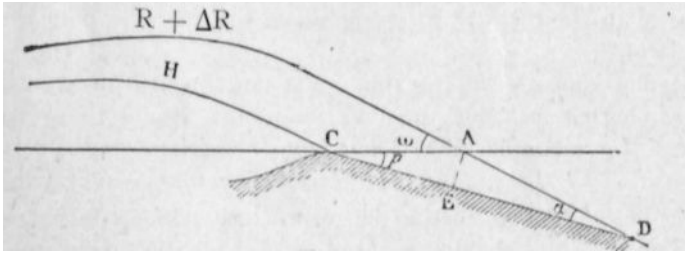


Fig. 2.

Draw AE perpendicular to the slope.

We have then: $AE = CA \frac{p}{1000} = ED \frac{a}{1000}$

But $a = \omega - p$

Whence $ED = CA \frac{p}{\omega - p} = \Delta R \frac{p}{\omega - p}$

But CD = CE + ED; and as CE is sensibly equal to CA = ΔR, we have:

$$CD = \Delta R \left(1 + \frac{p}{\omega - p}\right)$$

By varying the range (that is, ω) and the angle of slope *p,* we obtain for CD for an increase of 100 meters in the range, the values shown in the following table:

	Value of the slope in mils.									
Range.	10	20	30	40	50	60	70	80	90	100
1500 ----------	130	190	350	2100	___	___	___	___	___	___
2000 ----------	118	146	190	274	484	2100	___	___	___	___
2500 ----------	112	129	150	183	230	314	488	1100	___	___
3000 ----------	109	120	135	150	174	205	248	316	433	680
3500 ----------	107	115	125	136	150	167	188	215	252	304
4000 ----------	105	112	119	127	137	148	166	176	194	217

This table shows that a great mistake would be made in assuming, for example, that an increase of 100 meters in range for a crest 2000 meters distant would cause a percussion shot to strike a 5% slope at about 100 meters beyond the crest. As a matter of fact, the shot would strike nearly 500 meters beyond the crest.

ARTICLE II.

Influence of the slope upon the effect of the sheaf.

Let us suppose that the crest is 2500 meters distant and is outlined against the sky with no visible object in rear; that we have been unable to determine the long limit of the bracket with respect to the hostile artillery; and finally, that the corrector 18 gives a height of burst of 1 mil above the crest.

In order to study the fire against artillery behind this crest, we must distinguish the case in which the flashes of the hostile artillery can be seen, from the case in which they are not visible.

§1.—GENTLE SLOPE (2%).

Case in which the flashes are visible.

The flashes only being visible, the hostile artillery has a defilade

of approximately 1.8 m. to 3.8 m. It is therefore in the zone included between the distances 90 and 190 meters beyond the crest.

Let us study the effect upon this artillery using different ranges beginning with that of the crest.

Range 2500m.—In this case, on account of the gentle slope, fire at a range of 2500 meters will have only a slight effect upon the hostile artillery. But because of dispersion this effect will probably not be zero. Besides, since we cannot know generally whether the slope in rear of the crest is gentle or steep, it will always be advisable to fire at the range of the crest.

Range 2600m.—Let us suppose that the corrector 18 has been retained, which gives a height of burst of one mil above the plane of site of the crest.

We know that at 2600 meters for a height of burst of one mil the depth AD (Fig. 3) of the lower half of the sheaf upon the plane of site of the crest is about 18.5 meters. But on the slope the lowest element of the sheaf will be found at K. Let us determine the value of CK.

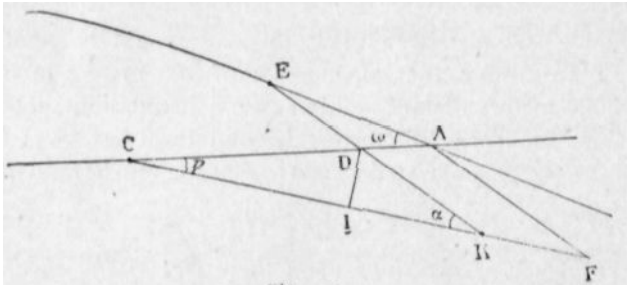


Fig. 3.

If from the point D we let fall the perpendicular DI upon the slope CK, we have:

$$DI = CD \frac{p}{1000} = IK \frac{a}{1000}$$

Hence: $IK = CD \frac{p}{a}$

But $a = EDC - p$

And EDC = ½ angle of opening of the sheaf + $\omega = \frac{174}{1000} + \frac{90}{1000}$

Also $p = \frac{20}{1000}$ in the case under consideration.

Therefore, $a = \frac{264}{1000} - \frac{20}{1000} = \frac{244}{1000}$

Hence, IK = CD $\frac{20}{244}$ = CD × 0.08

But CK = CI + IK; and since CI is very neary equal to CD = 100 — 18.5 = 81.5 meters, we have:

CK = CD + IK = CD (1 + 0.08) = 81.5 × 1.08 = 88 meters approximately.

The lowest element of the sheaf therefore strikes the slope at about 88 meters beyond the crest; and as this sheaf has an effective depth of about 150 meters, the ground is beaten up to about 240 meters beyond the crest. The zone in question is therefore entirely beaten by the sheaf $\left\{ \begin{matrix} \text{Corrector 18} \\ \text{Range 2600} \end{matrix} \right\}$

But would the effect of this sheaf not be greater if we were to modify the corrector 18?

Let us take, for example, corrector 17. The mean point of burst is now found in the plane of site of the crest at the point A (Fig. 3), and the lowest element of the sheaf pierces the slope at the point F, further down the slope, KF being equal to AD × 1.08 = 18.5 × 1.08 = 20. Therefore the effective portion of the sheaf of the trajectory $\left\{ \begin{matrix} \text{Corrector 17} \\ \text{Range 2600} \end{matrix} \right\}$ extends from 108 to about 260 meters beyond the crest. Consequently on the near side a depth of about 18 meters of the zone under consideration will perhaps not be beaten; and on the farther side, a depth of about 70 meters beyond this zone will be beaten. We may therefore conclude that with the corrector 17 there will probably be a decreased effect.

On the other hand we know that there is a greater probability of obtaining effect when the mean height of burst is about 3 mils above the target. In the present cases, we cannot see the target; but let us suppose it to be in the midde of the zone above referred to, that is, about 140 meters from the crest, and let us determine the mean heights of burst above this point with the corrector setting 17 and 18.

The point 140 is 1.4 meters × 2 = 2.8 meters below the plane

of site.* The corrector 18 gives a mean height of burst at 1 mil or 2.6 meters above this plane and consequently at 2.8 + 2.6 = 5.4 meters or about 2 mils above the point 140; while the corrector 17 gives a mean height of burst at 2.8 meters only, that is at 1 mil above this point.

There is, therefore, no necessity of decreasing the corrector on passing from the range of the crest 2500 to the range 2600.

This brings out a very important point the proof of which will be given later: In echelon fire against hostile artillery *whose flashes are visible* in rear of the crest, if the corrector giving a mean height of burst of one mil be taken as the initial corrector in the fire for effect, it should never be diminished as the ranges are increased, in spite of the generally accepted opinion and of section *h* of paragraph 171 of the Regulations.

This section *h* is true only when the flashes of the hostile artillery are not visible and when it is necessary to beat systematically a considerable depth of slope. It would not be amiss to draw this distinction in the Regulations.

Range 2700.—The table of variations of the points of fall shows that for percussion fire this trajectory would have its point of fall about 250 meters from the crest; that is, it would be about 60 meters beyond the long range of the zone under discussion. We must conclude from this that the probable effect of time fire using this range will be very small. In fact, with corrector 18, the lowest element of the sheaf strikes the slope at 181.5 × 1.08 = 196 meters from the crest, that is 6 meters beyond the zone supposed to be occupied by the hostile artillery.

Therefore the probable effect, although not zero on account of the dispersion, is small, and it will be all the smaller if the corrector be diminished, since the sheaf is thus moved further and further from the zone in question.

On the other hand if we increase the corrector by 1, what will happen? The nearest portion of the sheaf will be brought about 20 meters nearer the crest, that is about 176 meters therefrom. The sheaf begins to strike the far edge of the zone. With a corrector 20 the sheaf will be but about 156 meters from the crest, and about 34 meters of the zone will be beaten.

Therefore if in echelon fire we employ the elevation 2700, we

*For the sake of simplicity we will suppose the plane of site to be horizontal.

must increase, not diminish, the initial corrector in order that this range may have any probable effect.

The range 2800 would be wholly ineffective.

So then even in the case of a gentle slope, in echelon fire where the ranges vary by 100 meters, starting with the range of the crest 2500, the range 2600 would be about the only one having any considerable probable effect; that of 2700 would be very small, that of 2800 zero.

Echelon fire with ranges varying by 50 meters.—In place of using echelon fire with 100 meters variation in range, let us vary the range by 50 meters and study the effects of the ranges 2550 and 2650.

Range 2550.—With corrector 18 the sheaf begins to strike the slope at (50—18.5) × 1.08 = 34 meters, and the farther effective limit extends to 185 meters both measured from the crest. The zone in question is nearly all covered. But the farthest portion of the sheaf being less effective, it seems that it might be advantageous in this case to lower the corrector 1 mil, which would bring the sheaf back to within 54 meters of the crest. But, unfortunately, corrector 17 gives the mean point of burst in the plane of site and at 50 meters from the crest, that is, in the case of a 2% slope at a point but 1 meter above the ground. Consequently, half of the shrapnel would burst at less than one meter from the ground or would burst on impact, which would greatly diminish their effect. It is best, therefore, not to decrease the corrector.

Range 2650.—With corrector 18, the sheaf begins to strike the ground at (150 — 18.5) × 1.08 = 142 meters from the crest. Therefore but 48 meters of the zone are beaten.

If we were to decrease the corrector we should diminish the probable effect still more. On the other hand, corrector 19 would enable us to cover 20 meters more of the zone considered, and corrector 20, 40 meters more. But should we not have above the point 140, the middle of this zone, too great a height of burst, which would reduce the effect of the sheaf? The corrector 19 gives a height of burst 2 mils above the plane of site, that is (2.6 × 2) + 2.8 = 8 meters above the point 140, or 3 mils. The corrector 20 would give a height of burst of 4 mils; therefore the corrector 19 seems to be preferable.

To sum up, if, in fire for effect, we execute echelon fire at the ranges 2500, 2550, 2600 and 2650, each range will give us a probable

effect upon the zone in question, especially if we increase the corrector slightly at the longest range. Generally the corrector is decreased, which is wrong.

Case in which the Flashes are not Visible.

The hostile artillery, having flash defilade, is at least 200 meters from the crest. Consequently the range of the crest 2500 meters will be ineffective or nearly so. But since we do not know how steep the slope may be and as it is possible therefore that the opposing artillery may be much nearer the cover, it will always be advisable to fire at the range of the crest.

The sheaf of {Corrector 18 Range 2600} extends, as we have aready seen, from 88 meters to about 240 meters beyond the crest. It covers therefore but 40 meters of the zone supposed to be occupied by the enemy's artillery. With a corrector 17, the sheaf will cover 20 meters more of this zone.

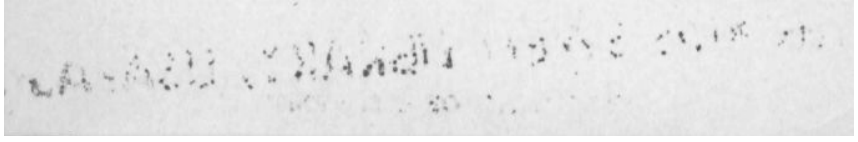
In the preceding case, where the flashes are visible, we have shown that the corrector should not be decreased for the range 2600. But here the case is different and it is possible that a decrease in the corrector might be advantageous.

Now we have just seen that a corrector 17 enables us to cover 20 meters more of the zone under consideration. But does this corrector give a proper height of burst?

The question may be stated as follows: What should be the mean height of burst with reference to the center of the zone covered by the sheaf, in order that the probable effect shall be a maximum?

It seems that we cannot be far from the truth in saying that the chances of covering the zone effectively will be greatest when the mean point of burst is 3 mils above the middle of the zone covered by the sheaf. Now with the corrector 18, the sheaf extends from 88 to 240 meters beyond the crest. 164 is the middle point. The height of burst with reference to this point is $\frac{2.6 + (1.64 \times 2)}{2.6} = 5.88$ meters, or 2.2 mils.

With corrector 17, the sheaf covers from 108 to 260 meters. The middle point is at 184. Height of burst above this point:



$\frac{1.84 \times 2}{2.6}$ = 3.68 meters, or 1.4 mils.

Therefore, on the one hand, with the corrector 18 the sheaf has a height of burst giving more chances of effectively covering the ground than with a corrector 17; and this result was to be expected because of the number of bursts on impact that this corrector may give. But since the corrector 17 enables us to cover a greater depth of the zone in question, it seems that either corrector might be used with equal propriety. In any case it should be observed that in the case of a gentle slope we should not decrease the corrector more than one mil for an increment of 100 meters in the range.

Range 2700.—Beginning with this range we will see the difference between the case where the flashes are visible and that in which they are invisible. Indeed in the first case we almost came to the conclusion to reject the range 2700. But it is different in this case.

With the corrector 18, the sheaf for range 2700, which extends from 196 to about 346 meters beyond the crest, strikes almost wholly upon the zone considered. But what is the height of burst above the point 271, the middle point of the beaten zone? It is $\frac{2.7 + (2.7 \times 2)}{2.7}$ or 3 mils exactly.

With the corrector 17, the sheaf covers the slope from 216 to 366. Middle point: 291. The height of burst above this point is: $\frac{2.9 \times 2}{2.7}$ = 2.1 mils.

Here again it does not matter whether we take the corrector 18 or 17. But we see in the case of gentle slopes, how careful we must be in decreasing the corrector as we increase the range.

Indeed with the corrector 16 the height of burst would be only one-third of a mil above the middle of the zone beaten by the sheaf.

Range 2800.—With the corrector 18, the sheaf strikes the ground at (300 — 18.5) × 1.08 = 304 meters beyond the crest; it covers the ground effectively to about 455. Middle point: 380.

Height of burst: $\frac{2.8 + (3.8 \times 2)}{2.8}$ = 10.4 meters, that is, nearly 4 mils.

With corrector 17; the sheaf extends from 324 to 474. Middle point: 400.

Height of burst: $\frac{4 \times 2}{2.8} = 2.8$ mils.

Hence it is not the corrector 18, but in this case the corrector 17 that must be used. But it should be noted that it is only for the range 2800 that a decrease in the corrector is required.

With the range 2900, the corrector 16 would have to be used.

To sum up, when the flashes cannot be seen and when the slope in rear of the crest is slight we should use echelon fire with ranges varying by 100 meters to cover the zone in question and we should take care that the successive decrements of the corrector should be by 1 and these only beginning at a certain distance beyond the crest.

§2. AVERAGE SLOPE (4%).

Case where the flashes are visible.

Here the hostile artillery is situated in the zone included between a point 45 and a point 95 meters beyond the crest.

Range 2600.—The table of variations of the points of fall shows that for percussion fire this trajectory would pierce the slope about 180 meters beyond the crest, or 85 meters beyond the farther limit of the zone in question. We must, therefore, conclude that for time fire at this range the probable effect will be small.

Indeed, with the corrector 18, the sheaf strikes $81.5 \left(1 + \frac{40}{224}\right) = 81.5 \times 1.17 = 95$ meters, approximately, from the crest; that is, just at the farther limit of the zone considered.

With the corrector 19, the sheaf is brought back $18.5 \times 1.17 = 21.6$ meters nearer the crest, and that amount of the zone is covered. With the corrector 20, the sheaf covers about 43 meters of the zone considered.

But with these correctors, what will be the heights of burst with reference to the point 70, the middle point of the zone?

With corrector 18: $\frac{2.6 + (0.7 \times 4)}{2.6}$, or 2 mils.

With corrector 19: 3 mils.

With corrector 20: 4 mils.

Therefore, in order to beat the zone supposed to be occupied by the enemy's artillery, we may use the range 2600, but only by increasing the corrector one mil if we expect to have any probable effect.

As for ranges greater than 2600, they must be rejected.

Range 2550.—With corrector 18, the sheaf begins to strike at (50 — 18.5) × 1.17 = 37 meters, approximately, beyond the crest. The sheaf therefore beats the entire zone. To decrease the corrector by 1 would be to move the sheaf to 37 + 21.6 = 58.6 meters from the crest. Hence, there would be a probable decrease in effect.

Moreover, with corrector 17, the point of burst is in the plane of site of the crest; that is at: $\frac{0.7 \times 4}{2.55}$ = 1 mil only above the point 70, the middle of the zone in question. Therefore, because of this fact also, there would be a probable decrease in effect.

On the other hand, with corrector 18, the height of burst is 2 mils; it would be 3 with corrector 19.

Consequently, the kind of fire which in this case seems preferable as regards probable effect is an echelon fire, as follows:

$$\left\{\begin{matrix}\text{Corrector 18}\\ \text{Range 2500}\end{matrix}\right\} \left\{\begin{matrix}\text{Corrector 18}\\ \text{Range 2550}\end{matrix}\right\} \left\{\begin{matrix}\text{Corrector 19}\\ \text{Range 2600}\end{matrix}\right\}$$

We see again that we must increase the corrector at a certain distance beyond the crest, and in no case must we decrease it.

Case where the flashes are not visible.

The hostile artillery is at least 100 meters from the crest.

Range 2600.—We have seen above that with corrector 18, the sheaf beats the slope from the point 95 to about the point 245, and, consequently, almost all the sheaf is effective upon the zone considered. But this corrector gives with reference to the middle point of the ground covered, the point 170, a height of burst equal to $\frac{2.6 + 1.7 \times 4}{2.6}$ = 3.6 mils, which is a little too great.

With corrector 17, the middle point of the beaten ground is 21.6 meters further from the crest, or at 192. The height of burst above this point is $\frac{1.9 \times 4}{2.6}$ = 2.9 mils. The corrector 17 is therefore preferable.

Range 2700.—With corrector 18, the sheaf strikes the slope at 181.5 × 1.17 = 212 meters, approximately, from the crest. But corrector 18 is too great for the range 2600; it must therefore certainly be too great for 2700.

The corrector 17 places the striking point of the sheaf 21.6 meters further from the crest; the sheaf extends, therefore, from the point 234 to the point 384. The middle point of the ground beaten by this sheaf is the point 309, and with the corrector 17, the height of burst above this point is $\frac{3.09 \times 4}{2.7} = 4.5$ mils, which is too great.

With corrector 16, the middle point of the beaten zone is at 331. Height of burst is $\frac{3.3 \times (4\ \ 2.7)}{2.7} = 3.8$ mils.

With corrector 15, the middle point is at 352, and the height of burst is $\frac{3.5 \times (4\ \ 2.7 \times 2)}{2.7} = 3.2$ mils.

Therefore, the corrector 15 is proper for range 2700. But corrector 15 moves the sheaf three times 21.6 meters further from the crest than that with corrector 18. Now it was at the point 212; it is therefore at the point 277 with corrector 15.

As the sheaf of $\left\{ \begin{matrix} \text{Corrector} 17 \\ \text{Range} 2600 \end{matrix} \right\}$ extends only from the point 116 to 266, there is between the extremity of this sheaf and the beginning of the sheaf $\left\{ \begin{matrix} \text{Corrector} 15 \\ \text{Range} 2700 \end{matrix} \right\}$ a part of the slope which is not covered. This difficulty is all the more serious because the farther portion of the sheaf $\left\{ \begin{matrix} \text{Corrector} 17 \\ \text{Range} 2600 \end{matrix} \right\}$ gives but very few effective hits.

We must conclude from this that as soon as the slopes begin to be somewhat steep, echelon fire in which the ranges vary by 100 meters does not cover the slopes completely. It is advisable, therefore, to employ echelon fire with variations of 50 meters in range and with decrements of 1 in the corrector for each increment of 50 meters in range.

§3. STEEP SLOPES (8%).

Case in which the flashes are visible.

The hostile artillery is located between the point 23 and the point 45 meters beyond the crest.

Range 2600.—The table of variations of points of fall shows that this range has its point of impact over 700 meters from the crest—that is, it would strike more than 650 meters beyond the farther limit of the zone occupied by the enemy. Its effect must therefore be *nil*.

Indeed, with corrector 18, the sheaf strikes the slope at 81.5 $(1 + \frac{80}{184})$, or at 81.5 + 1.43 = 116.5 meters from the crest, or more than 70 meters beyond the farther limit of the zone in question.

Each increase of 1 in the corrector would bring the sheaf 18.5 × 1.43 = 26.4 meters nearer the crest; and in order that the sheaf for range 2600 may cover the zone considered, we would have to bring back this sheaf 116 — 23 = 93 meters, or nearly four times 26; that is, we would have to increase the corrector 18 by 4. This would give too great a height of burst. The range 2600 must therefore be discarded.

Range 2575.—With corrector 18, the beginning of the sheaf is at (75 — 18.5) × 1.43 = 81 meters from the crest. To reach the zone under consideration we would have to increase the corrector by 2 points.

Range 2550.—With corrector 18, the sheaf begins at (50 — 18.5) × 1.43 = 45 meters from the crest, or just at the extremity of the farther limit of the ground to be covered. In order that the zone may be beaten, the corrector must be increased by 1.

Range 2525.—With corrector 18, the sheaf begins at (25 — 18.5) + 1.43 = 9 meters from the crest. The sheaf beats all of the occupied zone. The height of burst with reference to the point 34, the middle of the occupied zone is: $\frac{2.5 + (0.34 \times 8)}{25} = 2.1$ mils.

To sum up, the fire which, in the case we are now considering, appears to give the best probable effect, is an echelon fire as follows:

$$\left\{\begin{matrix}\text{Corrector}\,18\\ \text{Range}\,2500\end{matrix}\right\}\left\{\begin{matrix}\text{Corrector}\,18\\ \text{Range}\,2525\end{matrix}\right\}\left\{\begin{matrix}\text{Corrector}\,19\\ \text{Range}\,2550\end{matrix}\right\}\text{and}\left\{\begin{matrix}\text{Corrector}\,20\\ \text{Range}\,2575\end{matrix}\right\}$$

Case in which the flashes are not visible.

The hostile artillery is at least 50 meters beyond the crest.

To understand thoroughly the action of the different sheaves upon a steep slope which is to be beaten, it must be remembered that at mean ranges a decrease of 1 in the corrector increases the distance along the trajectory to the point of burst about 25 meters. Therefore in determining the height of the point of burst in mils above a given point of the slope, we must consider in reckoning the value of the mil, the range to the point of burst. For example, with $\left\{\begin{matrix}\text{Corrector}17\\ \text{Range}\,2525\end{matrix}\right\}$ the point of burst is in the plane of site of the crest and at 2525 meters from the firing battery. The value of the mil is then 2.52. But with $\left\{\begin{matrix}\text{Corrector}13\\ \text{Range}\,2525\end{matrix}\right\}$ the burst occurs 100 meters further along the trajectory and the value of the mil is 2.62.

Taking this into consideration, the table below gives for the range 2525 the elements of the sheaves with different correctors.

Corrector	Range to point of burst.	Limits of the ground beaten by the sheaf.	Middle point of the beaten area.	Height of burst with reference to the middle point.
18	2500	9 to 160	85	$\frac{2.5+(0.85\times 8)}{2.5}=3.7$
17	2525	35 to 185	110	$\frac{1.1\times 8/2.52}{2.52}=3.5$
16	2550	61 to 211	136	$\frac{1.36\times(8-2.55)/2.55}{2.55}=3.1$

We see then that for the range 2525, corrector 16 gives the proper height of burst, and the sheaf which with $\left\{\begin{matrix}\text{Corrector}18\\ \text{Range}\,2500\end{matrix}\right\}$ struck the ground 18.5 meters this side of the crest, with $\left\{\begin{matrix}\text{Corrector}16\\ \text{Range}\,2525\end{matrix}\right\}$ now strikes about 61 meters beyond the crest, that is, it has been displaced about 80 meters.

But we may continue to beat this slope with the same range 2525 by lowering the corrector again.

Indeed, the formula, $\Delta R\ (1 + \frac{p}{\omega - p})$, which gives the variations in the points of fall and in which in this case $\Delta R = 25$, $\omega = 90$ mils, $p = 80$ mils, gives 225 meters as the distance of the point of fall from the crest for range 2525. The range from the firing battery

to the point of fall is therefore 2725 meters and it is $2.25 \times 8 = 18$ meters below the plane of site of the crest, that is $\frac{18}{2.72} = 6.6$ mils below. After having fired with $\left\{ \begin{matrix} \text{Corrector} 16 \\ \text{Range} 2525 \end{matrix} \right\}$ we may then diminish the corrector by 3 and fire with $\left\{ \begin{matrix} \text{Corrector} 13 \\ \text{Range} 2525 \end{matrix} \right\}$ The sheaf will in this case be displaced by three times 26.4 meters, or about 80 meters, as above.

The middle point of the beaten zone is similarly displaced and is therefore at the point 216. Since the point of burst is at 2625, the height above the middle point is: $\frac{(2.16 \times 8) - (4 \times 2.62)}{2.62} = 2.6$ mils.

Using the range 2525 we could not make another decrease of 3 in the corrector because the burst would occur too close to the ground.

Range 2550.—We have just seen that the sheaf of $\left\{ \begin{matrix} \text{Corrector} 13 \\ \text{Range} 2525 \end{matrix} \right\}$ had its middle point at 216. Therefore by increasing the range 25 meters without changing the corrector, the sheaf will be carried parallel to its former position 25 meters further from the crest, and the middle point of the portion of the slope covered will be 25×1.43 = about 36 meters further away, that is it will be at 252. Therefore the sheaf will cover the slope from about 177 to 327, being displaced along the slope only about 36 meters. Hence if we want to displace it 80 meters more, as before, we must not on passing to the range 2550 let the corrector remain at 13, but must reduce it by 2, each decrease of 1 in the corrector moving the sheaf along the slope 26.4 meters.

The middle point of the zone covered by the sheaf of $\left\{ \begin{matrix} \text{Cor.} 11 \\ \text{R.} 2550 \end{matrix} \right\}$ will be at $252 + 2 \times 26.4 = 305$ meters from the crest; hence, the height of burst above this point will be: $\frac{(3.05 \times 8) - (6 \times 2.7)}{2.7} = 3$ mils.

So then to beat systematically a steep slope behind a crest, we should, after having fired with the range of the crest, execute an echelon fire with ranges varying by 25 meters, diminishing the corrector by 2 on passing from one range to the next, and firing

at each range a second salvo or rafale with the first corrector diminished by 3.

In the case under consideration, for example, we would fire as follows:

$$\left\{\begin{matrix}\text{Cor.18}\\ \text{R.2500}\end{matrix}\right\}\ \left\{\begin{matrix}\text{Cor.16}\\ \text{R.2525}\end{matrix}\right\}\ \left\{\begin{matrix}\text{Cor.13}\\ \text{R.2525}\end{matrix}\right\}\ \left\{\begin{matrix}\text{Cor.11}\\ \text{R.2550}\end{matrix}\right\}\ \left\{\begin{matrix}\text{Cor.18}\\ \text{R.2550}\end{matrix}\right\}$$

Each salvo or rafale is then displaced along the slope about 80 meters.*

Conclusions.

From the preceding theoretical study we may deduce the following simple rules:

Case where the flashes are visible.

1. Never diminish the corrector as the range of the top of the crest is increased, but rather increase it for the final ranges;

2. If the slope be not steep employ echelon fire at three or four ranges varying by 50 meters.

If the slope be steep, use echelon fire with 25 meters variation.

Case where the flashes are not visible.

1. If the slope be gentle, use echelon fire with 100 meters variation in range diminishing the corrector by 1 only for each 100 meters increment in range;

2. If the slope be an average one, use echelon fire with ranges varying by 50 meters and diminish the corrector by 1 for each 50 meters increment in range;

3. If the slope be steep, use echelon fire with 25 meters variation in range, diminishing the corrector by 2 on passing from each range to the next and firing at each range a second salvo or volley with the first corrector diminished by 3.

(*To be Continued*.).

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*We have seen above that with $\left\{\begin{matrix}\text{Cor.13}\\ \text{R.2525}\end{matrix}\right\}$ the burst will occur at 2625. So with $\left\{\begin{matrix}\text{Cor.13}\\ \text{R.2550}\end{matrix}\right\}$ it will be at 2650; and with corrector 11, at 2700.

THE ADJUSTMENT OF ARTILLERY HARNESS.

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

In considering the subject of draft, it must be recognized that the horse is like a machine and his energy must be utilized so as to obtain from it a maximum of useful work with a minimum of wear on the animal. The attachment of the horse to his load should therefore be in accordance with the mechanical principles governing the application of force. Any violation of these principles will be followed by injury and exhaustion to the horse, just as unmechanical arrangements damage machinery and waste power.

To many, the suggestions that follow may seem obvious and elementary, but the frequency with which they apparently are not considered justifies their presentation. Aside from the necessity of prolonging the usefulness of the animals, the pitiful suffering that inevitably results from ignorance and neglect appeals to humanity to help them in their efforts to serve us.

The adjustment of all parts of the harness should give the horse the greatest freedom of action and should enable him to work with comfort and without any wasted effort. The parts of the harness will be considered in detail, although much that is said may be found in our regulations and in various books available to the service.

The bridle with the snaffle bit now issued is so simple that few precautions are necessary. The bit should be placed low enough not to crease the corners of the mouth and the throat latch kept loose enough to admit the flat of the hand easily between it and the throat.

If a curb bit is used, the difficulties are greatly increased. The fitting of the curb bit is a subject about which so much is written and so little is practiced, that its further discussion seems superfluous. If one does not understand fitting it so as to procure the proper action, he should at least be able to prevent it from giving unnecessary pain and injuring the mouth. In the first place, the mouth piece should be the width of the mouth. Large sizes are necessary for some artillery horses and should be specially called for on requisitions. The mouth piece should rest opposite the chin groove so that the curb chain will be in the groove. In any case, it must not crease the corners of the mouth or strike the tusks. Knowledge as to the use of the curb is necessary to secure a proper

length in adjusting the curb chain. Where skill is lacking, the rule of making the length of the chain, including the hooks, one and one-half times the width of the mouth or the practice of having it admit two fingers between the chain and the chin when the branches of the bit are in prolongation of the cheek pieces, will be a safe guide. Leather curb straps should not be used, as the leather stretches and contracts and loses its flexibility. The double chain issued to the service, when kept clean and properly twisted, should not injure the lips.

The collar is the vital part of the artillery harness, and the source of most of the difficulties. It bears the same relation to the shoulders of the horse that the shoe bears to a man's foot. The fit of the collar should therefore be as nearly as possible like the fit of a shoe. If it is too large, it will slip over the skin and rub or gall the shoulder. If it is too tight, it will pinch the flesh and stop the circulation. The size must be such that when the muscles are expanded by the strain in draft, the collar will be close but not binding and will come into contact with all the bearing area of the shoulder. A properly fitted collar will be seen to rock from front to rear as the horse walks, while a loose collar will slide from side to side. A collar that is too tight will cause the skin on the shoulder to shrivel after being used a day or two. This injury is less serious than that caused by the rubbing of a loose collar. To fit the collar, one must understand the shapes of the different sizes and suit the shape, as well as the width, to the neck of the horse. For instance, a No. 5 collar is more curved than a No. 5-A and a No. 5-B is straighter along the neck than a No. 5-A. A horse with a thick upper neck will therefore require the No. 5, while a horse with a thin upper neck will require the B shape. The length of the collar is almost as important as the width. In order to diminish the pressure per unit of area on the bearing surface of the shoulder, it is necessary to distribute the pressure due to the draft, uniformly over all of this area. The bearing surface of the collar is shaped to correspond to the bearing surface of the shoulder, but in order to bring the corresponding parts of these surfaces together, the collar must be the same length as the shoulder. As a preliminary to fitting a collar, it is well to measure with a pair of wooden calipers, that any mechanic can make, the thickness of the neck at the thickest parts near the top and bottom, and also the depth of the neck at the shoulders from the seat of the collar pad to the bottom

of the throat. A reference to the table of sizes given in the Handbook will then indicate approximately the size of collar and the pad and connection with which to begin. In general, it will be found that at least half the horses now supplied to batteries require one of the No. 4 shapes on account of the adjustment in length. The remainder require one of the No. 5 shapes. Few horses in light batteries can be fitted with No. 6 collars, although many of this size are in use. The collar and the pads and connections indicated by the measurements are assembled and the collar is tried on. To test the fit, grasp the front flange of the collar about half way its length on the side of the neck that is free from the mane and pull the collar closely against the opposite side of the neck, while holding it in place against the shoulders. Then insert the fingers of the free hand between the end of the collar pad and the neck and move this hand down to the throat. The horse's neck should be straight and the muscles relaxed when this is done. (See Plate 1.)

PLATE 1.

The clearance should be the same all the way down and should be just enough to admit snugly, the flat of all the fingers, inserted as far as the knuckles. If the collar is closer than this, it may not leave sufficient room for the expansion of the muscles of the neck under the strain of draft. If it is looser than this, the collar is liable to slip around as the horse walks and a great deal of the

inner portion of the bearing area of the shoulder will not be utilized.

The proper width for any neck can be obtained by selecting suitable connections and by varying the attachment of the buckle. Repeated efforts and changes may be necessary, but the collar should not be accepted till it is as near the fit described as it can be made. A large number of assorted pads and connections should be kept on hand, especially of sizes 4, 5 and 6.

The adjustment in length must be such as to admit the flat of the hand only between the buckle and the throat. This is obtained by raising or lowering the extension when the proper size of collar is used. In all cases, the pad must fit closely against the side of the collar, and this can generally be accomplished by selecting the proper number of pad to suit the adjustment of the collar in width. Slight changes of width in the collar at the top can be made by bending the connection as explained in the Handbook, but this practice is not favored and can usually be avoided. A collar having been fitted, should be marked at once with the name of the horse. This is conveniently done by writing the name on a small leather tag and attaching it to the collar under an extension bolt nut. The final proof of the fit is the way the collar works on the march. By watching it along the road and carefully examining the shoulders at every halt, evidence of pinching because of tightness or of galling because of looseness, should be discovered in time to change the adjustments before any serious injury can result. The inside of the collar must, of course, be kept scrupulously clean and free from dents or roughness. As soon as the zinc wears off, the collar should be replaced. In many wheel collars, it will be found that the draft springs have become permanently compressed, so that the front flanges of the collar are mashed inward. The collar, in this way, loses its elasticity and the dead pressure on the flesh is injurious. A supply of these springs should be kept on hand and as soon as one collapses, it should be replaced by prying open the flange of the collar and inserting a new one.

As far as possible, horses in flesh should be fitted with collars in their widest adjustment. Then, as the animals lose condition in the field, the collars can be reduced in size. The fit of the collars must be changed with the condition of the horses and frequent tests should be made to discover the necessity for alterations.

Collars fitted as described can be worked without injuring the

shoulders as long as there exists enough flesh over the bones to form a cushion. With very thin horses, canvas pads are useful, but they must fit close.

On adjusting collars as indicated, to horses whose shoulders have been injured at the lower parts, it will be seen that the collars rest above or inside the old sores or scars, showing that these resulted from pressure where none should have been applied.

Opinions differ as to the relative merits of the breast strap, the leather collar and the steel collar. There has been little experience in our service with the breast strap, and it, no doubt, possesses many advantages. It appears to be objectionable in principle, however, since it restricts the end of the shoulder blade where the motion is greatest as the horse walks. The area covered by it must be less than the area on the shoulders available for the collar, and the pressure per unit of area for the same load must therefore be greater. It has the undoubted advantage of requiring little adjustment.

The leather collar is used in our field trains, and comparison between that and the steel collar can easily be made on the march. As long as it is kept clean and flexible and a proper direction is given to the traces it can be worked without injuring the shoulders. In order to secure a fit, the collar must be separated at the top and the ends shortened till they can be buckled with the sides close to the neck, as described for the steel collar. The principles of fitting are the same. On account of the impossibility of regulating the width of the leather collar to suit all parts of the neck, the canvas pad is found useful. It fills the irregular space between the collar and the neck and makes the collar bend to the shape of the neck. The inability to change the leather collar to suit different necks and shoulders and to suit the neck and shoulders of the same horse as he changes condition, renders it less desirable than the steel collar for artillery horses.

It has been objected that the steel collar blisters the horse's skin when exposed to great heat. The collar has been used under conditions of extreme heat in various parts of the world, and it has been found that as long as the metal is in contact with the skin, the evaporation of the sweat from the animal keeps the bearing area from becoming heated. The rules for marching require that the collar shall be unbuckled and set back at every halt. When this is done in hot weather, the collar pads should be placed on the withers

and the inner surface of the collar kept in contact with the sides of the shoulders.

It has been stated that the collar must be fitted so as to cover all the bearing area of the shoulder. In order to utilize this area to the best advantage, the pressure due to draft must be distributed uniformly over the surface. If it is localized near either end of the shoulder blade, this portion will be injured, while the remainder of the surface will be wasted. These considerations require that the point of attachment of the trace to the collar shall be opposite the center of the bearing area of the shoulder.

As the horse walks, the ends of the shoulder blade rock forward and backward. The amount of this motion is greatest at the lower end and least at a point near the middle of the bone. Since the ends are enlarged for the attachment of the muscles, the application of draft over them, not only opposes the natural motion of the bone where it is greatest but places the pressure where the tissues are easily bruised between the enlarged ends and the collar. It will be found that the great majority of shoulder sores are near one end of the shoulder blade, generally the lower, because the pressure has been unduly localized at those places. The point of application of the draft should, therefore, be where the motion of the shoulder blade is least. While this point does not generally coincide with the center of the bearing area of the shoulder, the two are sufficiently near together for practical purposes. With collars having only three adjustments of the trace plates, it has been found that the highest position is suited to nearly all shoulders. All collars should therefore have the trace plates attached in the third hole from the top, and if there appears any injury opposite either end of the shoulder blade, the trace plates should be raised or lowered one hole to reduce the pressure at that point. This adjustment applies to all horses, whatever may be their position in the team. All trace plates should have four holes for adjustment.

From the principle of the resolution of forces, it may be shown that when the direction of the trace makes an angle other than ninety degrees with the shoulders, there will be a component of the force exerted in draft, in a direction parallel to the shoulders. This may be called the vertical component of the draft. It may be assumed that a horse can overcome a resistance a little greater than his weight, and if the angle that the trace makes with the shoulder is measured, the value of the vertical component can be determined for any effort up to the maximum. When the direction of the trace

is above the normal to the shoulder, as is the case with the lead horse, this component acts upward and causes the collar to rise along the shoulder till it is stopped by the throat. If the effort is sufficient, the pressure of the collar will choke the horse. This is why lead horses are seen to fall when they pull hard or plunge into the collar, for when once a horse begins to choke, he will plunge till he strangles. It also explains why lead horses do not pull their share of the load, since they soon learn to avoid the pain of choking by not pulling enough to produce it. As an evidence that the leaders pull less than the wheel horses, it seldom will be found that the draft springs collapse in lead collars. There is no mechanical reason why, on a straight pull, the leader should not exert nearly as much effort against the collar as a wheel horse.

If the trace is made to work in a direction perpendicular to the shoulder (not the collar) the injurious component will disappear and the collar will not change its position. In most commercial harness, there is a back strap and a belly strap, both of which can be buckled so as to give the traces the proper direction. The lead traces of artillery harness can be kept in the proper position by a belly strap with a loop at each end through which the traces pass. One loop should be buckled to the strap so that the length can be adjusted to suit the horse. The strap is kept in place by a loop sewed across the middle of the cincha. Loops three inches long and a strap 30 inches long and 1½ inches wide will be found suitable. If the strap is shortened too much, the traces will extend downward from the shoulder and injurious pressure will be produced on top of the neck. The proper adjustment is found when, as the horse pulls, it is seen that the trace appears to make a right angle with the shoulder, the collar does not touch the throat and the hand can be inserted easily between the collar pad and the top of the neck. A horse will generally pull freely when he finds that he does not suffer because of his efforts.

An erroneous impression has been found that a collar should extend far below the throat in order to avoid choking the horse. However long a collar may be, it will tend to rise as the horse pulls, till the traces assume a direction at right angles with the shoulder. Besides having all the evils of not fitting, a long collar will choke the horse just as readily as a short one, unless the proper direction is given to the traces. Plate 2 shows the usual direction of the trace, causing the collar to press against the throat while the pad rises above the neck. Plate 3 shows the traces held

PLATE 2.

normal to the shoulder. The pad rests on the neck and the collar cannot touch the throat.

When all the horses of a team are in draft, it can be seen that the toggles of the wheel traces extend below the normal to the

PLATE 3.

shoulder. The pull of the lead and swing horses causes the wheel trace to form an angle at the end of the chain and the direction thus given to the toggle results in a downward component of the draft, which is transmitted by the collar to the top of the wheel horse's neck. If calculated, the amount of this component will be found very large. The area of the neck upon which the collar pad rests is small, so that the pressure per unit of area from this component is excessive. The neck of a horse is not adapted to weight carrying and though nature has provided a mane for its protection, even that is removed from the position of the collar pad in our service. In garrison, the effort in draft is not long sustained and sores may not result from this cause alone, but on the march, it is sufficient to produce a sore neck, even when the other causes of this evil have been removed. In addition to injuring the neck, this pressure increases the weight on the forehand and disturbs the balance of the animal. The forked trace chain was designed to correct the defect, but while it may lessen the pressure on the neck, it does not obviate it. It should be removed, as in the case of the lead horse, by keeping the toggles normal to the shoulders. This is accomplished by passing the wheel traces through loops at the ends of a back strap resting in the saddle. One loop should be buckled to the strap so that any desired adjustment may be made. The traces can then be supported at such a height that the toggles will always be normal to the shoulders when the horses are pulling. The effect is to transfer the vertical component of the draft from the neck to the back which is able to support it. The loin straps may be used for this purpose by placing them in the saddles and raising the loops. If the driver experiences any inconvenience from the strap in his saddle, it may be placed inside the cantle hook without injuring the horse's back.

Plate 4 shows the direction of the toggle of the wheel trace without the back strap and Plate 5 shows the toggle normal to the shoulder when the traces are properly supported.

The traces of the swing horse tend to rise above the normal to the shoulder, due to his own effort, but the traces of the lead horse pull the swing toggles down towards the normal. If the lead and the swing horses always pulled equally, the swing toggles might be made of such a length that they would work in a direction normal to the shoulders. Usually the lead horse pulls less than

PLATE 4.

the swing and there is a vertical component of the draft causing the swing collar to rise against the throat. Where, however, a lead horse is willing and his collar and traces are adjusted so that he

PLATE 5.

can pull without choking, it will be found that on the march, there will be a downward component on the collar of the swing horse that will injure the latter's neck. The swing traces should therefore be kept normal to the shoulders by a back strap and a belly strap. The pull of the leader is generally sufficient to keep the collar from actually choking the swing horse and it has been found in practice that a properly adjusted back strap is sufficient for most swing traces. These adjustments are independent of the angle of traction. It is more important to attach the horse to his load so that he can use his full strength than to sacrifice his power and comfort to any arbitrary line or theoretical slope of the traces.

The length of the traces should be adjustable to suit the conformation of the horse. While a short trace has no mechanical advantage over a long one, it is found practically, that a horse works better near his load. Short traces also make the team more compact for maneuvering and in turning, they give a better direction to the effort of the team. The wheel traces should be adjusted with reference to the breeching. When the latter is fitted as prescribed, the traces should be long enough to permit the horse to step freely without pressure from the body strap. The wheel traces now issued are fixed as to length. The lead and swing traces should enable the pairs to travel far enough apart not to be stepped on by the horses in rear at the fast gaits. The length can vary within wide limits and cause no injury to the horses or any great loss of energy in draft. With the traces now issued, the shortest adjustment should be used for ordinary work but where rapid gaits are expected, as in reviews, the longest adjustment should be employed. When pairs are hooked too close, the fore feet of wheel and swing horses may seriously injure the hind legs of the horses in front. Horses are also apt to kick and get over the traces when crowded or stepped on.

While the saddle has such serious defects in design that it is to be discarded, much of the injury to horses' backs is due to faulty use. The saddle should rest on that part of the back where the bearing area in contact with the saddle is greatest. This reduces the pressure per unit of area to a minimum. At the same time, the front ends of the side bars should not come in contact with the muscles of the forehand as they move. The saddle should also be over the middle of the back so that the center of the saddle is over the center of motion and the center of gravity of the horse.

Its position can best be determined by placing it on the back without a blanket, and shifting it till it appears to conform to the above requirements. The saddle should appear parallel to the ground and should rest evenly on the parts of the back in contact with it. When the desired position is found, the back strap should be adjusted to hold it there when the crupper rests closely but not tightly against the dock. Saddles are generally placed too far forward and with most horses, it will be found that the back strap must be buckled in its shortest adjustment to keep the saddle from being placed dangerously near the withers. Whenever the harness is cleaned, care should be taken to have the back strap reassembled in its adjusted position.

For ordinary work, the cincha when fastened, should admit the flat of the fingers easily under the quarter strap ring safe. When horses are to be maneuvered at rapid gaits and for a short time only, the cincha may be tightened slightly. Tight cinching is an evil that not only causes great distress to the animal and interferes with his breathing and heart action, but when long continued, it produces puffs and sores that are very difficult to heal. If the saddle is placed properly on the back, the tendency for it to move will be slight and tight cinching will be unnecessary. Plate 1 shows scars resulting from tight cinching.

The loin straps and the hip straps of lead and swing harness are intended to support the traces when they are not held up by the tension of the draft. The bottoms of the trace loops should be one or two inches below the traces when the horse is pulling. Any pressure on the back where these straps rest would seriously injure the animal.

The body of the breeching performs the same office in holding the carriage back that the collar does in moving it forward. When the horse walks, his thigh bone swings forward and backward about its upper end. The place of least motion is therefore at the pivot or the joint of the hip. This bone is the lever by which the remainder of the leg propels the body. The application of any pressure to the moving part of the bone restricts its motion and, if very great, as in the case of resisting the weight or the momentum of an artillery carriage, it deprives the animal of the proper use of the member. The body of the breeching should therefore rest against the thigh at the joint of the hip and the hip straps should be adjusted to hold it in this position. There will then be no

interference with the movement of the animal, the strap will not chafe the horse by shifting as he walks and the effort of holding back will be exerted in nearly a straight line from the point of contact to the martingale. The correct position is shown in Plate 4.

The side straps should be of such a length that the body of the breeching will check the carriage before the single tree touches the hocks. A satisfactory adjustment can be made by hitching the horse to the carriage and having him put his weight into the collar. Then insert the width of the hand and extended thumb between the body strap and the thigh and buckle the side straps to this length.

Probably the most serious difficulty with which field artillery has to contend on the march is sore necks among the wheel horses. Even in garrison, there are usually a number of horses with sore or tender necks and they are readily located by their flinching and their efforts to escape when any attempt is made to touch the seat of the collar pad. These sores obviously result from undue pressure and the only way to prevent them is to remove the causes.

It has already been shown that one of these is the vertical component of the draft, and the method of removing it has been indicated. The other causes are the weight at the end of the pole and the effort of holding back that is exerted through the collar and the breast strap. The injurious effect of supporting the pole from the neck is well known and in all commercial vehicles it is avoided by the construction of the running gear. In the artillery of some of the European countries, the desired results are accomplished by attaching the lead and swing horses to a double tree at the end of the pole, which is not connected with the wheel harness. When the pole is supported by the collar, every shock to the wheels and every rise and fall of the end of the pole is transmitted to the neck. The horse's balance is constantly disturbed and he is fatigued and worn by useless resistance in addition to suffering from the sustained pressure on the delicate tissues of the neck. The weight at the end of the pole constantly varies with the amount of ammunition carried, the number of cannoneers on the limber and the way they sit and in campaign, the equipment or supplies carried on the foot rests. Even if there were no weight at the end of the pole, the constant pounding and thrashing would be sufficient, when long sustained, to injure the neck. The best remedy is to support the pole from the carriage. Various devices

have been tried but the most satisfactory one was designed by Captain W. P. Ennis, 1st F. A. It can be made by the battery mechanics and applied to any carriage. The details are shown in Plate 6. An iron rod two feet long is attached to the rear end of the middle rail by means of a clevis. A triangular plate, 4 inches to the side, is bored in the center to fit over a tenon turned or forged at the top of the rod. From this plate two chains extend to steel bars attached by clevises to the hand rail tubes. The points of attachment of these chains to the bars should be directly over the axle. A third chain extends from the plate to a rod clamped to the flanges of the trail above the front tool box transom. This chain passes through a

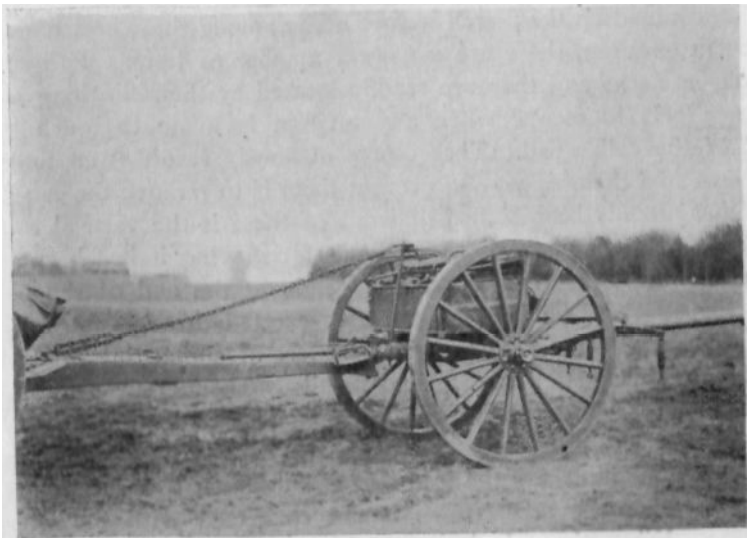

PLATE 6.

ring on the rod and has a hook that may be attached to any link to secure a proper height of the pole. To allow for sudden strains on the chain, a mogul spring is inserted between the plate and the rear chain. Corresponding points of attachment of the rear chain can be provided on the caisson. The reel cart pole support is shown in Plate 7. The rear chain should be detached before crossing ditches or very rough ground. It is so easily manupulated that it does not appreciably delay limbering or unlimbering. The pole should travel so that the end is about opposite the top of the forearm and should be held directly in the

axis of the carriage. The carriage is guided by the pull of the horses on each side, much as a ship is steered by two propellers. The free pole becomes a pendulum and indicates whether the horses are pulling equally. If it inclines to one side, it is because the horses on that side are not pulling their share and the drivers can be made to have their pairs distribute the draft in the most advantageous manner.

While the breeching is intended to transfer to the haunches the effort of holding back, it will be seen that a large part of this strain is exerted by the neck through the breast strap. This is necessarily the case when the pole is supported by the neck, for the breast strap will continue to

PLATE 7.

connect the pole with the neck whether the horse is holding back or pulling. One of the most important duties of the cannoneers on the march is to apply the brakes so as to keep the traces stretched on all down grades. The tension on the breast strap shows that the men do not, or cannot accomplish this duty and the neck of the horse will become sore from this cause alone. When the pole is supported by the carriage, the breast strap can be so lengthened that all the thrust of holding back the carriage will be borne by the breeching and will be transmitted to the part of the horses most fitted by nature to endure it.

Whether the horse is pulling or holding back, the collar should admit the hand easily between the pad and the neck. If any pressure exists on top of the neck when this test is made, it should be remedied by the methods described.

The changes indicated may not be pleasing at first to eyes that have been accustomed to seeing the horses closely trussed up in their harness, but appearances must be subordinated to utility. Probably ninety per cent of field service consists in marching and camping and during this part of it, the horse's power must be preserved for the great demands that may be made upon him in maneuvering and in combat. The successful marching of artillery demands a thorough knowledge on the part of officers and men of all the details connected with the care of horses and equipment and continued watchfulness to prevent injury to the animals and to remedy them when they occur. Officers must realize that nothing is too small or unimportant for them to do personally. Their places are in the column where the difficulties are to be found and the discomfort and effort incident to searching for them must be borne gladly. Eternal vigilance is the price of a successful march.

Some alterations in the design of our harness and carriages may be desirable in order to improve mobility, but the chief duty of a practical officer is ever to employ what exists to the best of his ability. No design can succeed without intelligent use and it is only by using what is furnished intelligently and skillfully that we can demonstrate the necessity for improvement.

PACK ARTILLERY.

Its Name, Requirements, Uses, and Tactical Roles.

BY MAJOR A. S. FLEMING, FIELD ARTILLERY.

Prior to the separation of the field and coast artillery, all the writer's service with field artillery had been with light batteries, and his affection for that service became deep and lasting. As an enthusiastic young officer expressed himself, "the swing of the patient horse, the rumble of the wheels, the dash and go of the battery grip my heart strings and excite all my energy and enthusiasm." Nearly five years' service in a mountain regiment (the Fourth) brought no diminution of this love of the light artillery, but added thereto an appreciation of the possibilities of mountain artillery that can be acquired only by service with it. The patience and faithfulness of the horse is more or less compensated for by the greater intelligence of the mule; the rumble of the wheels is offset by the quiet, stealthy movements of the pack mule; admiration for the dash and go of the gun carriages is shared by wonder at the ability of the pack mules to transport their guns over mere trails to points apparently inaccessible.

In the maneuver division assembled at San Antonio, Texas, in 1911, there was a full regiment of each of these classes of field artillery and good opportunities for observing both regiments existed, especially during the maneuvers and field artillery inspections at the Leon Springs Reservation. The terrain at Leon Springs is rough and hilly, with numerous ravines and rather dense patches of woods; such roads as exist are fair. In the choice of positions the mountain artillery had much the better of it, because practically all positions were accessible by pack mules, whereas many of the hills were so steep that the gun carriages could not readily negotiate them even by doubling teams; also, the mountain guns could nearly always be posted on the reverse slopes, whereas these slopes were often so steep that the field guns of necessity were posted in the valley behind or even on the forward slope of the next ridge in rear. In changing position, the mountain artillery could usually move by the shortest line, crossing ravines or moving along them, silently, surely, and unobserved, whereas the field guns were compelled to make detours to avoid ravines and

generally had to follow the roads to the immediate vicinity of their intended position. Even at a walk, the sound of the wheels over, the rocky roads carried far, and if time were saved by trotting the rumble of the wheels echoed through the hills. Finally, pack mules walk faster than horses in draft and, since the former determine practically its rate of march, mountain artillery *at a walk* will outmarch light artillery when both are marching free.

These observations led to a broader comprehension of the role of mountain artillery and to a study of the best methods of neutralizing its ballistic inferiority, as far as possible, when it is opposed to light artillery.

The results were prepared, in the form of notes, for the instruction of the officers of the Fourth Field Artillery and form the basis of this article.

Name.

Mountain artillery is an unfortunate misnomer for artillery transported on pack animals. Originally, mountainous country wherein wheel artillery could not operate, doubtless gave the *raison d'être* of such artillery, and the name followed. In the Philippines such artillery can penetrate jungles, etc., which are comparatively impassable for wheel artillery, and had artillery of the former kind been used in such terrain it might equally as well have been termed "jungle" artillery.

Increased familiarity with the use and the functions of mountain artillery have brought a better understanding of it and demonstrated that its useful sphere of action is far greater than it was originally considered to be.

According to its caliber, field artillery is classified as light and heavy. According to trajectory, it is divided into guns and howitzers. Artillery on wheels is often referred to as "wheel" artillery to segregate it from that transported on pack animals. It follows that the logical name for the latter is "pack" artillery. This term is self-explanatory, indicating the mode of transportation, the latter usually implying that it is also light artillery, i. e., of small caliber. Also the term pack artillery at once removes the artificial and erroneous conceptions as to the limitations of the uses and of the tactical roles of such artillery.

Requirements.

The fighting requirements of a gun for pack artillery are:

1. The greatest power possible, considering suitability for pack transport and rapid preparation for action. This limits the caliber and the initial velocity of the gun. It also excludes howitzer (proper) features, except, possibly, for supplementary batteries. A maximum elevation of 30 degrees is ample, this being a trifle greater than that of any foreign weapon of this type.

2. Maximum rapidity of fire. This excludes the zone system of fire with varying charges. In fact, zone fire is believed to be undesirable for any type of field artillery except howitzers proper, and even then its use should be limited to targets requiring high angle fire from well-concealed positions deliberately occupied. Fire sufficiently curved to reach troops behind covering field entrenchments can usually be obtained by howitzers using a single propelling charge.

Rapidity of fire also demands fixed ammunition and laying apparatus and division of laying duties to insure the maximum speed; also the recoil must be so controlled as to have the carriage stable during firing.

3. A shielded gun.

2.95″ V. M. gun versus 3.0″ field gun (both behind masks).—The angle of fall of the 2.95″ V. M. gun is so much greater than the angle of departure of the 3.0″ field gun (exceeding it by nearly three to one) that within its range (4000 yards) the former can reach the latter behind any mask which permits the latter to fire at the range of the former.

On the other hand, the angle of fall of the 3.0″ gun augmented by one-half of the angle of opening of its shrapnel is sufficiently greater than the angle of departure of the opposing 2.95″ V. M. gun to enable the former to reach the latter in any possible position not further from the covering mask than the effective burst interval, by bursting shrapnel low on the crest of the mask. This effective burst interval for field guns (except the French Q. F. gun, for which the assumption is somewhat too small) may be assumed as 270 yards,* since shrapnel bullets are practically harmless 275 yards from

* This assumption is believed to be very conservative. The Fort Riley experiments in 1906 led the Field Artillery Board to conclude that the effective depth searched by 3.0-in. shrapnel was about 200 yards up to 3000 yards range and about 125 yards at longer ranges (3500 to 4000 yards). The Board considered these conclusions well within limits.

the point of burst which, considering the height of burst, corresponds at mid-range to a burst interval of about 270 yards.

When the distance from the gun to covering mask exceeds the effective burst interval of the shrapnel of the opposing artillery, the latter must resort to the expedient of bursting shrapnel *beyond* the covering mask, in which case a great amount of ammunition may be expended with very little damage, unless the actual location of the target be known, e. g., from flank observers, aerial reconnaissance, etc. This expedient of placing the guns, say, 300 yards or more behind a mask is, of course, open to all artillery, but with high masks additional safety accrues to the 2.95″ gun, as will be shown.

Subsequent to the publication of "Gunnery and Explosives for Field Artillery Officers," the writer had deduced approximate equations for the 2.95″ V. M. gun corresponding to those for the 3.0″ field gun given in the publication quoted. By the use of these equations, and other similar methods, the data in the following table were determined. They may be accepted as sufficiently approximate for the purposes of this discussion, their deduction being omitted for brevity:

k	d	100	200	300	400	500
4	p	47	97	152	209	269
	z	62	130	183	232	276
3	p	62	126	195	267	342
	z	58	119	164	207	244
2	p	83	170	258	348	441
	z	46	99	137	169	199

The symbols used will be evident from the following example:

Values from the table: k = 3, d = 500, p = 342, z = 244. These values show that if a 2.95″ gun, 500 yards behind a maximum covering mask, is firing at 3000 yards range at a 3.0″ gun, the minimum range at which the 3.0″ gun can clear the mask is 3342 yards. The trajectory of the 3.0″ gun, therefore, pierces the horizontal plane containing the 2.95″ gun 342 yards behind the latter and the 3.0″ shrapnel must burst 244 yards short of the 2.95″ gun in order for its *lowest* bullet to reach the latter, all other bullets going over.

This example illustrates the fact that when the minimum range possible exceeds that of the target the latter can be reached only by increasing the burst interval—to 244 yards *at least* in the example.

As the burst interval of the 3.0″ shrapnel is increased beyond certain limits (about 50 yards at ranges up to 3000 yards and about 25 yards at longer ranges—3500 to 4000 yards) the effect on the target falls off rapidly until it becomes zero, i. e., the bullets are harmless when the burst interval exceeds 270 yards (see p. 3).

The value of z in the above table is therefore a measure of the effect of the fire of the 3.0″ gun against the 2.95″ gun. A study of the table shows that the safety of the 2.95″ gun increases with its range (1000 k), and also with its distance from its mask (d), and that this safety is complete when its range is about 3800 yards and its distance from its maximum mask is about 500 yards.

Practically, however, other considerations operate to increase the safety of the 2.95″ gun:

1. The 2.95″ gun cannot use its maximum mask, but must allow a factor of safety. This operates to its disadvantage.
2. All 3.0″ shrapnel whose trajectories have a positive variation (increase of range) are less effective.
3. All 3.0″ shrapnel whose trajectories have a negative variation (decrease of range) will burst on impact on the covering mask and be harmless.
4. In order to provide for range variations, the 3.0″ gun must slightly increase its elevation (which compensates for the factor of safety used by the 2.95″ gun per 1).
5. When the minimum range possible for the 3.0″ gun exceeds that of the 2.95″ gun, the former must raise its burst (increase z) to reach the 2.95″ gun effectively. This will be done at the cost of considerable effect, and when z thereby exceeds 270 no effect will be produced.
6. The target of the 3.0″ gun is not a point, but the 2.95″ gun with its ammunition and cannoneers. However, its depth is so little that the general conclusions are not appreciably modified.

Exactly how far behind its maximum mask the 2.95″ gun must be in order to be immune cannot be determined,—even by experiment,—since it is an indeterminate value varying with the ammunition, the character of the covering mask, etc. But it can be stated definitely that the greater this distance from the maximum mask the better; also, since the considerations just enumerated would, on

the whole, tend to increase this immunity, either indirectly or by increasing the value of z, and since the value of the latter, whenever d exceeds 270 yards (thus precluding effect by bursting 3.0″ shrapnel low on the covering crest), unless such increase already exceeds 150 for all values of k greater than 3, it may fairly be concluded that a 2.95″ gun posted more than 270 yards behind its maximum mask is practically immune from the fire of an opposing field gun at ranges exceeding 3000 yards.

The initial velocity of a field gun is about double that of a 2.95″ gun, but the striking velocity of the former exceeds that of the latter by only 5 per cent at 3500 yards and by less than ½ per cent at 4000 yards (827 f. s. and 824 f. s., respectively).

From the above considerations the following general principles may be laid down for the *safety* of mountain artillery when opposed to field artillery:

1. Seek a long range rather than a short one.
2. Select a masked position and post guns at least 270 yards behind it.
3. The higher the mask the better. A mask which is the maximum for the range and which requires the guns to be posted at least 270 yards from it gives practical immunity at ranges exceeding 3000 yards.

Conversely, field guns should seek a short range when opposed to mountain guns, and should be posted at least 250 yards behind the mask.

The principle that guns be placed a considerable distance behind the mask for safety is opposed to ease of conduct of fire, but its use warrants consideration, especially for guns of inferior power.

Comparing the 2.95″ gun and the 3.0″ gun, it appears that for a given position behind a mask the former can fire at a minimum range but little exceeding half that possible for the latter (from .55 to .6, according to the range). Thus if the dead space for the 3.0″ gun be 2000 yards it is but 1200 yards for the 2.95″ gun.

This gives an important supplementary role to mountain artillery since while enjoying mask protection equal to that of field guns it can reduce the dead space nearly fifty per cent.

Conversely for a given target the 2.95″ gun can use a mask exceeding by about 10 k the maximum mask for the 3.0″ gun, e. g., 160 mils at 4000 yards.

This discussion applies only to the relative safety of the opposing

guns from each other's fire, and is based on the assumption that both guns are in the same horizontal plane. But within the limits to which the principles of the rigidity of the trajectory are applicable the conclusions are equally true, whatever may be the relative heights of the guns. It is evident, however, that the gun whose position commands that of the other (i. e. is higher) derives advantages from such command, e. g. the maximum mask is more easily secured since the required defilade is not so great; more plunging fire is afforded; and (usually) better facilities (usually) for observation of fire are available.

It need scarcely be stated that considerations of safety must always be subordinated to tactical considerations and consequently pack artillery in a direct fire position or a masked position of slight defilade close to its mask may be opposed to masked field guns. Under these circumstances the only recourses of the pack artillery commander are to so place his guns as to render odservation of the hostile fire as difficult as possible, to make an artificial mask, and to construct cover for his guns and personnel. In such a situation pack artillery should suffer less at the shorter ranges because at those ranges the hostile fire is less plunging.

While the procedure of pack artillery unavoidably opposed to field artillery has been discussed in more or less detail, it should not be expected to hold its own when opposed to artillery of superior power. Its ballistic inferiority is a very great handicap and a maximum mask will seldom be available in service. Consequently a pack battery should not be assigned as a counter battery against an enemy armed with guns of superior power.

Tactical roles.

The special tactical roles of pack artillery to which attention should be particularly drawn are:

1. To operate with infantry or cavalry over terrain impracticable for wheel artillery.

2. By virtue of its quietness and mobility (not speed) to permit the concealed and silent occupation of positions less practicable for wheel artillery.

3. In rough, hilly, broken, or heavily wooded country to permit more rapid occupation and changes of position than can be made by wheel artillery, especially if there be poor roads or no roads at all.

4. As an infantry battery, because of its relatively high angle of fall and resultant effect on troops in trenches.

5. To accompany advancing infantry more closely than is possible for wheel artillery. In emergency the guns can be hauled considerable distances by the drag ropes, all animals remaining under cover in rear.

6. To cover dead spaces unavoidably left by artillery of higher power, especially on the defensive.

7. Counter attack battery, because of its mobility and the relatively small target presented by it.

8. In sieges it can be drawn by hand through the trenches to favorable positions.

9. To accompany a landing force. Its animals can be landed as expeditiously as those of wheel artillery; its packs will give no more trouble than the harness of wheel artillery; its guns can be placed in small boats and landed without special arrangements or difficulty and, if its animals cannot be landed, thereafter hauled by the men.

10. For the land defense of sea coast forts it can readily be moved, even by hand, from one point to another. It will probably not be exceeded in power by any gun landed by a naval landing force.

Pack artillery is indispensable in a mountainous country. Its ballistic inferiority to wheel artillery is largely offset in a terrain that is rough, broken, heavily wooded, or that has poor or no roads. As an adjunct to wheel artillery it is useful in any terrain and can fill many tactical roles peculiarly and particularly fitted to it.

THE ARMY SERVICE SCHOOLS.

BY MAJOR H. G. BISHOP, 5TH FIELD ARTILLERY,

Instructor, Department—Military Art.

The number of Field Artillery Officers who have attended this school in the past few years has been so small, comparatively, that the school is not, as a rule, well known or understood by the officers of that arm in general. It is, therefore, thought that a few words about the place may not be inappropriate.

It is thought that one reason for the small number of F. A. Officers attending is due to a misconception on their part that the school has little to teach them in their profession and to a number of incorrect ideas regarding the course itself, which, like all good things, comes in for its share of adverse criticism, *criticism invariably made by officers who have never attended the School,* for I have yet to hear adverse criticism of the institution by any of its graduates.

So far as instruction in Field Artillery itself is concerned, the conferences cover only such matter as will be of value to officers of the other branches of the service in explanation of the powers and limitations of field artillery and matter, a knowledge of which will be of value to them when called upon to command mixed forces containing field artillery, or when required to umpire the work of field artillery commands. Details concerning drill, equipment, organization, personnel, computation of firing data, adjustment of fire, and other technical matters are necessarily and purposely omitted.

The Field Artillery has its School of Fire at Fort Sill, where the technique of the profession is taught to our own officers and which is open under certain War Department regulations to officers of other branches who desire to inform themselves more fully on that subject. For this reason, principally, and for lack of time and of a proper plant, the technical part of Field Artillery instruction is omitted.

An attempt is made to teach the tactics of the arm to all students in order to secure the necessary skill for proper co-ordination with the corresponding operations of other troops, and instruction is given in its powers and limitations that commanders may not hamper

the arm with unwise and impossible orders or, on the other hand, leave the artilleryman entirely to his own devices.

Just as it is essential for officers of other arms to understand the powers and limitations of our own branch it is essential that the Field Artillerymen understand the powers and limitations and the tactics of the other arms. I would go even further and say that to bring out the full power of his firing plant, whether it be a battery or a battalion, it is *absolutely necessary* that he have not only a complete understanding of the powers and limitations of other arms but a thorough grounding in their tactics.

"The sole reason for the existence of Field Artillery is its ability to assist the other arms, especially the infantry upon the field of battle," and it stands to reason that the full measure of this assistance cannot be given without a knowledge of the way the other arms fight.

Instruction in the powers and limitations as well as in the tactics of all these arms and the auxiliary branches of the service, both singly and in combination, is the aim of the institution.

There are added reasons why Field Artillery officers should seek the instruction given here. Any officer, especially a field officer, is likely to fall heir to a mixed command, either in war or in maneuvers; or as an adjutant general or chief of staff be required to prepare orders for troops other than his own arm; as an inspector he may have to observe and report upon the efficiency of other troops in their own tactics, and in various other ways be brought in contact with them when a lack of thorough knowledge of the other arms will be embarrassing.

Like all institutions, the graduates of this institution carry with them into the service certain processes of thought and certain methods of expression which are characteristic. These manifest themselves particularly in field orders, written or verbal, the clean-cut decision, the lucidity and brevity of the orders for carrying it out which are often in remarkable contrast to orders put out by officers who have not had the benefit of the school, an accomplishment which is extremely advantageous to all officers, and one which is rapidly becoming essential as our graduates increase in number in the service.

It is true that an officer can pursue a course of study at his own station similar to the course here and by unremitting labor greatly improve himself, but it has been my observation that only particularly

constituted individuals will stick to such a course of self-imposed work long enough and conscientiously enough to produce substantial results; too often, especially in the applicatory system of education, which is the only true way of studying tactics, he is liable to come to erroneous conclusions. Only by contact with others in war games, and by the open discussion in conference will he acquire confidence in himself if he is too introspective, or realize his own incompetence if he is too cock-sure by nature and has acquired erroneous ideas.

The complete relief from all other duty and the opportunity to give one's individual attention to study, research and other lines of work in military subjects such as is afforded at the service schools is a very great advantage and one impossible to attain when on regular duty. Officers are not called on to perform any of the ordinary military duties, such as guard, boards, etc. Their time during the entire twenty-four hours is their own except during the hours scheduled for attendance at conference, map problems, war games, and work in the field. This rarely exceeds five hours a day during the indoor season. This, of course, does not include the time spent in preparation of studies. No duties are scheduled for Saturdays or Sundays.

The courses open to Field Artillery officers are the:—

Army School of the Line (September to July), the higher graduates of which are recommended for the Army Staff College (September to July).

Owing to the recent Manchu law, it is more than likely that the School of the Line, which has heretofore been restricted to Captains and Majors, will be open to 1st Lieutenants.

The special course for Field Officers, of about nine weeks' duration, which is open to all field officers, including Colonels.

In addition, there is the Signal School (September to July), which is technical, however, fitting officers for detail in the Signal Corps. It will probably be open to 2d Lieutenants this year as well as Captains and 1st Lieutenants.

The Staff College course is a very advanced course in Staff Administration, Historical Research, Law and Field Engineering. It affords the student unequalled opportunity for independent work. In addition, the course embraces elective courses in Spanish, French and German.

The criticism has been made that this is a "spec" school. This

is absolutely incorrect. With the necessary exception of languages which are not required in the Line Class year, there is nothing in the course that requires memorizing, and any voluntary tendency to memorize is discouraged.

Another criticism is that the School teaches the handling of brigades, divisions and armies to the detriment of a knowledge of the leading of lesser units. This is entirely untrue. The art of tactics is one of the few where instruction must begin at the top, so to speak; until the principles upon which the larger units are handled are well understood, the leading of the smaller units cannot be successfully accomplished, and instruction must begin with the larger ones. If an artist were called on to complete a painting by the addition of some trees, though he may be a very skillful painter of trees, he must study and understand the picture as a whole before he can put brush to paint. He cannot take a type tree from his mental plant and stick it on the landscape. Nor more, can a battalion commander put his three batteries on the battle line to the best effect, simply from his perfect knowledge of artillery drill regulations and the powers of the weapon. He must have some knowledge of the part the other units are to play and how they are going to play it; he must study and know how to estimate the picture as a whole before he can handle his little part to the best advantage. The handling of a single battery with a regiment of other troops is not necessarily similar to the way it would be handled in the same area and under similar conditions with a larger force.

The post of Fort Leavenworth is large and pleasant. It is one hour by rail—one and three-quarters by trolley—to Kansas City and 15 minutes to Leavenworth. The quarters are modern and in good condition. They are ample in number for the usual size classes and only a few very junior married officers have failed in the past in getting houses if they wish them. There are two good messes maintained. Servants (colored) are plentiful. Privates' mounts are well cared for at the detachment stables for $2.50 per month per horse. There is a garage for motors. Golf course, tennis courts, roller-skating rinks, polo field, large steam-heated riding hall with equitation classes every week day, library, play ground for children, etc. A post better equipped for recreation does not exist in the army.

As to preparatory work previous to coming here, the following information may be useful:

MILITARY ART.

Infantry Drill Regulations, Parts 2 and 3.
Artillery Drill Regulations, Parts 5 and 6.
Field Service Regulations (reference and read carefully).
Minor Tactics (published at School).
Letters on Applied Tactics, Griepenkerl.

Follow this course of reading and study by taking a few of the map problems of the School (Line Class) and solve them. By solving, I don't mean pinning the problem out and then reading the approved solution. But devoting 4 to 6 hours to writing an estimate and solution and then about 2 hours more comparing your solution with the School solution. There is no royal road to a tactical education

ENGINEERING.

Get some graduate to explain to you the method of sketching used here. Then go out and practice position, outpost and road sketches. Let the graduate criticise your work, or compare it carefully with a good contoured map. Practice map reading constantly.

LAW.

Study nothing. Be up on Army Regulations and Summary Court Manual.

The Secretary of the School will give you detailed information on subjects not fully explained above. All necessary maps, books and problems can be obtained at nominal cost by addressing him.

It is hoped that next year will see a representative from each regiment in the Line Class, and a larger representation in the Special Class for Field Officers than heretofore.

If the Line course is thrown open to 1st Lieutenants I would advise as many as possible to take advantage of it before the privilege is revoked. (See G. O. 128, W. D., 1911, for regulations governing the school.)

A NEW PHASE IN THE DEVELOPMENT OF FIELD ARTILLERY

BY LIEUT.-GEN. VON REICHENAU IN "MILITAR WOCHENBLATT," JAN. 7, 1913.

Translated from the German by Capt. A. W. Bjornstad, 28th Inf.

An important phase in the development of field artillery lies behind us—the introduction of recoil-cylinder guns in the artillery of all countries. A further development, the creation of a new form of ammunition, engages the attention of field artillery today. A third development is now making its necessity felt.

1. It is becoming constantly plainer that the present flat-trajectory guns are too heavy.

2. No horse artillery can follow the cavalry in extensive operations in all kinds of terrain; none has at its disposition a sufficient ammunition supply.

3. Because of its weight no modern light artillery gun is able to accompany the infantry attack; moreover, the modern shield does not give (for this purpose) sufficient protection against infantry and machine-gun fire.

4. With their present construction neither flat nor curved trajectory pieces are suitable for combat with aircraft.

From these conditions there must result a development resting not on a mere demand for change, but upon certain sharply defined tactical requirements.

When recoil-cylinder guns appeared and were adopted for flat trajectory use the problem was the designing of a model which, as to total weight, would be better suited to the requirements of light artillery than the last types of non-recoil-cylinder guns. When an actual, though not considerable, diminuition in weight was obtained, it was hoped that the new type could be used for horse artillery as well, since the total load could be lightened by the weight of passengers and seats at least. But this was a false hope that was not to be realized in practice, as was demonstrated long ago, in Scharnhorst's tme, in connection with the determination of the continuous work, for long periods, that artillery teams could do. The old error of overloading was soon admitted, and first in France, the land of

the heaviest types of guns. After a short trial, the horse artillery declared that the horse artillery gun, because of its weight and its unwieldiness in movement by hand, was not suited for the task in hand. The failure was so pronounced that the old 3.15-inch fixed-barrel gun was restored to the horse artillery. At the same time there was inaugurated a search for a practicable gun to accompany cavalry.

This search has now extended over the unusually long term of twelve years and yet today it can not be regarded as ended, as the French have been compelled to admit.

The reason for this failure must, in the main, be charged to the circumstance that in trying to live up to the perfectly sound principle of employing a uniform projectile for flat trajectory guns the proposed light model gun was given the ammunition of the heavier (infantry) gun. But when we fire from a gun a projectile considerably too heavy and not consistent with the construction of that gun we cause digestive troubles and, as in the case of any other excess, this continued *over feeding* will result in chronic disease and unfitness. To lighten the strain of the over-heavy ammunition upon the light gun it was necessary to shorten the barrel. Through this (ballistically considered) irrational procedure there resulted a decrease of twelve per cent in initial velocity, and probably even then without obtaining a gun that would stand in its tracks, in spite of a weight (2000—2100 lbs.) that is really not permissible. And, further, the use of over-heavy ammunition in the light gun led to another defect that, by contrast, might be called *under-feeding;* that is, the number of projectiles that it is possible to carry in the battery is severely limited. As a result, the horse artillery, frequently separated from the ammunition columns by great distances, may exhaust its supply too early. The very light limber of the French trial gun (gun and limber weigh about 2975 lbs., leaving about 900 lbs. as weight of limber) can carry only 12 shell, rather an unfavorable outcome in design when coupled with the necessity of carrying two kinds of projectiles—shrapnel and shell.

No gun suitable for the needs of cavalry can be built on such specifications. The arming of cavalry with carbines that approach the infantry rifle in effectiveness, and the intention, thereby expressed, of employing the cavalry's fire power more than formerly assumes the same close relation of cavalry to its artillery that subsists between infantry and its artillery, since in a fire fight cavalry

must proceed very much as infantry. However, keeping the cavalry and horse artillery together without fail in the same column is sometimes difficult when it is a matter of extensive operations or when it is desired to utilize the cavalry's mobility so as to effect surprise. Has any effort ever been made to determine whether a modern battery, equipped for action, can follow the frequent cross-country movements of cavalry with the diminished draft power resulting from assumed campaign or battle losses of draft animals? Such a test would demonstrate very clearly that a horse artillery gun can be designed only on the basis of a projectile materially lighter than that now used by light and horse artillery. To insist upon the heavy projectile for the horse artillery gun leads only to fruitless groping, as the French failure demonstrates.

If we wish to have uniform ammunition for all flat-trajectory field artillery we shall be obliged to give the light artillery the light projectile of a practicable horse artillery gun. An attempt to reverse this propostion will not succeed.

Many still hold to the opinion that the flat-trajectory gun requires the great projectile-weight now in use. But this contenton still lacks the substantiation of comparative tests. The effectiveness of a gun is assured if its range corresponds to battle distances, if its projectile can destroy artillery material, masonry (such as is found in villages and around enclosures) and light overhead cover or penetrate the latter, and finally, if the projectile can make itself seen with sufficient clearness to permit the correction and control of fire. All else relates to quantity of ammunition, ease of handling the gun and simplicity of firing methods. We have no war experiences pertinent to these points because, wherever modern guns have found employment there have been no light guns of the same system or type to form the basis of a comparison. However, the fact, now frequently emphasized, that modern field artillery has been disappointed with its effectiveness, deserves serious thought. Can its deficiency be lessened in the least by a still further increase in the weight of projectile? Hardly. From many French sources we have reports of the complete failure of the model 1897 gun in the Morocco campaign; these reports do not justify an affrmative answer. A participant in this campaign, Captain Féline, whose book "L'artillerie au Maroc" appeared a short time ago, speaks therein of the "collapse" (*bankerott*) of that gun. It is in particular charged that the gun was

much too cumbersome in action against rapidly disappearing targets. A cumbersome gun and a heavy projectile are, however, inseparable.

Even the *mobility* of the light artillery gun has not always sufficed. In the Manchurian War as well as in the more recent Balkan War, Russian and Turkish guns were captured because, on account of their weight, they could not be withdrawn in time. There is no detailed informatiton available as to whether the artillery of the attackers in the Balkan campaign was sufficiently mobile. Being always on the offensive they laid down the law for the opponent, and moved when ready.

In general, however, it is to be observed, that the efficiency or inefficiency of material is often better demonstrated by means of suitably arranged tests than by experiences gained by actual use in war, because in the latter case success and failure depend upon so many partcipating factors over which artillery has no control. In any case it is better to let our tests demonstrate the truth, as far as possible, rather than to await the outcome of a war.

Returning to the question of the weight of projectile, I maintain that if we produce a horse artillery gun whose mobility and effectiveness suffice (and with the technical means now available, this can be done), then the ammunition designed for this gun can be used by the light artillery gun. With the introducton of such ammunition and the corresponding gun no violence would be done to light artillery service, since it can not be too strongly emphasized that the light artillery is in urgent need of a light gun in order to be able to accompany the infantry in its difficult advance to the attack. It is plain that in such a movement the artillery teams can not show themselves within infantry range. They can only bring the carriages as far as the last cover. From this point, however, the unlimbered gun and the necessary carriages must be pushed forward by the personnel behind shields and, if necessary, must be pulled by others. For this purpose fittings similar to those found on the French experimental gun are required. That this kind of movement by hand can succeed only with considerably lighter matériel scarcely needs to be pointed out, but it is so urgently necessary that we provide for such contingencies that every means therefor should be investigated.

There have been periods in which the ballistic efficiency of guns was more in harmony with the tactical task than is the case today. Thus, the principal field gun of the Napoleonic era, the smooth-bore six-pounder, was a terrible weapon because its mobility and the short

range of the infantry musket permitted it to reach positions from which it could jump decisively into the fight. In the hail of grapeshot of guns that swung swiftly into action the attacking infantry enjoyed a fire support the equal of which has not been seen since those days. Today we require other means to produce such effect. These means are lightness in gun and caisson, reliable protecting shields for the crews, and a firing method so simple that it can be mastered by each man, since each is a potential "last survivor" and hence a potential one-man gun-crew.

The real power of artillery, in a fight where it is linked with infantry in attack, cannot be utilized when the artillery takes up positions far in rear, perhaps even when the guns are behind hills. The counter batteries in the second line must protect the infantry batteries against the defender's artillery; if this is done, and if the other conditions referred to are fulfilled, the infantry will again acquire a battle ally with an offensive power even superior, relatively, to the old grape-firing cannon.

Is it not significant to note the fact that, as a result of her experience in the last African campaign, Italy is considering the reintroduction of grape because the present-day projectiles were not in a sufficient degree able to ward off short-range attacks? So great is the desire for more powerful artillery support that, to meet the emergency, it has been proposed that mountain guns accompany the attack. But if these guns were made light enough for this function, their adoption would result in an additional type of gun and projectile; therefore introducing a complication instead of the uniformity sought for.

All these efforts must convince us that the days of the heavy flat-trajectory gun are numbered; otherwise we must hold the view recently expressed in France by the employment of flat-trajectory guns for high-angle fire—a boasted new discovery, but in reality a device long ago laid aside by us. If it is expected that by such means the introduction of field howitzers (now lacking in France) can be avoided, it will in the end be found that the effort to kill two birds with one stone will, as a matter of fact, create two deficiencies—an inadequate howitzer and an over-heavy gun. The projectile of the gun is too light for high-angle fire. Its effect against living targets may be sufficient, but its power of penetration will not suffice for the destruction of the artificial cover that will be employed

in prepared positions. Furthermore, its angle of fall will not be great enough for many of the tasks of howitzers.

For these reasons the howitzer is growing in favor, and there is in many places an inclination to increase the number of them. The greater the number that is provided, just so much greater is the justice of the demand for a light flat-trajectory gun to supply, without fail, artillery effect in places and at times that are beyond the howitzer because of its insufficient mobility, on which account it would generally arrive late, if at all. And arriving late is frequently of no more use than staying away.

In this connection it is worth while to record the fact that Italy has chosen 2.56 in. as the caliber for her new mountain gun and 2.76 for her new horse artillery gun. Nothing but a long trial can determine whether these types will do.

The tendency towards the introduction of lighter guns receives further support by reason of the influence which the development of aircraft will exert upon changes in field guns. The possibility of obtaining, by means of aircraft, invaluable reports and information of incalculable value concerning the enemy, demands that we provide the most thoroughgoing means for protecting our aircraft against damage. This can be done practically only by artillery fire, and on that account (and by means of special devices such as are found in automobile guns) *all field guns* must be able to participate in the fight against aircraft. The howitzer will continue to be too cumbersome for this purpose, but the *flat-trajectory gun* at least must be so constructed as to be a dangerous enemy for aircraft. But this can be done only by employing lighter guns that permit rapid sideward changes.

The future field gun must be a complete unit ready for ground or air targets. Of the problems to be solved in this connection the most difficult one will be to equip the gun with a simple type of projectile suitable for both classes of targets.

Along with the necessity for energetically overcoming aircraft, there presents itself another factor which with equal force drives the artillery along new lines. The development which has so far only incompletely met the demands of land tactics, will persist until it meets the demands of air tactics—and to the advantage of artillery in both fields of usefulness.

There can scarcely be any doubt but what the requirements as to construction that have been touched upon here are in accord with the tactical situation as it has developed, and that these specifications

may be recognized as problems in development which press urgently for their solution.

To summarize the basic conditions imposed by tactics:

1. For its service far in front of the huge modern army as well as for its extensive operations on or near the battlefield the cavalry requires artillery with such mobility and ammunition that it may support the cavalry constantly and effectively.

2. Because of the constant increase in the effectiveness of infantry fire and of the fire of the increasing number of machine-guns, infantry must be heartened and aided by a part of its artillery which, for this purpose, will stick to it closely in attack.

3. Finally, we must find means whereby aircraft may be checked in their reconnaissance work, and whereby such aircraft as appears within range may be destroyed by artillery fire.

The requirements which have been sketched very briefly present many vital questions for the artillery and, therefore, for the whole field army.

PRACTICAL SUGGESTIONS AS TO THE CONDUCT AND DIRECTION OF FIRE BY A BATTALION COMMANDER.

BY MAJOR BROOKE PAYNE, 2ND FIELD ARTILLERY.

The following remarks are intended to serve merely as a nucleus around which may be permitted to crystallize any unsettled ideas on the subject that may have been suggested by a study of the few pointed paragraphs relating thereto in our 1911 Drill Regulations for Field Artillery.

They may serve to focus and materialize one's notions concerning the matter; his finished work will possibly bear little resemblance to this first model.

(1) Advance to and occupation of position.

This matter is well covered in Drill Regulations, but one or two practical questions are left open to doubt.

(a) What shall be done with the Headquarters Detachment?

If a battalion commander moves forward from his point of subdivision for action accompanied by his Adjutant, battery commanders, agents, horse holders, headquarters detachment, and mounted orderlies, he will start out with something like twenty-four mounted men; his party will resemble a half troop of cavalry. This will not do, of course.

The artillery is an auxiliary arm; it will be given a definite mission on the firing line to supplement the work of other troops, and will be assigned an infantry support.

As a rule it will move into areas previously covered by friendly troops, and will move under the protection of its support. Normally, therefore, it would seem that its scouts need not accompany the battalion commander on his reconnaissance, but might better be employed to act as mere ground scouts, route markers, and to maintain contact between the battalion commander and the head of his command; and furthermore, only so many of them as are actually needed should be employed. Scouts preceding the battalion commander can not know where the latter is going; he doesn't always know that himself. Also they needlessly expose themselves, perhaps the location of the guns, and have been known to get lost or to mislead.

The guns being in position, however, the place for the scouts to operate naturally becomes to the front or on the exposed flank.

(*b*) Who shall accompany the Battalion Commander on this reconnaissance?

At least the Adjutant, the Commander of the leading battery (perhaps all three), the agents and one horse holder—seven men instead of twenty-four.

(2) Fire control.

We will assume that the battalion commander has selected the position for his batteries (in a continuous line or separated); has identified his targets or sectors of observation; has indicatetd to the leading battery commander (or to all three), where his battery is to be placed, in a direct or indirect position; has despatched an agent to bring up the battalion, and another to place the combat train, etc. The next question confronting him is: how shall I adjust on the target?

Three distinct cases here present themselves, which will be designated as cases 1, 2, and 3.

And these cases are differentiated with respect to the nature of the target to be attacked, and not with respect to the grouping of the batteries of the battalion. For, with a complete system of telephone connections between the batteries and the battalion commander, it is immaterial so far as the conduct (or direction) of fire is concerned whether the batteries are formed in one continuous line or are separated by intervals, since so far as control is concerned the conditions are identical.

Whether you talk to a battery commander a few feet from you or phone to him a half mile away, it matters not so far as your *control* of him is concerned. The degree of perfection of this control will, of course, vary with the efficiency of the phone system; but imperfections in this material (while so far quite common) must give rise to exceptional cases which differ only in the time involved, and not at all in principle.

Case 1.—A battery will effectively cover a front of forty mils, or it will effectively cover four separated targets whose separate fronts do not exceed ten mils each. Thus if the target to be attacked by the battalion does not exceed forty mils of front, adjustment must be had by the batteries in succession. For example, if the target is a portion of an infantry skirmish line, a two-hundred yard bracket will be determined; if it is an infantry trench, a fifty-yard bracket will be sought.

The commands of the battalion commander may then be as follows:

"Case 1; Right Battery the Adjusting Battery; fire when ready." The right battery proceeds to get the appropriate bracket and reports "Right Battery adjusted."

The Battalion Commander: "Center Battery verify short limit." (The two remaining batteries should be kept laid at the last data announced by the right battery during the stages of its adjustment. This data is either heard by them or, if separated, is phoned to them from battalion headquarters which is near the adjusting battery.)

The center battery then fires a salvo at the short limit, corrects the range, corrector and distribution from the sense of the shots, and lays its guns with the data thus corrected.

The battalion commander having observed the discharge of the guns of the center battery, commands: "Left Battery verify short limit."

The left battery similarly fires a salvo at the range, etc., last announced by the *adjusting* battery and corrects as was done by the center battery.

The battalion commander then commands: "Walk through by volleys, ten seconds interval between batteries." Batteries will then fire single volleys, ten seconds apart in succession from right to left with data at which they are laid, and continuing at the stated intervals, will progress through the target with bounds of one hundred (or fifty) yards until each has fired three (or five) volleys.

The length of the bound and the number of volleys fired by each battery will either be prearranged upon reconnaissance of target, or may be conveniently added to the last commands noted above.

If firing on a battery the commands will be precisely the same with appropriate modifications as to bounds, prearranged, or stated in the command.

This scheme assumes that the battalion commander is exercising fire direction. Should he desire to exercise conduct of fire, he merely acts as battery commander of each battery in succession; his commands are then to be found in the Drill Regulations.

Case 2.—If the target to be attacked has a front as much as one hundred and twenty mils, or if it may be arbitrarily divided up into three parts that are well separated laterally (and perhaps longitudinally) simultaneous adjustment will be undertaken.

While it is quite true that adjustment may also in this case be successively performed, it is not desirable that it should be so; for effect must be produced as early as possible.

The batteries in Case 2 will converge their fire on the right end of the sector of the target assigned to each, or will cover their particular groups which in this case are assumed to be so separated as to permit simultaneous adjustment.

The battalion commander commands "Case 2; fire when ready." Each battery will get its appropriate bracket, lay its guns at the short limit of this bracket, open up its sheaf so as to cover the entire front of its target, and report itself adjusted.

The battalion commander then commands: "Verify short limit by salvos, ten seconds interval between batteries." Each battery will then in turn from right to left fire one salvo ten seconds after preceding battery, and correct its distribution, corrector and range. (The range is corrected by the sense of the proportions of over and shorts.)

The battalion commander then commands: "All batteries walk through." All batteries will then open volley fire independently, the length of the bound and the number of volleys fired by each battery being either prearranged, affixed to the last command, or left to the discretion of the battery commanders.

This scheme assumes that the battalion commander is exercising fire direction.

The necessity for early production of effect and the impossibility of the battalion commander conducting the *simultaneous* adjustment of three batteries, forces fire direction upon the latter officer in this Case 2 with its broad front of target.

There are, however, two special situations which arise under this case which will be considered separately. (a) The guns of the battalion are in a position for indirect laying, and only the battalion commander can observe the fire. He will therefore exercise conduct of fire. He will designate the adjusting battery, conduct the fire, and open the fire for effect. With the front assumed, he may either control the adjustment of each battery in succession (which is a slow method against moving troops, but a good method against an obstacle or immobilized material); or he may adjust the fire of one battery, verify with the others and control the successive volleys. The latter alternative is better for fire against a skirmish line, for example.

His commands in this situation (a) would be: "Right Battery the Adjusting Battery, aiming point, etc., commence firing," acting precisely as a battery commander.

Then: "Center Battery the Adjusting Battery, etc., *** commence firing;" similarly with the left battery—if separate adjustment by each battery is desirable in order to destroy matériel. Or, if firing from this masked position on an advancing skirmish line and conduct of fire were necessary, his commands would be: "Right Battery the Adjusting Battery, etc., *** commence firing," and having satisfied himself that he was adjusted he would command "Verify short limit by salvos, ten seconds interval between batteries." Then: "All the guns,—volley fire one round, range, etc., commence firing."

(b) The second situation is only a special method of applying the first general method described above immediately under the caption, "Case 2." The target being about equal in front to that of the battalion, quick results may be obtained by adjusting with a single battery, and then opening volley fire at once for all batteries with data as determined by adjusting battery. This method is reliable if the range is the same from all batteries; but if not, there is no "getting around" separate and simultaneous adjustment.

Case 3.—If the front is too narrow or the targets too much bunched together to permit simultaneous adjustment, and yet the front is too great or the number of target-groups too many to be effectively covered by one battery alone, then successive adjustment becomes necessary.

This case differs only slightly from Case 1, and in that the targets or portions of the target will not be identically the same for the three batteries. It is true that the fire effects may overlap but they do not coincide as in Case 1.

The procedure and commands will be precisely as in Case 1, except that the definition of each battery target must be distinctly given to the battery commanders.

SUMMARY.

The adjustment by any battery (in the battalion) that will not participate in the fire for effect is useless unless the remaining two are, at once, to take up fire for effect based on the data obtained by the adjusting battery; in this case separate adjustment by the two remaining batteries is not always necessary (as was pointed out above), though they each should preferably fire a verifying salvo.

The selection of the adjusting battery should be determined in a large measure by the distribution of ammunition.

Two general methods seem, therefore, to present themselves to the battalion commander.

1st. To adjust by each battery in turn, suspending its fire as soon as adjustment is attained, and uniting it in the end in the fire for effect.

2nd. To adjust by one battery only, and then to open for effect with the two remaining batteries, based on the adjustment obtained by the first.

Any other method seems to be merely the exercise, by the Major, of fire control of three batteries separately and in succession, and therefore results in the Major's performing successively the duties of his Captains.

A RUSSIAN VIEW OF SUPPORTING THE DECISIVE INFANTRY ATTACK WITH ARTILLERY.

Translated from the German from an article in Mitteilunger uber Gegenstande des Artillerie und Geniewesens.

BY LIEUT. G. A. WIESER, 15TH INFANTRY.

The question of mutual support and a more united action of the several arms has recently been the subject of much discussion. In this category should be placed the universal demand for supporting the infantry attack with artillery and for moving the artillery to within closer proximity of the enemy.

To clear up the point of accompanying the infantry by artillery seems to grow more difficult with the increase in range and efficacy of the field artillery fire, and it cannot be settled at the present epoch of powerful quick-fire arms by simply ignoring this demand for such an escort in the field artillery regulations.

A requirement which can easily be met in time of peace should likewise be applicable under actual service conditions. The Russo-Japanese war does not record an example on either side of escorting attacking infantry by mobile artillery. The Russian infantry was usually about 4.2 km. to 5.3 km. in front of the artillery, which naturally precluded any joint action and support on part of the latter. And yet most regulations for field artillery contain provisions as to how the quick-firing batteries must meet this requirement.

Paragraph 471 of the German Field Artillery Drill Regulations provides that "while the infantry is working its way up to within charging distance, the artillery must maintain an uninterrupted fire endeavoring to shake the hostile infantry. The batteries assigned to this duty must keep down the hostile artillery fire which is directed on the attack. When the enemy proceeds against the artillery with fresh batteries or with those that had for the time being been withdrawn, they must be only so far considered as is compatible without minimizing the support of the infantry. Single batteries escort the attack to within the closest range. This improves the morale of the infantry and prevents reaction." And paragraph 472 states "While charging, the infantry expects the artillery to direct its fire on the points of assault until just before the assault."

The Austro-Hungarian Drill Regulations for the Imperial and

Royal Artillery, Part III, Chapter 4 (Provisional), Paragraph 81, provide "To support the attack, to imbue with new energy the perhaps now feeble advance, to quickly clinch successes gained by the infantry or to afford the latter, in case of local reverses, a temporary feeling of security, it is recommended that wherever the terrain is favorable, to have single batteries escort the infantry attack to within the shorter ranges and to direct a superior fire on those portions of the objective from which is delivered the heaviest fire on the attack. In the event that these batteries should suffer heavy losses or, even if completely annihilated, they have served a good purpose and their destruction has been crowned with glory."

The French Field Artillery Regulations of 1907 (Reglement de manoeuvre de l'artillerie de campagne), paragraph 635, are considerably more careful in this respect by saying "As soon as the movement of the infantry starts, each portion of artillery will be assigned to its proper task.

The different operations which must be taken cognizance of during an attack are as follows:

1. To resume the fire against the hostile artillery. The batteries* which have been detailed for this purpose will generally retain the positions occupied by them during the preparation.

2. To destroy obstacles which will impede the advance of the infantry (walls, abatis, etc.), to direct the fire on flank works of fortifications, on the hostile reserves in rear of the position and on troops assigned to the counter attack.

The batteries* assigned to these duties are usually taken from the divisional artillery. They will change their positions if that will give them any advantage for the execution of their tasks. For some batteries special flanking positions will be selected from which they will deliver an oblique fire over the terrain to be traversed by the infantry and to support the attacking column to the last possible moment. Some of these batteries may be ordered to rush quickly into the hostile position after a successful assault in order to open up fire on the retreating enemy or effectively meet a possible counter attack."

The French regulations for the field artillery, which embody the ideas of General Langlois and which, according to the Russian author, are the model for all other regulations for quick-firing field

*In France these batteries are simply called "infantry-batteries" (batteries d'infanterie).

artillery, have gone through three editions since 1901, none of which, however, brought any considerable change with the exception of the article on "Escorting the Infantry in the Attack." The Russo-Japanese War, which saw the first actual test of the quick-firing field gun, evidently proved to be the principal cause in remodelling this article. As a matter of fact, the same paragraph of the French Field Artillery Regulations of 1903, i. e., prior to the above-mentioned war, and also of 1905, i. e., immediately after that war and before the experience of the war could be utilized, reads as follows:

"Just before the attacking infantry advances the artillery, which has been engaged in the special preparation, will be divided into two parts.

"The first portion, which is taken principally from the divisional artillery, escorts the attacking infantry, and, in order to at all times render the latter material and moral support, must not lose sight of the following points:

"1. To follow the infantry in echelons and by leaps and in case of necessity it must open fire on the enemy from the closest possible range.

"2. To pay no attention to the hostile artillery in case the latter should endeavor to re-enter the action because this is the duty of the batteries in the second fraction.

"3. To break all opposition as soon as possible which is directed against the advance of the infantry. For this purpose it may assume any formation adapted to the terrain without permitting itself to become scattered.

"4. To select flank positions from which to maintain an uninterrupted fire up to the last moment, thus furnish the attack with a certain amount of animation which is absolutely necessary to the success and also to properly guard against counter attacks.

"5. To proceed quickly to the hostile position after it has been taken by the infantry, to force the defender's troops completely back and to prevent any possible counter attack.

"The batteries of the second fraction remain, as a rule, in the positions which they occupied during the special preparation. Their duties consist of the following:

"1. To continue the fire against the hostile position so long as it does not expose one's own attacking force to any danger and thereafter to direct the fire on the hostile reserves.

"2. To promptly combat any hostile artillery with the greatest energy.

"3. To observe all approaches leading to and from the enemy's position (woods, defiles, etc.) by means of which counter attacks can be made."

Comparing the verbiage of this paragraph of the French field artillery regulations of the 1905 and 1907 editions, one cannot help noticing the complete change of views within such a short space of time of the most prominent French artillery officers concerning the "escorting of the infantry by artillery." The former regulations were very concisely worded, clear and to the point, the principle of the conscientious escorting of infantry by artillery without any restriction or uncertainty was distinctly pointed out, while this doctrine in the new regulations is barely perceptible, although the duties which the infantry batteries are called upon to perform are enumerated in detail.

This same principle can be read between the lines in paragraph 635 of the new French field artillery regulations. The artillery can take possession of the position just carried by the infantry only if it follows the latter at very close distances, in other words, when the artillery escorts the infantry.

It would indeed be interesting to learn the views of the Russian field artillery regulations on this particular point, but, unfortunately, such regulations have as yet not been issued since the war.*

When probing more into the question of escorting the attacking infantry by artillery one cannot help drawing the conclusion that this requirement is, under modern battle conditions, generally impracticable when it is most desirable.

The artillery, while maneuvering within the effective zone of modern rifle and shrapnel fire, cannot at all be compared with infantry and cavalry in the matter of vulnerability and the extent

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* The only pertinent official auxiliary works at present are the "Instructions for Combat Operations of Detachments with the Three Arms" and the "Guide for Employing Field Artillery in Battle," by Lieut. General Iwanow. Both works are dated 1904, and the latter-mentioned book "Guide," etc., is prepared for the old artillery. So far as the so-called "Project" of Part IV of the regulations, "Combat," is concerned, it may be said that the book is almost obsolete, having been published in 1900, and it cannot be recognized as an official publication because it did not emanate from the Russian general staff and the copies which had already been circulated throughout the army were ordered destroyed by the general staff. The last private edition of this "project" of 1907 even led astray an associate of the "Artilleristische Monatshefte" (edited by General Rohne), who mistook the book for a project of some Russian artillery regulations "based on the experiences of the last war." (See Artill. Mon. No. 36, Dec., 1909, Blume: "What can be learned from the war in East Asia of 1904-05 regarding the employment of artillery in a campaign?").

of losses. Infantry, as a general rule, has less mobility, but this arm is greatly adaptable to the terrain and its formations permit of considerable flexibility. In the prone position the infantry soldier reduces his vulnerable surface by about one-half, even when he exposes himself on perfectly open and level ground. There are, however, mostly always slight folds in the terrain which offer at least partial cover.

In contradistinction to the infantry soldier, the cavalryman offers a considerably greater vulnerable surface, which increases in proportion the more lateral his movements are with respect to the enemy. But this drawback is partly counteracted by the superior mobility of the mounted soldier.

The artillery, however, offers a large target to the enemy, and it is neither adaptable to the terrain nor has it very great mobility.

While with infantry and cavalry the disabling of single soldiers or horses, or even of entire platoons, does not at all impede the advance of the other troops, it is entirely different with artillery. In this arm, not only when a horse is wounded but even the accidental stumbling or fall of an animal causes the gun to come to a standstill. A gun here represents a fighting unit. In some cases such occurrence may cause a delay of no small moment to the entire column in rear. This sudden stop of single guns or probably of the whole column, which resembles the change from the moveable to a stationary target, may entail heavy losses. The color of the horses, which is in contrast with that of the terrain, makes the artillery all the more visible.

The heavy losses to be expected by the artillery at the shorter ranges would be justified only if corresponding advantages are thereby gained for the other arms, in other words, the artillery should not be needlessly exposed because a certain movement had been decided on as part of the program.

To attain good results in firing with the modern quick-firing field artillery an approach to within 1700 m. (1860 yards) from the enemy is deemed sufficient. While the experience of target range work has shown that still shorter ranges increase the fire effect to a great extent, yet, when in action the artillery approaches so closely to the enemy's position it comes within the zone of effective small arms fire and is thus prevented from firing over its own troops. This is the reason why in action under service conditions in the majority of cases, the effect of artillery fire, while diminishing its

distance to the enemy, is far below that attained at target practice in time of peace.

If, on principle, the escorting of the infantry by artillery is desirable, it is due to two reasons, firstly, to give a moral support to the infantry and secondly, to make possible prompt action against a counter attack. The latter is facilitated by working in close conjunction with the infantry, and also by the more favorable opportunities for observation.

These efforts of the artillery, however, may be entirely frustrated through the activity of the hostile artillery and infantry, and instead of assisting one's own infantry, the artillery may be placed *hors de combat* or compelled to remain inactive and thus have a very detrimental effect on the infantry which it originally escorted. In addition to this, the infantry would be deprived of the valuable coöperation of several guns. Finally, the ammunition supply would be difficult to keep up, although several guns could be moved into position at a close range and the gun personnel would find protection behind the gun shields and armored ammunition wagons, it would still be almost impossible to carry ammunition to the guns.

Utilizing the natural cover in the terrain at close ranges also presents difficulties on account of the flatness of the trajectory, and at times it is even impossible because every covering feature has its corresponding dead space which can entirely nullify the support of infantry by artillery. These circumstances would compel the artillery to go into exposed positions, and thus subject itself to the full volume of the hostile fire.

As has already been mentioned, there was not a single instance in the Russo-Japanese War where infantry was escorted by artillery. And yet this proposition must not be entirely put aside as a physical impossibility. The correct solution of the difficult problem is perhaps to follow a happy medium.

To discard this theory altogether would everlastingly create a sort of a barrier between the two arms and would be synonymous with ascribing to the field artillery the term "position artillery" which could be employed only at long ranges and at a considerable distance from the infantry.

From a new construction given to paragraph 635 of the French Field Artillery Regulations can be seen that the French do not desire to entirely discard the principle of escorting the infantry: they merely discontinued some old-fashioned ways of applying this theory in practice.

The possibilities of solving this important question will be discussed in the following pages.

The first solution seems to tend toward obtaining automobile guns. Experiments in this direction have, so far, been made only with field guns for airship attack.

The next solution, which was recommended immediately after the close of the Russo-Japanese War, consisted of replacing the artillery with machine guns. But it proved unsuccessful. While a machine gun can follow the infantry anywhere, and although it can render material assistance and add a great moral effect to that arm by means of its effective fire, it nevertheless cannot at all be compared with artillery in the matter of long-range firing, nor is it of anywhere near the same value in helping the infantry to maintain itself in the captured position. There is no doubt but that such a position would be effectually bombarded by the hostile artillery against which fire the machine guns would prove almost entirely helpless in the point of range alone, and even though the range were within machine gun limits, its fire would have no effect on the artillery on account of the latter's shield protection. General Langlois of the French army states that two arms (infantry and machine guns) are always more powerful than one alone (infantry), and three arms (infantry, machine guns and artillery) are more effective than two (infantry and machine guns).

The third solution, which seems to be coming more to the front of late, lies in the organization of pack animal artillery.** The "pack animal" is here especially emphasized because its proper employment holds the key to the solution before us.

One of the first who in military literature started the solution of the question under discussion with the aid of mountain artillery was Major Knapp of the heavy artillery of the British army.*** Basing his deductions on the experiences of the Russo-Japanese War, he called attention to the fact that the Japanese troops employed mountain

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** The author first uses the term "pack animal artillery" and later on "mountain artillery." While in our service the latter term is the only logical one to use, it was thought best to give the former when entering upon this phase of the discussion, especially in view of the emphasis placed by the author on the term "pack animal."

*** "Royal United Service Institution," February 1906, June 1907. The idea of employing mountain artillery to escort the attacking infantry is, however, not Knapp's own. This method was followed by the Japanese during the Russo-Japanese War (to which Knapp refers), and in some cases by the Russians. The Japanese used mountain artillery in the most advanced skirmish lines.

artillery to escort their infantry with considerable success when the field artillery proved to be impracticable for that purpose.

The ideas of Major Knapp concerning the employment of mountain artillery were mostly all embodied in the new British field artillery regulation. (Field Artillery Training, 1908.)

Below will be given several extracts of the pertinent part of the British regulations. It will be seen how extremely careful and studied the English treat the point in question. The regulations state:

"As soon as the attack begins it must be supported by artillery which must be in the immediate vicinity of the infantry. The support of infantry at great distances is impracticable, except in the one instance when the terrain is very open. Consequently, those guns which in the early phases of the attack occupied covered positions at long ranges will gradually have to be moved forward by batteries, or even by sections, and sometimes under the protection of the fire of the batteries which remain in their positions until the former have reached favorable points from which they can effectively coöperate with the infantry attack. These changes of position involve a certain amount of risk except in cases where the hostile artillery has already been silenced or when the terrain to be covered is screened from view of the enemy. When these favorable conditions do not obtain, then the advance must be made under cover of darkness" (p. 216, Attack).

In the paragraph on mountain artillery this idea is further amplified, thus:

"Since the pack animals are completely under cover when in rear of fences, folds in the ground, bushes, etc., in case these features are of a man's height, the mountain batteries are in a position to execute movements on the battlefield entirely unnoticeable which would be impossible for field artillery batteries under like conditions.

"The mountain batteries are especially adapted to march and operate on a broad front, which enables them to rapidly cross spaces held under an effective fire of the enemy. In this respect they have the advantage over the fastest moving field artillery, because in the latter each vehicle with its animals offers a large moveable target, which is greatly delayed if even one horse stumbles or is wounded. In the mountain artillery the disabling of one pack animal does not result in any delay of the gun, and, in case that the loss cannot be replaced by a reserve pack animal, the load can generally be carried by some members of the gun squad."

"The mountain batteries detailed to support the infantry attack advance simultaneously with the infantry and will select positions which will favor the advance of that arm."

The British artillery regulations concludes its view concerning the mountain artillery as follows:

"There is no limit to the usefulness to which the mountain artillery can be put, for instance, in supporting the infantry attack, in defending woods, in advancing over broken and undulated ground, in occupying advanced positions on the defense, in counter attacks and in rear-guard actions, because mountain batteries are not confined to roads, and, on account of their extreme mobility, they will very frequently render valuable service."

The principle of escorting the attacking infantry by artillery (including field artillery) must be set forth in the regulations governing the employment of artillery in action. Such a definite and fundamental statement possesses logical force and practicability of execution. It all depends on the manner of execution. The activity of the artillery must be so regulated that the advance of the field artillery within the zone of effective hostile fire takes place with the full coöperation and support of the other artillery, which must prevent the hostile artillery and infantry from maintaining an effective fire against the advancing artillery.

The Russian author recommends the following construction of the paragraph for the new Russian field artillery regulations dealing with the support of the infantry attack:

"As the infantry begins the advance single batteries or platoons are detailed to escort the infantry to within the close ranges from the enemy. Since this advance of the field artillery within the zone of effective shrapnel and, especially, rifle fire involves the danger, on account of adverse circumstances (such as lack of cover and good communications, rain, snow, clouds, etc.) of placing the artillery *hors de combat* without fulfilling its mission, it is best to assign this duty, in the majority of cases, to the mountain artillery."

The author remarks that the inserting of this fundamental principle in the regulations is only a theoretical solution of the question. It would further be necessary to provide the preliminary conditions essential to accomplishing the object in view, which would be:

1. To broaden the view in the army at large in regard to the mountain artillery and hereafter to term it "pack animal artillery" and to speak of single batteries as "pack animal batteries."

2. To each division should be assigned pack animal batteries.

3. The proportion of pack animal batteries to the field batteries should be correspondingly increased.

What would be the proper proportion? It should not be made too great, for it must be remembered that the staying quality of the pack animal artillery is far less than that of the field artillery. Taking 60% of the entire artillery for field artillery, then the remaining 40% can be distributed as follows: 18% (or roughly, 1/6) for field howitzers; 12% (1/8) for pack animal batteries, and 10% (1/10) for horse batteries.

The author suggests that it would be a good idea if Russia would adopt the four-gun-battery system, in which event there could be formed 18 field batteries (65%), 6 howitzer batteries (21%) and 4 pack animal batteries (15%) of the 112 guns of an army corps.

The pack animal artillery should not be synonymous with the present mountain artillery, i. e., it should be equally well adaptable for work on level terrain as in the mountains.

Translator's Note.

This article seems to be of timely interest, involving, as it does, a question not touched upon in our Field Service Regulations. The major portion of the points mentioned, however, as to the general use of artillery in combat is almost identically the same as those found in our F. S. R. But for artillery to actually escort the infantry during the various stages of attack in its immediate proximity is a rather new idea, and the successful application of this theory is so far only problematical, as it has as yet not been tried in actual campaigning.

Whether the loss which artillery (field, mountain, or pack animal) in this case would undoubtedly suffer and would be compensated for in the increased fighting efficiency and general morale of the infantry remains to be seen. It seems that the disabling of an animal in a mountain battery would create a delay of similar consequence for that particular gun as that occasioned under like circumstances in a field battery. The proposition of carrying a mountain gun, in the event that an animal is rendered *hors de combat,* by members of the gun squad, under a severe artillery and probably small-arms fire, over several hundred or probably a thousand or more yards, does not appear to be a promising factor for the employment of mountain batteries for escorting the infantry attack over open ground.

The distinction made, or to be made, between mountain batteries and pack animal batteries seems more apparent than real. The term "pack animal battery" is too awkward for use in fluent English

and would most likely have to be contracted into pack battery, mule battery, or something of that nature, in contradistinction from "horse battery."

The main theory advocated in the above discussion is, as yet, in its infancy, and will have to be tested under service conditions in order to formulate a definite code of rules for supporting the infantry attack by artillery where the latter pushes forward simultaneously with the infantry, and coöperates with that arm while advancing over the same ground.

SEA TRANSPORTATION OF HORSES.

BY 1ST LT. JOHN S. HAMMOND, 3RD FIELD ARTILLERY.

The following hints on the transportation of horses on long sea voyages are the result of observations made during a voyage from New York to Buenos Aires with 70 odd head of thorough-bred racing stock belonging to Mr. James R. Keene, which were being shipped to South America for sale, in June and July, 1910.

The voyage covered a period of 25 days, and the animals were yearlings, two and three year olds, and seven brood mares in foal. The voyage was made in the summer and the heat during much of the time—and particularly while in the tropics—was intense, yet due to the excellent care taken of these delicate animals, all arrived in Buenos Aires in good condition.

With the exception of one groom, all the care-takers (nine in number) were picked up in New York during the last couple of days before sailing and knew very little of the proper care of horses. However, Mr. G. T. McDonald, who had charge of the consignment, had had large experience in shipping race horses back and forth from Europe, and to his management and energy is due the fact that no horse was seriously sick en route and that all were unloaded in really first-class condition.

A separate narrow stall was provided for each animal, and immediately after loading they were quieted by feeding hay. All stalls had been previously bedded with straw to allow urination. Four hours after the loading had been completed the horses were watered and two or three hours after watering a small feed of bran and oats was given. The sight of other horses feeding had a very quieting effect on the nervous animals. A careful inspection followed, and in the case of a few very nervous colts a sedative was given as a fever preventative.

The real troubles began after about two days out, when chills, fever and urinary troubles began to develop. The most painstaking efforts were made to keep that portion of the ship occupied by the horses at an even temperature. Thermometers were hung at various places and tarpaulins hung with great care permitted the circulation of air, but prevented any horse standing in a draft.

Each morning at five o'clock the floors and stalls were swept

clean, washed down and disinfected. The head and rectum of each horse was washed with a vinegar solution, and then a small feed of hay given. While the men breakfasted the horses and stalls were inspected by Mr. McDonald; after which metallic feed boxes were hung on the head boards, and the animals watered. All the feed boxes were kept filled with water and the horses permitted to drink all they desired. The boxes were taken down and cleaned at about 10 A. M. preparatory to the 11 A. M. feeding. This feed consisted of about a quart apiece of a damp mixture, two of bran and one of oats. A stocked horse was given a bran mash of about the consistency of thick soup. As soon as a horse had finished eating, his feed box was at once taken away and cleaned. The feed box was not permitted to remain in front of, and sicken, any animal that did not eat. A handful of nitre was mixed with the feed of those horses that did not urinate freely. This 11 A. M. feed was the only time grain was fed during the day, but hay was fed liberally at night and a smaller feed again in the morning.

At about 5 P. M. the mouths were washed out with a solution of one pint of vinegar to half a bucket of water. This dose Mr. McDonald called a "cocktail," and claimed for it great virtue. The stalls were heavily bedded for the night, and after watering, hay was fed. Each man had from 7 to 10 horses to groom and rub down. This was done during the forenoon, except in those cases where stocked horses needed special hand rubbing.

The principal maladies encountered were fever, indigestion, urinary congestion, stocking and swellings from lack of exercise. These are considered troubles which can not be prevented, while sickness resulting from improper ventilation, drafts, and sudden changes of temperature are, generally speaking, preventable. On this voyage, by constant care and attention both day and night, these latter sicknesses were practically eliminated.

Briefly, the unpreventable sicknesses, enumerated above, were treated in the following manner. Horses having fever or high temperatures were given Garstin's Fever Mixture and on every second day an injection of two ounces of pure olive oil. Doses of salt-petre usually relieved urinary congestion. Feeding but one small feed of grain a day, and in some cases nothing but hot bran mashes, alleviated indigestion, and the swellings resulting from lack of exercise were cared for by vigorous hand rubbings. No animals were bandaged except for bruises, and no blankets were used.

As the application of this simple system resulted in the delivery of the animals in Buenos Aires in such condition that all horses were sold at auction at high prices a few days after their arrival, the above observations are set down as helpful hints to persons having charge of like shipments.

THE ARTILLERY AT WILLIAMSBURG—MAY 4TH AND 5TH, 1862.*

BY CAPT. J. H. STEVENS, 2D FIELD ARTILLERY.

It was towards noon on May 4th nearly twelve hours after the last Confederate troops had evacuated their trenches on the Yorktown-Warwick line, before any pursuit was begun. This long start combined with the slowness of the cavalry, made it nearly 3 p. m. before contact was gained with the Confederates on the main Yorktown-Williamsburg road at a mill-dam about two miles from Williamsburg, where a breastwork had been thrown across the road. A section of artillery was ordered up and put into position at less than 300 yards from the enemy. After a few rounds it was found that the enemy had retreated, and he was not again encountered until the pursuers came in sight of the prepared position in front of Williamsburg.

The position consisted of a chain of redoubts across the Peninsular from the York river to the James. The principal work, "Fort Magruder," was on the main Yorktown-Williamsburg highway. Ravines, in which trees had been felled to clear a field of fire and form a kind of abatis, extended northeast and southwest from this road in front of the position.

The Cavalry Division which was leading the pursuit consisted of four regiments and one squadron of cavalry (1st and 6th U. S., 3rd Pa. and 8th Ill. and Barker's squadron), with Benson's, Gibson's Tidball's and Robertson's batteries of horse artillery. Part of this command had been sent under General Emory to the left so that at this time the force in front of Fort Magruder consisted of two regiments of cavalry (1st and 6th regulars) and one battery.

As the advance guard approached the clearing about eight or nine hundred yards in front of Ft. Magruder, Gen. Cooke, who was in command, says that although a considerable force of infantry, cavalry and artillery were in plain view, he thought that he might by boldness push on, especially as he had learned that there was a forest road which turned the enemy's right. (Report Cooke R. R. 12-427.)

Fuller's section of Gibson's battery was, accordingly, put into

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* A paper prepared in the course in Military History, Army Staff College.

action at (1) against Ft. Magruder. This fire was returned by the infantry and artillery in Ft. Magruder and the adjacent works; whereupon the remainder of the battery was brought up and the whole battery moved forward to a larger clearing at (2)† where it was supported by three squadrons under Lt. Col. Grier, placed in the ravine to the front. The Confederates had occupied Ft. Magruder and the adjacent works with Semmes' and Kershaw's brigades and Manley's and McCarthy's batteries. The cross fire of these batteries and the fire of the infantry whose numbers continued to increase, proved too severe for Gibson's battery to hold the position. Therefore Gen. Stoneman, learning that Hooker's division was not within supporting distance, ordered a withdrawal. Some of the carriages of the battery had become so much mired that it was impossible to extricate them under the enemy's fire, so one gun, three caissons, and one caisson body had to be abandoned.

Some cavalry skirmishes had taken place on the right in an effort to turn the Confederate left flank, but Gen. Stoneman decided that nothing further could be done until the arrival of the infantry, which came up too late to do anything that evening.

COMPOSITION OF THE ADVANCE GUARD.

The strength of the advance guard does not here concern us, but the artillery with it does. Did the situation warrant a departure from the rule, that frowns on putting artillery with a small cavalry force, especially an advance guard of a flank guard? The country was unknown and wooded, and in many places it was low and swampy. It is true, the battery performed the useful service of clearing away the enemy at the mill-dam, two miles from Williamsburg, but this was so easily done it leads to the conclusion that it could have been accomplished just as easily by the cavalry alone. But whether useful in one case or not, it should not blind us to the disadvantage of having the advance guard, especially in difficult country, tied down to the road, unable to move freely to right, left, front or rear, or to deploy without always thinking of the artillery and its protection. If the enemy is met in force the battery is silenced, the cavalry is not strong enough to take the offensive and the whole action of the cavalry is likely to be expended in defending or trying to extricate the battery from a ticklish situation, as happened in this case, resulting in the loss of one gun and three caissons. There can be no

†See map.

Jones Pond
College Creek
R.F. 1/21120
WILLIAMSBURG
Queen Creek
WILLIAMSBURG BATTLEFIELD
Tutters Neck Pond
HOOKER
PECK
Fort Magruder
SMITH
Whiteman Swamp
ROAD TO YORKTOWN
Kings Millpond
King Creek
KINGS MILL
(OLD ALLEN WHARF)

doubt but that the battery was a hindrance to the advance guard in this case.

OBJECT OF GEN. COOKE'S ATTACK.

Gen. Cooke states in his report "that although there was a considerable force of the three arms in front, I assumed that it was only a rear guard of a few regiments or a legion; that I might by boldness push on, especially as I received a report that there was another forest road which turned their flank, and sent an order to Maj. Williams, commanding the 6th cavalry, to take that road and attack the enemy's left flank." This left him with only one regiment and one battery, a very insufficient force to attack several regiments and artillery in position, as he could not expect that the enemy would not have a sufficient cavalry force on his left to meet Maj. Williams' regiment without dividing his infantry. Gen. Cooke, had he considered what he was up against, could not have failed to realize that he would be exposed to the fire of the "several regiments" mentioned and at least one battery of artillery, probably more; and that therefore he could have no chance of accomplishing anything by an attack. To put a battery into action against such odds with only a small cavalry support was almost sure to expose the cannoneers to annihilation if they remained to serve the guns, and the guns themselves, to certain capture.

It seems, therefore, that Gen. Cooke's attack was ill-advised and should not have been made. Had he not had the battery with him, he probably would not have attempted such an attack and his whole force on the enemy's left flank might have accomplished something against their cavalry. This is an example of how the mere presence of artillery with a small force may seriously compromise that force by causing it to attempt the impossible. The Confederate Artillery already realizing the advantages of a cross-fire, placed their guns here, so as to get that effect, and were rewarded by the results accomplished. Manley's battery of four guns were placed (2) in Ft. Magruder and (1)* in each of the two redoubts to the right. McCarthy's battery came up just as the engagement was ending. His horses were sent to bring in the enemy's guns and caissons. (Report of McLaws, R. R. 12-442.)

*See map.

OPERATIONS ON MAY 5TH.

Hooker's Division of the Third Corps, which had come up during the night on the James River road, deployed and attacked Ft. Magruder from the south. Smith's Division of the Fourth Corps, which had come up on the main Yorktown-Williamsburg road, made its preliminary deployment in the woods across the ravine, east of Ft. Magruder and (1)* in each of the two redoubts to the right cock was sent with a detachment by a detour to cross the ravine at the dam east of Jones' Pond and occupy some unoccupied redoubts on the left of the enemy's position. About one o'clock Peck's Brigade of Couch's Division, Fourth Corps, was put into position on the right of Hooker, directly in front of Ft. Magruder. The Confederates sought to defend the position by an energetic attack on Hooker's Division, enveloping his left flank, which was, to a certain extent, successful. Later in the day, Kearney's Division, Third Corps, was brought up and replaced Hooker's Division, which had suffered both in numbers and morale. Peck's Brigade was also attacked and lost heavily, being forced back but not routed. The cavalry and horse artillery were on the left flank near King's Mill opposed by the Confederate cavalry, but took no part in the action.

OPERATION OF THE UNION ARTILLERY.

Hooker's Division had four batteries as follows:

Battery "H" First U. S. Artillery, Capt. Webber, 2-12 pdr. and 4-10 pdr. guns.

Sixth New York Battery, Capt. Bramhall, 6-3 in. ordnance guns.

Fourth New York Battery, Capt. P. Smith, 6-10 pdr. parrot guns.

Battery "D" First New York Artillery, Capt. Osborn, 4-3 in ordnance guns.

Total ---------- 22 guns.

Smith's Division had the following batteries:

Battery "F" Fifth U. S. Artillery, Capt. Ayers, 4-10 pdr. Parrot guns, 2 Napoleons.

Third New York Battery, Capt. Mott, 4-10 pdr. Parrot guns 2 Napoleons.

Battery "E" First New York Artillery, Capt. Wheeler, 4-3 in. ordnance guns.

First New York Battery, Lieut. Cowan, 6-3 in. ordnance guns.

Total ---------- 22 guns.

The Cavalry Division had four horse batteries:

Battery "E" Second U. S. Artillery, Capt. Robertson 6-3 in. ordnance guns.

Battery "M" Second U. S. Artillery, Capt. Benson 6-3 in. ordnance guns.

Battery "A" Second U. S. Artillery, Capt. Tidball, 6-3 in. ordnance guns.

Batteries "C" and "G" Third Artillery, Capt. Gibson, 6-3 in. ordnance guns.

Total ---------- 24 guns.

This makes a total of twelve batteries containing sixty-eight guns present and available before Williamsburg on the morning of May 5th. Upon the arrival of Kearney's Division about three p. m. four more batteries were available but not made use of. The artillery of Couch's Division—4 batteries—was also near the field of operations, after the arrival of Peck's Brigade. It was also not used, except that about 3 p. m. Flood's and McCarthy's batteries were posted by order of Gen. Sumner, in reserve in rear of Peck's Brigade.

ORDERS TO ARTILLERY BY HOOKER.

Hooker ordered his artillery to be put into position in advance of the felled timber and in a cleared field to the right of the road, about 700 yards from Ft. Magruder. The first battery to appear in the open (Webber's) was opened on so heavily from the enemy's position as to drive off its cannoneers, so it had to be manned largely by men from Osborn's battery which was just behind it. Bramhall's battery then came up and went into action to the right of Webber's.* As Osborn's cannoners were manning Webber's battery, there were no men to man Osborn's battery. Thus it is seen that the attempt to move the battery across the open field in full range and full view of artillery and infantry in position, resulted disastrously. Only two of the three batteries which were up, got into position, and the third was entirely out of action. The fourth battery, Smith's, did not get up until after the other two

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*Position of Webber's and Bramhall's batteries at (3) on map.

*Position of Smith's battery at (7) on map.

had been captured by the enemy; it was placed on a knoll just inside the edge of the woods. It was practically the only artillery in this part of the field at the later stage of the action, as the Confederates had taken into their works four of the captured guns and the remainder could not be worked on account of the position of the enemy's skirmishers.

The losses here were four men killed and two officers and 18 men wounded. Forty horses were captured and as many more were killed besides others wounded and missing. *Major Wainwright reports two batteries unfit for service after this engagement, one lacking horses, and one horses and pieces. In the disposition and handling of the artillery here, there is a decided misconception of its use. It does not appear that any preliminary reconnaissance was made to determine positions which might be reached with least exposure to the enemy's fire and which might offer some chance of being able to open a sudden and concentrated fire from all the batteries at once. On the contrary each battery is put into position individually after marching over open ground, thus giving the enemy notice of the artillery positions and allowing him to concentrate on each battery separately as it moves to its position. This does not seem to have been the fault of the battery commanders, but of the higher commanders. There is a Major of Artillery acting as chief of artillery on Hooker's staff, who gives the orders to the artillery, but he does not appear to direct the fire of the two batteries he gets into position. On the contrary he finds time to go to the rear to bring up another battery,—work which should have been done by a staff officer or agent of communication. This shows one of the weakest points in the artillery organization of the division at this time, no unity of command so as to provide for directing the fire of the batteries so that they could best support each other and the infantry attack. The organization of the four batteries into a battalion under the command of a Major who realized his responsibility would have secured this.

During the early stages of the fight none of the Artillery of Smith's Division was used. About 10 p. m. Cowan's battery was detailed to accompany Hancock and a little later Wheeler's battery was sent to reinforce him. Of the remaining two batteries, Motts' was put in position in front of the woods about 12 o'clock and opened fire on a battery of the enemy which was being fired on

*Report Wainwright R. R. 12-472.

by the two batteries with Hancock. This cross fire was very effective and is the only instance of such fire being used on the Union side during the fight. This battery was, however, soon withdrawn and with the remaining battery of the division moved around to the right where it went into camp. This cross fire is mentioned by Capt. Ayers in his report as having been very effective which indicates it must have been recognized by him that such use of both his and Motts' batteries would have been of material assistance to Hancock, but no such use is made of it here other than in the case mentioned.

There seems to have been an excellent opportunity to have used Smith's Divisional Artillery from a position in its front to support Hooker and cross its fire with that of Hooker's Artillery. But as there was no co-operation among the batteries with the Division so there is none among the battalions in the corps, and apparently no one ever thought of using Smith's Artillery to support Hooker's, consequently Smith's stands idle while Hooker's is being captured.

A chief of Artillery of each corps was needed to co-ordinate the work of the divisional artillery in that corps and in this case as Smith's and Hooker's Divisions belonged to different corps, that work should have been done by the chief of Artillery on the staff of the army commander.

The horse artillery which was with the cavalry near King's Mill should have been made use of in the same way that it is proposed to have used Smith's divisional Artillery. Being on the left of Hooker, it ought to have been able to find a position from which it could have supported his attack and thus have contributed to the general result.

From the present point of view, the employment of the artillery on the Union side at Williamsburg could hardly have been worse. The cardinal principles, co-operation with the other arms, unity of direction, and utilization of a sufficient force to gain a superiority of fire from the outset, were all violated. Just how much of this was due to the space available for the use of artillery being so contracted as to be of little use, as General Heintzelman reports,* can only be conjectured.

On the Confederate side Gen. Longstreet was charged with covering the withdrawal from Williamsburg, May 5th. He had ordered R. H. Anderson's and Pryor's Brigades, Mason's battery

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*R. R. 12-456.

(6 guns), two guns under Capt. Garrett and two under Capt. McCarthy to occupy Ft. Magruder and adjacent works the night before. They were reinforced during the day by the brigades of Wilcox, A. P. Hill, Pickett and Colston, also by two guns under Capt. Dearing, three guns under Capt. Pelham (Stuart Horse Artillery), Capt. Stribling's battery of four guns, and late in the afternoon by three guns of Capt. Maurin's battery under Lieut. Fortier. This gives a total of six brigades and twenty-two guns which took part in the main engagement. G. H. Hill's division, which was still within reach, was used as a kind of a reserve, a part of it being thrown against Hancock on the extreme left. Capt. Watson's battery was also in reserve, but was not engaged.

The defence consisted in:

1. Occupation of central work (Ft. Magruder) and adjacent works by the Infantry and Artillery as ordered on May 4th.
2. Employment of the cavalry to guard the right flank against the Union force at King's Mill.
3. The offensive counter attack against the left of Hooker's Division undertaken by Wilcox's Brigade and reinforced by other brigades as they came up.
4. Employment of Early's Brigade to throw back or neutralize the threatened flank attack by Hancock's Brigade.

OPERATIONS OF THE ARTILLERY IN SUPPORT OF THESE MOVEMENTS.

Disposition to meet Hooker's attack.—Macon's battery and the two guns of McCarthy's battery were in Ft. Magruder while Garrett's two guns were placed, one in the first redoubt to the right and one in the third to the right. This disposition enabled a cross fire to be brought on the enemy, and being already in position when Hooker began his attack, they were able to co-operate with their Infantry, and concentrate on whatever target appeared to be most dangerous at any particular time.

The Artillery in Ft. Magruder and the adjacent works was attached to Anderson's brigade and under his command until he found it necessary to visit other parts of the field. When the command at Ft. Magruder and the adjacent works fell to Col. Jenkins, Gen. Stuart states in his report that he assumed the direction of the pieces in the redoubts to the right of Ft. Magruder and that, as Gen. Anderson commanded in person on the right, he frequently had to take the responsibility of despatching reinforcements

of Artillery as well as Infantry, to places obviously requiring them.

2. *Dispositions to support Wilcox's attack.*—There was no change in the position of the Artillery until about 11:30 o'clock, when Capt. Dearing's two guns came up and were put into Ft. Magruder. About two o'clock Capt. Pelham arrived with three guns which were placed in front and to the right of Ft. Magruder. About the same time Capt. Stribling arrived with four guns which took position near Pelham's battery.

As the Artillery came up it was reported to Gen. Stuart or Col. Jenkins commanding at Ft. Magruder, and assigned a target by them which contributed to the general result desired at the time. The artillery thus supported the attack by Wilcox and as the Union Infantry fell back a flank fire was poured on them which was not ceased on account of the nearness of their own troops, two shots dropping into the enemy's battery after it was occupied by Wilcox's men.

3. While the attack of Wilcox was going on and all the artillery was being held ready to support that attack, as occasion required, the artillery with Hancock opened a long range fire on Ft. Magruder. Capt. Dearing's two guns and two guns under Lieut. Clopton were sent to the left at (6)* to reply to this fire. It was here that Mott's battery of Smith's Division opened a flank fire on Dearing and Clopton, causing them to change target to Mott's battery. As Mott's battery ceased firing very soon and the battery on the enemy's right was too far to do much damage, Dearing returned to Ft. Magruder while Clopton's guns were practically retired from the action on account of fatigue and loss of men.

4. The attack of A. P. Hill and Early on Hancock which took place about 5 p. m. was not supported by artillery fire. This was clearly a mistake and largely responsible for its failure.

COMMENTS.

1. The orders to the Artillery were generally correct. They were in furtherance of the general plan desired by the commander of the troops, which is the important consideration. That part of the Artillery with Anderson's and Pryor's brigades was placed so as to cover the ground over which the enemy was expected to

*See map.

attack, and that it was well placed is proven by the fact that it continued in action there for the entire day except when a part of it was ordered to the left against a movement on that flank.

2. As other Artillery came up it was reported to an officer who was familiar with the entire situation and received its orders from him. A certain amount of fire direction and co-operation with the infantry was thus obtained which materially aided in the final result.

3. The Confederate Artillery does not seem to have been any better off as to organization at this time, than the Union Artillery, but there was displayed unquestionably a much clearer conception of its proper handling and use. The first few guns which arrived at the position are placed so as to bring a divergent fire on common objectives and fire is kept up only so long as the result justifies it: the uselessness of random shelling of woods is recognized and fire is withheld until suitable targets appear; when the occasion seems to demand it, they do not hesitate to keep up their fire even at the risk of firing on their own infantry. This is a situation which infantry should be prepared to accept, as the cessation of artillery fire at a critical moment might cause the attack to fail, but losses due to one's own artillery should be reduced to a minimum by having the infantry in an attack carry flags to signal to the artillery when their fire should cease.

CONCLUSION.

The Confederate success in standing off greatly superior forces at Williamsburg on May 5th must be ascribed in no small measure to the superiority of artillery fire gained and held throughout by them. And it must be borne in mind that this was due to the correct initial orders for the artillery on the Confederate side, to the good understanding by the confederate artillery officers of the correct principles of the employment of artillery, and especially to the co-operation of the artillery not only with itself, but with the other arms. On the other side the Union failure must be ascribed almost entirely to their failure to employ the superiority of artillery which they possessed; failure to employ correctly what they did employ and failure to have the batteries actually employed either to co-operate with each other or with the infantry. The only place where the Confederates can be said to have met with defeat on this date

was on their extreme left against Hancock and the reason for this defeat and Hancock not being destroyed was in all probability their lack of Artillery support.

It must be remembered that, due to the inexperience of the troops on both sides at this stage of the war, artillery had probably a much greater moral effect than it would have had later during the war, or even later in this same campaign.

MASKED. FIRE OF THE ARTILLERY.

BY GENERAL PERCIN.

Translated from the Journal Des Sciences Militaires for January 15, 1913, by Lieutenant Benjamin F. Castle, 29th Infantry.

Some time ago I received from a distinguished field officer of Infantry a letter complaining of the great amount of time consumed by the artillery in making reconnaissances for masked fire positions during the field exercises recently conducted by him. He asks if it is defensible for the artillery to delay the infantry while it thus consumes valuable time in assuring its own safety.

In thus writing to me my correspondent is well aware that he addresses one who has long been the champion of masked fire, and he seeks assurance as to the value of this class of fire, the conduct of which appears to him to leave much to be desired, rather than an opportunity to confound me as its advocate.

It is a fact that artillery officers devote a great deal too much time to the preparation of their fire. This, however, is because they mask, not too much, but rather too little.

This statement appears paradoxical at first glance and demands explanation.

When the mask is a vertical obstacle such as a wall, railway fill, screen of trees, etc., in rear of which the ground is almost horizontal, nothing is easier than the determination of the emplacement of the battery. It suffices to establish this far enough from the mask to insure clearance of the latter by the trajectory corresponding to the objective. With a little practice one can readily determine this distance by estimation. Moreover, there is no disadvantage in establishing the battery even farther to the rear than is strictly necessary to ensure clearance. This even has certain advantages. The projectile is sure to have clearance, and the enemy, in order to reach the battery, must beat a greater depth of ground.

The question is not quite so simple when the mask is formed by a fold in the ground. Let us suppose that the piece placed first at the crest is gradually moved to the rear. It finally reaches a point from which it would be impossible to obtain clearance for the given trajectory. At this position, or a little in advance, is the point of maximum defilade compatible with the given elevation.

If the withdrawal of the piece is continued the projectile strikes

the mask. The ground thus traversed is therefore forbidden as an emplacement.

But if the movement to the rear is continued still more the distance from the crest is found increasing more rapidly, proportionately, than the defilade, and the trajectory again commences to clear the crest. We now enter a region of great defilade from whence the projectile clears the crest "hands down"—a region which may be several kilometres in depth and where we can find as many emplacements as we may desire.[1]

As long as the artillery used direct fire exclusively it was forced to select emplacements on dominating positions assuring it an extended view in all directions. The pieces were then placed even on the very crest. At most, they were withdrawn only slightly, so that the line of sight grazed the crest. Thus was defilade of matériel obtained. The cannoneers were uncovered from head to waist.

Once supplied with sighting apparatus and methods of fire which did not necessitate a view of the objective by the cannoneers, the artillery should have completely changed its methods of functioning. It should have fixed upon the captain alone the necessity of remaining at the crest where the pieces were formerly placed, and, if necessary, should have assigned the pieces to positions some distance to the rear, in the region of great defilade; for it is not any more difficult to execute indirect fire 20 metres below the mask than at 2 metres therefrom. The emplacement should have been so selected that there would have been no doubt as to the clearance of the crest by the projectile. The proper distance in rear of the mask should have been estimated. The battery commander would thus have chosen first his post of observation and, secondly, the battery emplacement at a distance equal to the length of the telephone wire from the line of orderlies or group of signallers that are at his disposal. This was the solution of the problem to which the Japanese and Russians were led in the war in Manchuria.

During the battle of Da-tchi-tsiao,[2] in July, 1904, four Russian batteries emplaced 500 meters in rear of a crest and 25 metres below it successfully engaged 13 Japanese batteries for 15 hours. The Japanese batteries were poorly defiladed, and several times when

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[1]See:—Double solution of the problem of the mask, p. 129 of Cinq Annees d'Inspection; Chapelot;

[2]Revue d'artillerie, February, 1905. "Renseignments extraits du Rousskii Invalid," Nos. 326, 240, and 242 of 1904.

they attempted to limber rear they were prevented from so doing by the fire of the Russian guns.

The Japanese had trained their fire on the crest of the mask of the Russian batteries. Seeing that their fire was not at all affecting the volume of fire from the Russian side, they attempted to beat with sweeping fire the entire slope occupied by the Russians. They did not find the Russian batteries. After 15 hours of bombardment the 1st Siberian corps had lost only 50 men.

To carry out this system of firing, which the Japanese were not long in imitating, the Russians did not hesitate to place the battery commander as much as 600 metres from the pieces to which his orders were conveyed by telephone or signal.[1] They saw no difficulty in control at this distance; they even declared that it had its advantages in freeing the battery commander from the annoyance that the noise of the enemy's projectiles and his own pieces might cause him.

French artillerymen would never have dared to advance such a proposition. In their peace-time studies they would have feared a reflection on their bravery. It is fortunate that the idea has come from the Russians, whose bravery is unquestioned, and that it was conceived on the field of battle.

The writer of the article from which the incident related above is taken does not attempt to conceal the complete aversion that the Russians had for indirect fire at the beginning of the war.

In a memorandum dated May 17, 1905, which embodied some of the remarks set forth above and which I forwarded to the 26th Regiment of Artillery, then under my jurisdiction as division commander, I invited attention to the questions involved and directed that they be subjected to careful study.

On the 25th of August, 1905, I reported to the Minister of War the results of the practical study of these questions. The conclusions reached, as stated in my report, showed that the control of a battery from a distance considerably increased the number of available emplacements, thus making the artillery independent of the terrain and securing for it complete freedom of movement.

Formerly, said I in this report, when during a reconnaissance one reached one of those dominating positions from which all the surrounding terrain could be seen, one never failed to say, "There is

[1] "France Militaire," 28 February and 4 June, 1905. "Extraits des Nos. 23 et 89 du Rousskii Invalid."

a fine position for artillery." Henceforth one will say, "There is a fine post of observation." The battery commander will station himself at this point, but he will search the neighboring ground within a radius of several hundreds of metres for emplacements from whence the enemy cannot be seen (the only means of insuring complete concealment from the enemy), and he will select from these available emplacement positions one which, while allowing easy attainment of the objective, also insures clearance of the mask. In a word, he will seek positions in the vicinity of the observation station, and not observation stations in the vicinity of a position.

But the long-established practices of an arm are not discontinued in a day. My proposition has been considered revolutionary—too radical for complete adoption. The artillery contented itself with retouching the solution of the problem of direct fire already admitted. They withdrew the piece a little in rear of the position for sight defilade, thus accomplishing after timid trials, first dismounted defilade, and finally defilade of the mounted man.

Great was the joy among the advocates of masked fire when they read in a memorandum of the Artillery Commission, dated April 18, 1907, that: "When the mask is formed by a fold in the ground, the line for mounted defilade, liberally estimated, presents suitable emplacement for the artillery desiring to completely fulfill its role without exposing itself to unnecessary losses." But the rule thus enunciated by the Commission was only a compromise, a half-way solution—a single method of procedure for all the cases which might arise under many and varied circumstances of terrain and fire. It was only in 1908—that is to say, ten years after the adoption of the model 75 gun—that the Commission affirmed the subordination of the choice of the emplacement to the possibility of carrying out a given mission and at the same time pointed out the method of determining the maximum defilade compatible with that mission.

The rule formulated by the Commission, after having undergone certain modifications, is now embodied in the Regulations of the 8th of September, 1910, paragraph 144, Part IV. It will not be discussed here. From the geometrical point of view, it is unassailable. But its application requires the measurement of two angles on the ground, reference to the firing tables for a third, and with these three angles, one of which is frequently negative, the performance

of certain additions or subtractions, with due regard to signs, and, finally, the checking of the result of these mathematical processes to see if they readily enter the formula given by the Regulations. In short, calculations must be made. One must not determine the emplacement by estimate.

The emplacement once determined, the pieces are conducted thereto. If they are halted in advance of this point they are liable to be uncovered. In any case, they lose part of the protection that the terrain offers them. If they stop short of the selected emplacement the projectile will carry away part of the crest of the mask and burst out upon the Infantry in front. Then the pieces must be pushed by hand toward the crest, a difficult thing on rough and steep ground. The caisson carrying the observing ladder must likewise be moved by hand if it has not been established at the right spot for the observing station at the first trial. These operations are so delicate that at manoeuvers they are generally performed in a haphazard way unless an enormous amount of time is devoted to their consummation, and thus justification given for the despairing letter of my brother in the Infantry.

How much more simple and quick it is to select the emplacement in the region of great defilade. It matters little if the teams pass several paces beyond the exact position selected or halt in rear of this spot, since the projectile clears the mask "hands down" from any point in this region. Not even an error of 10 metres in the position forward or back will reduce the ordinate of the trajectory at the mask sufficiently to prevent clearance.

Glancing about from his post of observation, the battery commander can at once select the emplacement. He proceeds to that point while his trumpeter installs the telephone. The latter, having done this, follows the captain, unrolling the wire as he goes. When the battery arrives, communication has thus generally been established.

From the moment he returns to his post of observation, the battery commander is completely free to control the fire and watch the terrain. He can seat himself, remain standing or walk about. He can change his post to see the objective better; to watch our Infantry or that of the enemy; in order to search for another objective; perhaps to seek cover from the enemy's fire. He does not draw that fire on his own battery.

It is quite otherwise with the battery commander perched on his

observation ladder, where he is most uncomfortably riveted to his position. The top of the ladder projecting above the crest indicates to the enemy the emplacement, and, after ranging on the crest, he commences searching fire. I pity the captain who is obliged to remain for several hours in such a situation.

These are the difficulties that have so dismayed some officers as to lead them to consider flash defilade impracticable and to content themselves solely with mounted defilade, in the use of which they can observe the fire by climbing on a caisson or standing upright a short distance in front of the battery.

On the contrary, what these officers consider impracticable is a too timid solution of the problem. The best way to reconcile the requirements of observation and the advantages of defilade is to solve the two problems separately. That is, as I have said above, to select first the post of observation at a point from whence, without mounting any artificial elevation, one can completely survey the surrounding terrain; then to select the emplacement, not in the immediate vicinity, but far from the crest if necessary, in the region of great defilade. The lowest points behind the mask will often be inaccessible on account of woods, water courses, or habitations, but the emplacement should be located as far to the rear as possible.

When the slope behind the screen is very gentle there is no point at which the battery is not defiladed. The emplacement may be selected then at any distance from the crest, as it is obvious that the projectile will have clearance. For example, if, as frequently occurs in this country, the ground has a slope of 1/100, an objective at 1000 metres on terrain of the same slope would easily be reached from any emplacement behind the mask. It would therefore be an error to select the emplacement near the crest. The sole means of assuring cover from the enemy's fire is to be placed far to the rear.

Unfortunately, this solution is neither recommended by the Regulations nor by the chiefs of the French artillery.

Battery control from a distance is treated in the Regulations of September 8, 1910 (par. 143, Part IV), as follows: "The greatest ease of control is obtained when the captain is within speaking distance of his battery. But the advantages of flash defilade, and that obtained by the selection of an emplacement at such distance from the crest that the enemy will be unable to find the battery, often render it desirable to control from a considerable distance. This is accomplished by means of signals or by use of the telephone."

The subject is treated in the German regulations in the following manner: "When the covered position is near the mask, the captain can generally remain in the immediate vicinity of the battery, using the observation ladder if necessary. When the emplacement is at a distance from the screen, however, the post of observation is necessarily too far away for direct control. In this case, connection is maintained by the telephone. When the emplacement is near the mask, the pieces can be advanced by hand if it is desired to change to direct fire. Then, however, the flash, smoke and dust caused by the firing will reveal to the enemy the exact position of the battery.

"The more removed the emplacement is from the mask, the more difficult for the enemy to obtain the correct range. He will thus be forced to diminish the efficacy of his fire by resorting to a systematic and extended distribution of it while he is endeavoring to make it effective. This will result in a considerable expenditure of ammunition. In addition to their other advantages, these positions at considerable distance in rear of the mask often admit of control of the terrain immediately in front of the mask or, at least, quite near it. On the contrary, the distance of the post of observation from the battery is so great that control of fire is made quite difficult. A change to direct fire is also not generally possible without the use of the teams. It is true that ground can be gained obliquely, thus permitting the battery to leave the beaten zone and surprise the enemy by coming into action at a new position."

It must be admitted after reading the two extracts given above that the German regulations are much more explicit on this subject than the French regulations and that they give a better conception of the value of masked fire positions. The French regulations begin with the statement that direct control by voice is preferable. The idea is then conveyed that, although undesirable, control from a distance will *sometimes* be unavoidable. Farther on (par. 172), the difficulty of lateral observation is insisted upon. Finally, in paragraph 55, Part VI, it is said that in making this reconnaissance, the captain may, *if necessary,* be followed by men who can install a telephone for him—as if the captain would know in advance each time whether or not he would subsequently need his telephone.

In short, the French regulations treat control from a distance as something exceptional, to be resorted to only in extremity. Nowhere in the text is reference made to the War Department

memorandum published June 12, 1909, describing the method of using the model 1908 telephone. These instructions are relegated to a place in the appendix of Part IV, where only those who know that they are there will find them.

The memorandum referred to above was drawn up by Major Anglade, 3rd Artillery, the inventor of our artillery telephone. Although the German telephone is different from ours, our neighbors have, nevertheless, followed the text of this memorandum and have embodied it in a brochure, copies of which have been distributed among their officers. This copy of our instructions has been translated by the Spanish, who have adopted the German telephone. I recently found a superbly bound copy of this Spanish brochure at a Spanish bookstore in Paris.

Thus has the work of our officers been profitable to foreign nations. Such is the result of the unreasonable opposition to new ideas that has been manifested by our higher officers.

In forwarding the report covering the firing practice in 1904, General Massenet wrote: "Masked fire is the tactics of fear; its use should not be encouraged."

Two years later General Francfort said: "It appears that the lessons which our officers have sought to draw from the combats in Manchuria have inspired in them an exaggerated circumspection in the handling of their batteries. I have, therefore, attached as much importance to training in going into battery rapidly with defilade or semi-defilade of matériel (sight defilade), or even in front of the crest, as I have to the corresponding practice in completely defiladed positions."

Even General Langlois, who was one of the first advocates of masked fire, appears to fear the triumph of his ideas. In 1904 he wrote: "The artillery seeks cover too much, and thus is often prevented from taking a hand in the infantry fight. Behind the crest the captain makes fine calculations—and allows the infantry to escape."

The same year General Brugere wrote: "The artillery has an unfortunate tendency to mask the pieces behind the crests regardless of the tactical situation. The result of this is that the battery commanders make a practice of perching themselves on the caissons, from which positions they alone can see the objective. A vigilant watch over the field of battle can only be maintained by batteries that see."

During the course of his artillery lectures at the Staff College from 1901 to 1907, Colonel Fayolle evinced unceasing opposition to the use of masked fire. Making an erroneous application of the usual methods to the terrain at Froeschwiller and Saint-Privat, he pretended that masked batteries would there have been condemned in advance not to fire a single shot against the German infantry, and he exclaims: "That is what becomes of the theory of the 'always invisible' artillery on the actual field of battle." I have shown the error of this conclusion in one of my articles.[1]

In the "Journal des Sciences Militaires," page 266, issue of August 1, 1912, Colonel Potel, who has been an instructor in the school of fire at Poitiers, says: "The whole infantry battery is necessarily visible, and is therefore destined to be wiped out if victorious supporting batteries do not assure it relative immunity."

Colonel Potel thus admits that our infantry battery will only be attacked by a hostile battery whose fire we will oppose by means of supporting batteries. Would the hostile battery complacently dispense with the advantages of defilade for itself? Moreover, would the personnel of our infantry battery be so heroic as to continue the service of their guns under fire?

In a number of the periodical referred to above published July 1, 1912, Colonel Potel says again: "Control from a distance is chimerical; a battery which is not under the eye of its captain is a body without a soul; it is deprived of all efficiency and ceases to be a rapid-fire unit. The observing ladder," he adds, "will suffice for the captain when he is at his proper station, namely, near the battery personnel, whom he will watch with the eye of a master, animate with his words, and, in short, keep in hand by his whole demeanor." As if an artillery lieutenant is not qualified to maintain the morale of the battery in the same manner that a lieutenant or non-commissioned officer of infantry performs this function when, as frequently happens on the battle field, the command of a section of the line several hundred metres from his captain falls to him!

In the course in which he lectured at the Staff College in 1911 and 1912, Lieutenant Colonel Besse admitted the necessity of defilade. He even recommends that the defilade be as deep as possible, preferably more than four metres from the crest, with the condition that the battery be within hearing distance of the captain.

[1] "La Liaison des armes." Published by Chapelot, 1909, p. 45.

And he insists (page 285) that it will be impossible, very frequently, to conciliate these two contradictory conditions. Thus he says: "If the experience of a European war waged with inexperienced, nervous, and impressionable soldiers, forbids, as it probably will, control from a distance, then it will be all over with defilade—the most valuable use of the best feature of our matériel."

The reasons for Colonel Besse's arbitrary conclusions appear on page 281: "The apparatus works badly or not at all. Communication is defective. The noise of the guns drowns the voices of the operators."

All these objections appear groundless in view of actual accomplishments. For several years control from a distance has been practiced readily and with the greatest success by an officer whom I shall presently name. Formerly a horse battery commander noted for his tactical and technical skill, now an instructor in the school of fire for the District of Causses near Castres, Major Anglade has devoted himself to the task of demonstrating the fact that with telephone control, fire from deep defilade is neither less rapid nor less efficacious than fire from unmasked or semi-defiladed positions; that under this system the selection of the emplacement and establishment of the battery therein can be made more expeditiously; that changes of objective can be more easily effected, and that finally the efficiency of the battery may often be changed from zero to the maximum attainable by the simple detachment of the post of observation. (See "La Question de l'obusier" in La Vie Militaire—Alcan and Lisbonne, publishers.)

In a fire problem with service charges executed May 6, 1912, a battery was placed so as to fire on an objective at 2000 meters. While it was in this position an observer posted on a small rise 1200 meters to the front signalled the presence, a little farther off, of four hostile guns, which could be reached by our battery but which could not be seen from the captain's post of observation. The latter went at once to the observing station that had sent the signal and, by using the telephone, caused his battery to direct a plunging fire on the new objective. The fire of the battery became effective after a few rounds.

The captain did even more than this. Calling his lieutenant, he directed the latter to demolish with the two left pieces of our battery the two left guns of the hostile battery. The battery commander continued to use the remainder of the battery on the other

sector of the objective, and the two officers sent their commands to their respective platoons by successively using the same telephone. This they did without interfering with or delaying each other. This feat might not have been expected, but it shows, none the less, the use that can be made of the telephone in controlling from a distance deeply defiladed fire.

Major Anglade discusses the results of several of his fire problems in an article in the "Revue d'artillerie" for April, 1912.

The question of masked fire with complete defilade has also been discussed in the following articles: "Batterie hors d'atteinte," by Major Sautereau du Part (Revue d'artillerie, September, 1911); "Batteries a grand defilement," by General Herment (Revue d'artillerie, November, 1911).

It is well known that recently Germany has adopted a light field howitzer which will be used in deeply defiladed positions in the valleys, from whence they will reach our guns while we are unable to reply. Therefore, many of our officers demand that we follow the example of the Germans and introduce into our field armament a number of howitzers. If this is done, we must necessarily soon come to the use of masked fire with deep defilade. Therefore, let us practice this class of fire with the 75-mm. gun, which is perfectly adapted to it. The artillery will then be able to go into battery almost anywhere, to fire in almost every direction, and to be concealed from almost every point. The selection and occupation of emplacements will become, so to speak, instantaneous.

And thus will the accuracy of the seemingly paradoxical statement that I made above be verified:

"Artillery officers devote a great deal too much time to the preparation of fire. This, however, is because they mask it, not too much, but not enough."

NOTES ON THE EMPLOYMENT OF SPECIAL DETAILS.

Prepared at the School of Fire, Fort Sill.

(CONTINUED FROM LAST NUMBER.)

EQUIPMENT.

Although every effort should be made to keep the prescribed equipment as issued in working order, nevertheless constant use will usually develop certain faults which must be met by making certain modifications in the authorized equipment and authorizing certain departures from the method of employment laid down. Among the faults and modifications which have developed during actual use, are the following:

a. Metallic circuits can be relied upon only when wire is new and has not even been carried about to any extent. It his been found that the heavy wire will not remain a satisfactory twin-conductor after it has been repeatedly laid and taken up over rough ground and that the small battery buzzer wire will become unserviceable even without use simply by being carried about in a 5th section limber on the prescribed spool. A leather cover for spool and hand reel can easily be made by battery saddlers and will be found to be of great value in protecting the wire, but due to the necessarily thin insulation of this small wire, it is believed that time and trouble will nearly always be saved by starting in at once with ground return.

b. It is further believed that the small buzzer wire is in general unreliable and that it is advisable to improvise a small reel to be carried on the 5th section caisson so that the heavy wire may be used for ordinary battery service. This would permit the buzzer wire being kept on protected spools ready for use in emergencies only. If the heavy wire is used for battery service a permanent connection at each end can be made by the use of a substantial binding post on the connectors so that it is necessary only to plug in the cords in order to establish communication.

c. When the small wire is used the connection made by the steel points in the connectors is often faulty. This is another reason for doing away with the regular use of the small wire and is also a reason for modifying the connectors so that binding posts instead

of steel points are used. If binding posts are not used it will be found advisable to double the wire so that there will be more surface for the points to pierce. These steel point connections belong to that class of devices which are satisfactory only when used under the most advantageous circumstances. Telephone service in Field Artillery, when it is needed, is needed badly; and no device which depends upon advantageous circumstances for its successful use should be retained. Binding posts consume more time but they are sure means of obtaining a good connection.

d. It is important that signal men realize that battery cells deteriorate while in storage and they should not depend on the successful working of a cell simply because it has recently been issued to them. A cell should be tested as soon as it is received by the telephone detail. For this purpose at least one volt-ammeter should be provided in every artillery command and put at the disposal of signal details for testing purposes.

e. The signal flags as issued are in pairs, one red with a white center, the other white with a red center. This, of course, makes one flag or the other appropriate for use with certain backgrounds; but a pair of flags of this kind is not entirely suitable for semaphore signalling at any distance because if the background is suitable for one flag it will not be suitable for the other. Both the sender and the receiver should be equipped with both colors of flags and should use a pair of the same color, depending upon the background.

TECHNICAL INSTRUCTION.

The instruction of details in telephoning and visual signalling is covered completely in Lieutenant Dawson Olmstead's pamphlet on "Battery Lines of Communication" and the theory and practice of telephone communication as therein laid down should be gone over carefully until all the men under instruction can make the prescribed connections and tests and can trace telephone troubles.

(The following additional test is suggested: insert one plug in the telephone, hold the plug at the opposite end of the cord against the brass spring of the first plug in such a way that both metallic elements make a connection, then move the transmitter arm up and down and blow into the transmitter; if the blowing and the moving up and down can be heard through the receiver, the telephone as a whole is in good order, If it is not, the trouble may be located by one of the prescribed tests.)

It is advisable to turn over a complete set of equipment in good order to a temporary telephone detail made up of men undergoing instruction and require them to keep the equipment in working order, make the necessary inspections and use the telephone daily at all drills and special hours of instruction until they are proficient. The first temporary detail can then be relieved and others detailed until all the men undergoing instruction are proficient and those best qualified for the work can be permanently detailed.

Instruction in visual signalling with flag, heliograph and acetylene lantern is best accomplished by pairing the men off so that an experienced man works with each beginner. This is usually possible because signal men are ordinarily men who have had some previous experience and it is only necessary to keep substitutes in training. In using the heliograph and the acetylene lantern it will be found necessary to make the pauses between flashes noticeably longer than in other forms of signalling. Proficiency in this work depends largely upon constant practice and some visual signaling should be required of signal details daily. If enough interest can be stimulated to make the men voluntarily signal to one another in barracks and during rests at drill, great proficiency will result.

EMPLOYMENT.

Battery Service:

In selecting positions for the actual delivery of fire, every effort should be made to get near the battery and so do away with the necessity for telephone communication or visual signals. No matter how well the telephones may be working their use always implies a certain amount of delay in the transmission of commands, a chance for error and a possibility of interruption.

But whenever there is the slightest possibility of their being required, telephone lines should be laid and communication established. For purposes of drill and instruction they should be used at least once daily during drill. This will give the signal detail constant instruction and will be a daily check upon the condition of the equipment. In a similar way commands should be sent by visual signals at least once daily.

In general the battery signal detail is organized and employed as prescribed in Paragraph 790 Field Artillery Drill Regulations.

In detail the duties and employment of the signal detail are as follows:

Signal Corporal.

1. Under the general supervision of the Chief of the Fifth Section he has charge of and is responsible for all the signal equipment of the battery. He should be required to inspect this equipment before and after each drill, to make such tests and repairs as he is authorized to make and to report all trouble which he can not remedy to the Battery Commander personally at the first opportunity. He should make timely report to the quartermaster sergeant concerning the expenditure of wire and dry cells and the need for requisitioning for such expendable material.

2. Equipped with field glass, one telephone and one megaphone he reports to the Battery Commander at the subdivision for action or at any prearranged signal as prescribed for the Chief of the 5th Section. It is important that all telephones are carried at all times on the person. It is impossible to keep them in order if they are carried in the 5th Section limber. When not in use it is better to keep them in the battery office or office tent.

3. If no telephone or signal communication is required he acts as an additional observer at the Battery Commander's station and if required, transmits the Battery Commander's orders by megaphone. This method has the advantage of allowing the Battery Commander to keep his field glasses almost constantly on the target during the delivery of fire and to transmit his commands without shouting and without pausing to turn around. It should not be used during direct fire at decisive ranges when the personal control of the battery is important.

4. If telephone communication with the battery is desired, as soon as the Battery Commander's station and the gun position are located he directs No. 2 to carry the end of the wire rapidly to the gun position, leave it with the scout who marks the position of the flank gun and return to the Battery Commander's station. While No. 2 is gone, the signal corporal makes the necessary connections so that No. 2 can plug in his telephone as soon as he returns. After communication is established he reports the fact to the Battery Commander and supervises the service. If the communication is interrupted he makes such inspections and repairs as he can. If he is unsuccessful, he reports the break in communication to the Battery Commander and gets his instructions as to visual signals.

5. When a reel of field wire on the Fifth Section caisson is being

used instead of the prescribed equipment, he indicates the position of the Battery Commander's station and the kind of communication desired as soon as it is possible for him to communicate with the privates of his detail, both of whom, in this case, remain with 5th Section until after the battery has reached the gun position. The telephone corporal then supervises the paying out and reeling up of the wire and the establishment of communication and performs his other duties as herein prescribed.

6. If battalion telephone communication is desired and there is no battery telephone communication required, he directs No. 2 to connect with the battalion line as soon as laid. He himself supervises the service, reporting the establishment of communication and all interruptions to the Battery Commander.

If battalion communication is desired in addition to battery communication the signal corporal connects with the battalion line as soon as laid and acts as operator at the Battery Commander's station.

7. If telephone communication is interrupted or if for any other reason visual signals are required, he receives messages from the Battery Commander, delivers messages to him and acts as receiver and recorder while directing and supervising the signalling done by No. 2.

8. When telephone service is no longer required he gives the necessary directions for closing the stations, reeling up the wire, and joining the battery commander. During the intervals in which he is not otherwise employed he makes such tests and repairs as are possible in the field.

No. 1 *Signaler*.

1. Equipped with one telephone, one flag kit field glasses, and one megaphone, he rides as a cannoneer on the first caisson limber of the 5th section.

2. Upon arriving at a gun position, he finds out from the scout marking the position if telephone communication is to be established and, if it is, receives the end of the wire from him, makes his connection promptly and reports the establishment or interruption of telephone service to the executive officer. He then acts as operator at the guns, being governed in the use of the telephone by the provisions of paragraph 796, field artillery regulations. The use of the word "Hello" is forbidden. When called, he should answer, "Battery" and, when calling the Battery Commander's station, should

ask for "B. C." It is important to shield the transmitter from the wind.

3. When a reel of field wire on the fifth section is being used instead of the prescribed equipment he has charge of the reel, connects his telephone as soon as possible after the battery has reached the gun position, and reels up the wire as soon as orders are received to close station. With assistance of No. 2 it will be found practicable to reel up while the battery is moving away from the position, provided the gait is not too rapid nor the changes of direction too abrupt.

In other respects his duties are similar to those prescribed when the authorized equipment is used.

4. If visual signals are to be employed, he sends and receives messages for the executive officer.

5. If the megaphone is to be used, he hands the megaphone to the executive officer and takes it from him when it is no longer required. He is responsible that it is not left when the position is changed.

No. 2 *Signaler*.

1. He is equipped with one hand-reel and spool of buzzer wire, one telephone, one flag kit and field glasses, and reports to the battery commander at the same time as the signal corporal. He is always mounted.

2. Under the direction of the signal corporal, he runs out wire to the gun position, returns, plugs in his telephone and acts as operator at the Battery Commander's station as prescribed above for No. 1. The use of the word "Hello" is forbidden. When calling he should ask for "Battery" and when called should answer "B. C."

3. When a reel of field wire on the fifth section caisson is being used instead of prescribed equipment, he remains with the fifth section until the battery has reached the gun position. At an indication from the telephone corporal that telephone communication is desired, he takes the end of the wire from No. 1 and rides with it as rapidly as possible toward the Battery Commander's station, taking advantage of cover and dismounting before reaching the crest. He then connects his telephone and acts as operator as prescribed. Upon receiving orders to close station he disconnects his telephone and follows the wire as it is reeled up. If the battery moves before the wire is all reeled up, he picks up the wire near the fifth section

caisson and prevents any twisting or kinking due to changes of direction. In other respects his duties are similar to those laid down when the prescribed equipment is used.

4. When acting as an operator on a battalion line, when calling he should ask for "Headquarters" and when called should answer, for example, "'A' Battery."

5. When visual signals are used he sends and receives messages at the Battery Commander's station under the direction of the signal corporal.

Battalion Service:

The battalion reel-cart marches at the head of the column at all times after the subdivision for action. Before the subdivision it is advisable to post it at the rear of the leading battery in order that the gait may be set by the leading team of the leading battery rather than by the reel-cart team.

The signal corporal accompanies the battalion commander during the reconnaissance and at all other times except when laying or operating a line. The private detailed as his assistant rides on the cart and is responsible for its proper operation.

The battalion signal corporal is responsible that the same inspections and tests are made as are prescribed for battery telephone corporals and also that his entire reel of wire is tested before it is taken out.

When telephone service is desired the sergeant-major receives his orders from the adjutant and notifies the signal corporal of the location of the headquarters station and the proposed positions for the batteries. The signal corporal returns at once to the reel-cart, brings it up and causes it to be unlimbered as near as possible to headquarters, taking every possible precaution that neither the horses, the reel-cart or any of the men are exposed at this or at any other time during the laying or operation of the line. If it is absolutely necessary to take the cart over an exposed place it should be done at as rapid a gait as possible.

As soon as the cart is unlimbered the sergeant-major opens it and takes out and sets up such of the observing instruments as may be required. He then connects the headquarters telephone and acts as operator until the return of the signal corporal. After the signal corporal returns, the sergeant-major supervises the service of communication.

If telephone communication is interrupted he takes the necessary steps to provide communication by visual signals.

In laying the line the signal corporal gives explicit directions to the reel-cart drivers as to directions and gaits and rides in rear of the reel, facilitating in every possible way the proper laying of the line, removing it from damp or wet places when possible, hanging it on trees and whenever it is possible to raising it above heavily traveled roads and straightening out kinks. If time permits it is advisable to drive the reel rapidly to the position to be occupied by the battery furthest removed from headquarters in order that when the line is laid, the reel may be at headquarters and available to extend the line in case the Battalion Commander desires to change his station. If this is not practicable the line should be laid at once, beginning at headquarters and going to the nearest battery first. If it can be done without exposing the reel, the line should be laid in front of the gun positions where it will not be interfered with by the limbers.

As soon as the battalion line reaches the vicinity of a battery it becomes the duty of the battery signal corporal to have it brought to his Battery Commander's station and to establish communication promptly as prescribed in "Battery Service."

As soon as the line is laid the battalion signal corporal returns to headquarters, relieves the sergeant-major and acts as operator. If visual signals are required he acts as sender and the sergeant-major as receiver.

In calling for batteries they are designated as "'A' Battery." In acknowledging calls the Battalion Commander's station is known as "1st Battalion." When two or more battalions are working together the regimental headquarters are the only headquarters which should be referred to over the line as "Headquarters." If all batteries are to receive the same message "All Batteries" is called and each battery acknowledges in turn by reporting, for example, "'C' Battery." All operators should be required to keep the receiver on at all times. The use of the buzzer to call a battery should be unnecessary. Operators should pay no attention to messages not intended for them. The word "Hello" is unnecessary and should be forbidden.

At the command "Close Stations" the battalion signal corporal supervises the reeling up of the wire and the sergeant-major is responsible that all instruments are replaced in the cart. It is advisable

to carry all telephones on the person to avoid their being jolted in the cart.

Regimental Service:

With obvious modifications, regimental service conforms to battalion service. The regimental signal sergeant performs the duties herein laid down for the battalion signal corporal. The regimental signaller sergeant is responsible for the same inspections and tests of his matériel as are prescribed for battalion signal corporals. When connected with a regimental line, each battalion sergeant-major is the operator at his own battalion headquarters. If no lines from battalion headquarters to batteries are laid the signal corporal may be used as operator on the regimental line. Stations are designated as in battalion service. If the same message or order is intended for both battalions, "Both Battalions" is called and each one acknowledges the call by reporting, for example, "2nd Battalion."

FRENCH FIELD ARTILLERY REGULATIONS OF 1910.—AMMUNITION SUPPLY.

Translated by CAPTAIN FOX CONNOR, 6TH FIELD ARTILLERY.

CHAPTER V.

INSTRUCTION UPON THE REPLENISHMENT OF AMMUNITION IN THE FIELD.

69. Independently of the exercises in replenishing ammunition which form a part of the training of each battery and of each group, instruction must be had on a larger scale, by the use of *cadres*. The object of this instruction is to familiarize the officers and noncommissioned officers with the manner in which the several echelons of the artillery park function, as well as with the establishment and working of the various organs of communication involved. Some of the units of supply may, if the available resources permit, be represented by their leading vehicles. All the commander's assistants must be employed, and all the communications called for by each exercise must be actually established and put into operation.

ARTICLE I.

ORGANIZATION OF THE SERVICE.

70. The replenishment of the ammunition, for guns and for small arms, consumed during the course of operations, is assured by the artillery. For this purpose supplies are provided as follows:

1st. *At the front,* there is in each army corps an organ of supply having the name of *park of artillery of the army corps*. The ammunition of this park, all carried upon vehicles, is intended to replace, immediately upon expenditure, the ammunition of the line of battle. (By ammunition of the line of battle is meant all the ammunition carried with the combatant troops, whether upon the person or upon vehicles.)

2d. *At the rear,* there is for each army an organ of supply under the name of *grand park of artillery of the army*. The ammunition of this grand park, echeloned in rear of the troops in the field back to the interior of the home country, is partly upon vehicles, partly in cars, and partly in arsenals. It is intended to fill up the parks of

the army corps when the latter have had to resupply the combatant elements.

The service of artillery is directed in an army corps, by the general commanding the artillery of the corps, under the direction of the corps commander; in an army, by the commander of the army.

71. *Artillery Park of the Army Corps*. Aside from its supply of ammunition for guns and for small arms, the artillery park of the army corps carries spare matériel and other equipment for the corps. Normally, the park of artillery is divided into three echelons, each commanded by a major, the whole being under the command of a colonel or lieutenant colonel. The commander of the park has the title *commander of the park of artillery of the army corps*. This officer has, relative to the personnel under his command, all the attributes of a *"chef de corps."**

72. The park of artillery of the army corps is composed of two kinds of units of supply: the first, *light,* for supplying ammunition direct to the line of battle; the second, *heavy,* are not able, under all circumstances, to make contact with the line of battle and are intended, normally, to resupply the light units.

The two first echelons are entirely composed of light units, the third echelon of heavy units.

73. The first two echelons have an identical composition; they are interchangeable. Each of them has a staff, sections of ammunition for the 75 mm. gun, and sections of infantry ammunition. All of this ammunition is carried in caissons.

The third echelon has a park, several park sections, and one mixed section. All of the ammunition of the third echelon is in boxes and is carried in wagons. The mixed section has, aside from wagons carrying ammunition of the 75 mm. gun, 4 spare guns (75 mm.) and wagons carrying tools and spare parts.

74. *Grand Park of Artillery of the Army*. The grand park of artillery of the army is under the orders of a colonel or lieutenant colonel belonging to, or having belonged to, the active army, and who takes the title of *director of the grand park of artillery of the army*. This officer is at the same time the director of the service of the artillery of the line of communications. He is under the orders of the director of the lines of communication of the

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*A literal translation of this expression does not give an exact idea. The real meaning relates to internal administration and is to the effect that this officer has certain administrative functions which with us are usually exercised by a post or regimental commander.—*Translator*.

army, who, in turn, receives his authority from the army commander.

The director of the grand park exercises, with respect to the personnel under his orders, the functions of a general commanding the artillery of an army corps. As to matériel, he has all the functions fixed by law and regulations of directors in active management of arsenals, etc., at home.

Aside from the supply of ammunition, the service of the grand park consists:

1st. In maintaining the supply of arms and of matériel.

2d. In receiving or collecting arms, munitions and matériel, whether as a result of capture, of disarming the inhabitants, or from collections made under the direction of sanitary organizations.

3d. In effecting minor repairs to matériel turned over to it.

4th. In evacuating useless matériel, sending it to points designated by the director of the lines of communication.

75. The grand park of artillery comprises:

A staff of the grand park;
Batteries of foot artillery;
Detachments of artillery workmen;
Sections of park, with vehicles;
Supplies of ammunition and of matériel.

All of the ammunition of the grand park is in boxes.

76. The supplies of ammunition and of matériel are formed, in each grand park, in divisions, sections of reserve and lots of ammunition for heavy artillery. Normally it contains one division and one section of reserve for each corps in the army.

Each division is composed:

1st. Of several lots of ammunition of identical composition; each lot contains ammunition for the 75 mm. gun, for rifles, for carbines, for muskets, and for machine guns;

2d. Of one section of park (personnel and vehicles).

Each section of reserve is divided into two groups. The first contains gun carriages and caissons for the 75 mm. gun (these are loaded similarly to those of the battery), ammunition for the 75 mm. gun, for small arms (especially for revolvers), explosives, and various supplies of spare parts. The second group contains supplies and spare parts for the repair and upkeep of the matériel.

The lots of ammunition for the heavy artillery vary according to the composition of the heavy artillery assigned to the army.

77. From the point of view of the organization of the service of supply, the grand park is divided into four elements. The first two elements are organs for resupplying the army corps and the elements of the army directly. There are:

First element: *echelon on the road*: this is designed to assure the supply by wagon roads. To this end it has horsed wagons (sections of park) and carries normally one lot of ammunition per division of grand park.

Second element: *echelon of the regulating station*: this comprises:

(a) One or more railroad trains loaded with ammunition for the 75 mm. gun, for heavy artillery, and for small arms. These trains are side-tracked either at the regulating station or at some other place within the zone controlled by the authorities in charge of the regulating station. Each of these trains is called "mobile train of ammunition."

(b) A part of the spare matériel and spare parts, etc., of the grand park, supplied by sections of reserve.

(c) The personnel necessary to assure the upkeep of the matériel needed under (b), to carry out slight repairs, and to assure the service of the mobile trains.

The detachments of artillery of the grand park (batteries and detachments of workmen) who are under the direction of the director of the artillery of the line of communications are assigned under his direction to organs of direct supply (echelon upon the road and echelon of the regulating station).

The two last elements are composed of organs of supply which are maintained in magazines. These are:

Third. Element: *echelon of magazine* stations; stored in one of the magazine stations belonging to the army. The supplies of this echelon form a part of the grand park; accountability is kept, and upkeep assured, by personnel which is assigned to the magazine station.

Fourth. Element: *echelon of arsenals;* deposited in the arsenal which mobilizes the grand park. The material and the ammunition of this echelon forms a part of the grand park, but the accountability for it is kept and its upkeep assured by the personnel of the arsenal.

78. The detailed composition of the lots of ammunition and of the sections of reserve is given in special directions from the Ministry of War. The personnel, matériel and ammunition contained

in the three first echelons are mobilized and transported under regulations fixed by the Minister of War.

At the beginning of operations these three echelons have the same composition in so far as concerns the ammunition for the 75 mm. guns and ammunition for small arms (normally one lot for each army corps). The echelon of the arsenal has as its initial supply the total of the lots assigned to the army and not contained in the three first elements.

In addition to the ammunition contained in their lots, the echelon of the regulating station and the echelon of the arsenal contain the ammunition of the sections of reserve or the fractions of sections of reserve which form a part of each one of them.

The ammunition for heavy artillery is divided into two lots, one of which is placed with the echelon of the regulating station, and the other with the echelon of the arsenal.

ARTICLE II.

PRINCIPLES OF SUPPLY COMMUNICATION.

79. The replacement of ammunition is carried out in accordance with the following principles:

1st. Within each army corps the supply is always assured from rear to front by all the echelons. It is the duty of each of them to seek, as soon as they are in position, contact with the echelons or with the troops which are in front, in such a manner that no one will have to look to the rear. The combatant organizations, in particular, must be relieved of all preoccupation relative to their supply.

2d. The resupply of the army corps is carried out according to the orders of the army commander. These orders will set forth the conditions under which the echelons of the park of the army corps must make contact with the elements of supply sent forward from the grand park of artillery of the army.

3rd. Upon the field of battle, without sacrificing order, promptitude must take place over regularity in carrying out the operations of supply.*

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*This refers to questions of accountability, etc.—*Translator*.

81 TABLE OF COMMUNICATIONS.

Communication to Establish.	Agents	Cases in which communications are established.
Between the commander of the park and the general commanding the artillery of the army corps.	1 officer	Under all circumstances.
Between the commander of the park and each of the commanders of divisional artillery and of corps artillery	1 sergeant	As soon as the commander of the park has received notification as to the points or zones where the resupply is to take place.
Between each of the commanders of echelons of the park and the commander of the park.	1 sergeant & 1 bicyclist	Under all circumstances.
Between the third echelon of the park and each of the two first echelons.	1 sergeant & 1 bicyclist	Under all circumstances.
Between the second echelon of the park and the first echelon.	1 sergeant & 1 bicyclist	Under all circumstances, except when the second marches with the first or is established at the same distance from the line of battle.
Between each section and the commander of the echelon upon which it depends.	1 corporal	At the beginning of the march.
Between each section of artillery ammunition and the commander of the group of battery reserves which are to be supplied.	1 sergeant & 1 corporal	As soon as the section has been assigned.
Between each section of infantry ammunition or each detachment of a section and the commander of each of the regiments of infantry to be supplied.	1 corporal	As soon as the section or detachment has been assigned.

Besides these communications, the general commanding the artillery of the army corps must take measures to notify without delay the commanding generals of divisions that the sections of ammunition are ready to be placed at the disposal of the troops under their orders.

ARTICLE III.

EXECUTION OF THE SERVICE.

1. *Operations of the Park of Artillery of the Army Corps*.

(a) Subdivision and place of echelon of the park; place of the echelon of the park on the march.

82. *In march*. The 1st echelon marches, as a rule, at the head of the combat train of the army corps. The other elements of the park march at the place indicated in the order for the movement (with the groups of parks and convoys). It may be advantageous to have one of the two first echelons march with the combat train of each of the two columns. In this case the third echelon marches with the groups of parks and convoys.

83. *During combat*. The most advanced echelon is established at a point called "point of dislocation," chosen preferably in the neighborhood of a cross-roads. From this point the sections of ammunition, or detachments of sections of infantry ammunition, are dispatched towards the points of the field of battle where their presence may be necessary. The point of dislocation is at the same time an assembly point for the empty sections as well as the full sections. As a rule, it should not be at a less distance than five kilometers from the line of battle.

Under certain circumstances it may be advantageous to establish the two first echelons at practically the same distance from the line of battle, each of them playing the same role with respect to the two subdivisions of the army corps. In this case a point of dislocation is fixed for each one of them. When this disposition is not used, the echelon of the second line is established in rear of that of the first line at a place called "point of station," from which point sections of ammunition are sent to the point of dislocation, according to the necessities.

The third echelon of the park (heavy echelon) is always established in rear of the first two and at a point called "point of station," from which point the empty sections of the two first echelons are refilled.*

84. The sections of ammunition halt on the road only in case of

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*In this paragraph the two expressions, "point of dislocation" and "point of station" can not be exactly translated into brief English. The context, however, shows the characteristics of these two points in carrying out the transfer of ammunition from the trains to the troops on the firing line.—*Translator*.

absolute necessity; under such conditions they place themselves on the right side of the road in single file and leave the left side of the road as free as possible. Whenever it is possible they form park beside the road, taking care to so locate themselves as to be able to move in any direction.

The sections of ammunition are indicated during the day by a yellow flag for infantry ammunition and blue for artillery ammunition; during the night they are indicated by lanterns of the same color as the flags.

When a section leaves the road it posts at the point where it turned off, a man with a flag or lantern, so that the section may be easily found.

The sections of ammunition collect so far as possible the arms, ammunition and material of the army which has been abandoned upon the field of battle.

85. The sections of park are indicated by blue signals. Having arrived at their point of station they form park, placing their vehicles at sufficiently great intervals as to be able, if necessary, to easily refill the ammunition sections.

(b) Duties of officers in resupply. Duties of echelons.

86. The general commanding the artillery of the army corps is responsible for the supply of troops with ammunition, and gives orders and instructions to this end to the commander of the park. When an action begins the general commanding the artillery, having received instructions of the general commanding the army corps, informs the commander of the park as to the points for the most advanced centers of supply. He informs the general commanding the army corps as to the number of sections of ammunition which have been put at the disposal of the troops engaged. This information is supplemented by information obtained from the troops engaged during the course of action relative to the consumption of ammunition, and by information of the same character which the commanders of troops may consider desirable to bring to the notice of the general officers.

As soon as he has been notified, the general commanding the artillery acquaints the commander of the park with the conditions under which the park of the army corps may be resupplied by the advanced echelons of the grand park. After the combat he submits, as is said further on, in paragraph 105, a statement of the needs

of the army corps in ammunition matériel, and draws up for the signature of the commander of the army corps requisitions for the necessary supplies for refitting, to be transmitted to the director of the line of communications.

87. The commander of the park, under the instructions which he receives or which he requests from the general commanding the artillery of the army corps, must exercise a great initiative to assure with the means at his disposal, the satisfactory execution of the supply of ammunition.

In march at a distance from the enemy he commands in general the group of parks and convoys of the army corps when all of these march together. When in proximity to the enemy the commander of the park marches, as a rule, with the first echelon of the park. He may also, in anticipation of an engagement and upon order of the general commanding the artillery, march with that officer.

Upon the beginning of an engagement the commander of the parks, as soon as he has received from the general commanding the artillery the indications as to the points where it is desirable to form the most advanced centers of supply, fixes the exact location of the first echelon (or the points of dislocation of the first two echelons), as well as the points of station of the echelons of the second line (if there is to be one) and of the third echelon, and notifies the commanders of the echelons as to the exact positions of the several points. In the absence of instructions from the commanding general, the commander of the park must not hesitate to push forward the advanced echelons upon such points as may appear to him to be necessary. Under all circumstances he makes immediate report as to his dispositions for the location of the units under his command.

By means of reconnaissances carried out by the officers under his immediate orders, or by officers taken from the staffs of the echelons, he studies the terrain in rear of the troops and draws up his plan for assuring communication with the line of battle. He receives from the general commanding the artillery the orders relative to the troops to be supplied, and assures the execution of this supply by informing the commanders of the echelons of the first line as to the troops which they have to supply, as well as the conditions under which the supply must be carried out. He transmits to them at the same time all useful information which he may have been able to collect by means of the reconnaissances above indicated.

As soon as he has received from the general commanding the artillery the instructions relative to the resupply of the park of the army corps from the grand park of artillery of the army, he notifies the commander of the third echelon, and if there is necessity he also notifies those of the first two echelons.

88. The commander of an advanced echelon of the park of the army corps, after having, upon the order of the commander of the park, located his echelon at the point of dislocation which has been assigned to him, assures in accordance with the instructions which have been given him, the organization of the supply of the line of battle. In case of need he issues without special orders, but he also remains in communication with the commander of the park. He reports to the commander of the park all the measures which he has taken, and especially he must always keep the commander of the park informed of any modifications which may be made in the location of the sections of ammunition, and as to the number of sections which may be available.

He has the neighborhood of the position which his sections occupy reconnoitered, and if there is necessity for it, he makes arrangements with neighboring troops so that measures of security may be taken in ample time.

He endeavors to always have at his disposition at least one section of artillery ammunition and one half section of infantry ammunition. To this end, if the other echelon of sections of ammunition is not itself occupied in the supply of another part of the line of battle, he calls, at the proper time, and successively, for the sections of ammunition from that echelon. In the contrary case, he utilizes every means to fill up his empty sections from the sections of park of the third echelon.

He enters into communication with the commander of the third echelon, so as to know the place where the sections of park will resupply ammunition sections. This place is not necessarily the point of station of the third echelon; if possible, it should be somewhere between the point of station and the point of dislocation of the advanced echelon.

After having completed, so far as possible, the sections of ammunition which are only partly emptied, he directs the empty sections upon a point at which the sections of the park of the third echelon are to resupply them, unless he has received from the commander of the park an order to direct them upon the advanced echelons of the grand artillery park of the army.

He assumes command of the sections of ammunition which are sent up to him from the rear.

89. The commander of an echelon of the second line of the park of an army corps installs his echelon at the point of station which has been assigned him. He sends to the advanced echelon the units which are asked for, and receives under his command the sections of ammunition which, after having been resupplied either by the sections of the park of the army corps or by the advanced echelons of the grand park, have returned to the point of station.

90. The commander of the third echelon (heavy echelon) installs his echelon at the point of station which has been assigned to him. He locates or causes to be located the roads which lead to the points of dislocation of the advanced echelons, and the routes by which these roads may be reached, so as to be able to determine upon the points to which he must move the sections of the park to resupply the sections of ammunition. If the two first echelons have both been used in the direct supply of the line of battle, he sends forward to within a few kilometers of them a section of park, which installs itself in the immediate neighborhood of the route leading from the point of dislocation to the point of station. When one of the first two echelons acts as an echelon of the second line, it is desirable, if possible, to choose in its immediate neighborhood a point to which the sections of park may proceed to resupply the empty sections of ammunition; in this case a section of park is directed upon this point.

The commander of the third echelon notifies the commanders of the first two echelons as to the dispositions which he has taken.

If the terrain does not lend itself to the organization of intermediate points of supply as indicated above, or if the situation does not admit of pushing forward sections of the park, the point of station of the third echelon is adopted as the point of resupply of sections of ammunition by the sections of park.

The commander of the third echelon takes measures to resupply the sections of park from the advanced elements of the grand park of the army, according to orders received from the commander of the park. If these elements are sufficiently near they may be directed to refill directly the ammunition sections.

The commander of the third echelon takes temporarily under his command those units which have duties to carry out at the point of station of his echelon. After such duties have been carried out, he assures their prompt return either to the point of station

of the echelon of the second line, if such point exists, or to the points of dislocation of the advanced echelons.

He sends to the points indicated, such spare guns as may be called for by the commander of the park.

91. To sum up, the role of the commander of the park with respect to the echelons, is limited to prescribing the points of dislocation of the advanced echelons, to indicating the points of station of the other echelons, to informing the advanced echelons as to the troops which they have to resupply, and the location of such troops, and to acquainting the third echelon (in the extreme case, also the two others) as to the conditions under which the resupply by the grand park will be carried out. It is the duty of the commanders of the various echelons, according to the place which each of them occupies, to use every necessary exertion, and to take of their own initiative every useful measure to satisfy, in the minimum of time, the needs in ammunition of those elements which preceded them and also to replenish their own supply.

(c) Operations of the infantry ammunition sections.

92. Upon the field of battle the sections of infantry ammunition may, if necessary, be subdivided. In this case, each fraction must always be placed under the command of an officer, and as a rule the captain commanding the section fixes a rendezvous for empty vehicles. When an officer commanding a section or a detachment of a section of infantry ammunition has been notified as to the troops which he must supply, he gathers before leaving his station all the information that can be obtained as to the position of the troops to be supplied, and as to the route by which he may reach them. He precedes his vehicles, searches for the reserves of the troops which he is to supply, reconnoiters the terrain in rear of these reserves and establishes himself in a position favorable for the movement of his vehicle. He establishes communication with the commanders of the troops, which he follows whenever movements of considerable distance take place; and whenever he leaves his vehicle, he takes measures to enable them and the agents of communication to find him again.

93. During the combat the ammunition wagons are not refilled. When they are empty, the commander of the troops notifies, by an agent of communication, the commander of the section of infantry ammunition or of the detachment of that section, as to the number

of the necessary caissons (normally, one caisson per battalion and one for the machine guns) and indicates to him the exact point at which those vehicles will find the sergeant major and chief artificer of the regiment.

The officer in charge of the ammunition section sends forward, under a noncommissioned officer, the number of caissons required. The agent of communications brings the caissons to the sergeant major and then returns to the ammunition section.*

94. When it is necessary to resupply troops in action, the commander of the troops fixes the number of caissons which should be brought forward and indicates the points upon which it is desirable to direct them. Every accident of the terrain is taken advantage of to bring these caissons as near as possible to the firing line. In critical circumstances, the commander may even order caissons to move at rapid gaits right up to the firing line.

The sergeant major causes each caisson to be accompanied by a sergeant and two men taken from such men as may be available (sappers or men from reserves). The sergeant, mounted upon the caisson, directs it and supervises the distribution of the ammunition by the two men who accompany him.

As soon as a caisson is empty, it is sent at a walk to the sergeant major, and from there it is sent back to the ammunition section by means of the agent of communication who brings up a full caisson. Each time that he sends to the ammunition section a caisson either wholly or partly empty, the sergeant major gives to the agent of communication a receipt indicating the regiment which has been supplied and the quantity of ammunition actually delivered.

The horses required during the combat to replace horses belonging to the infantry combat wagons are furnished by the infantry ammunition sections upon the order of the general commanding the brigade of infantry, who must always report his action.

95. When the commander of a section of infantry ammunition, or the chief of detachment of such a section, has sent his last full caisson to the troops in action, he notifies the commander of the advanced echelon of the park of the army corps, who takes dispositions to replace the exhausted elements. As soon as the commander of the section of infantry ammunition has collected all of his empty

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*In this section, the ammunition wagons referred to are manifestly the combat wagons of the battalions. The caissons belong to the ammunition sections.—*Translator*.

supply caissons, he directs his unit or his detachment upon the point of dislocation of the advanced echelon.

When the section has gotten all of its empty caissons together at the point of dislocation, the chief of section asks orders as to resupplying his section. This resupply is carried out either at the third echelon of the park of the army corps or at the advanced echelon of the grand park of artillery of the army.

d. Operation of the sections of artillery ammunition.

96. In general, the sections of artillery ammunition are not subdivided. When a captain commanding a section of ammunition has been notified as to the troops which he must supply, he receives all the available information concerning the location of the troops to be supplied. He informs himself as to the location of the battery reserves which he is to supply, reconnoiters the terrain in rear of them and establishes his section in a position favorable for the movement of vehicles. This position is chosen at about 1000 or 1500 meters from the battery reserves. He establishes communication with the commanders of the groups of battery reserves and sends to them, under command of a noncommissioned officer, the number of caissons, men and horses required. He follows the battery reserves in their movements, and takes the necessary measures to insure that his section and his agents of communication may always be able to find him.

97. As soon as the commander of a battery reserve has sent forward caissons called for by the battery commander, he notifies the commander of the group of battery reserves to which he belongs. The commander of the group of battery reserves consolidates the requisitions of his battery reserves, and sends to the section of ammunition which is supplying him for the necessary number of caissons.

The commander of the group of battery reserves divides among his battery reserves the caissons sent from the section of ammunition. The commander of each battery reserve, assisted by the quartermaster sergeant, proceeds to the replenishment of the ammunition. The caissons arriving from the ammunition sections are placed alongside of the empty caissons, and the ammunition is transferred; caisson bodies should be filled first.

If one of the firing batteries is detached from its group, its reserve follows it. The agent of communication from the ammunition

section accompanies the battery reserve. The resupply of an isolated battery is carried out according to the preceding principles, the chief of the battery reserve entering into direct communication with the ammunition section.

If the three batteries of the group separate, the commander of the group of battery reserves takes measures to assure the direct communication of each battery reserve with the ammunition section. He employs for this purpose a noncommissioned officer taken from one of his battery reserves.

98. During a combat, bringing the batteries to their normal effective in men and horses must not be considered; they must only be furnished from the battery reserves the number of men and horses necessary to enable them to continue firing and to horse their carriages. If the resources of the battery reserves are not sufficient, the necessary men and horses are requested from the general commanding the artillery of the army corps, by the corps or divisional artillery commanders. In this case the men and horses are furnished by the ammunition section when they supply the groups of battery reserves.

99. As soon as a section of ammunition is about to be exhausted, the captain who commands it notifies the commander of the advanced echelon to which he belongs. The commander of the advanced echelon makes arrangements to replace the empty section. When the section has all of its empty caissons together, its captain directs it upon the point of dislocation and receives orders concerning refilling the section. This refilling is carried out either in the vicinity of the third echelon of the park of the army corps or of the advanced echelon of the grand park of the army. After being refilled the section returns to place itself according to orders received either from the commandant of the second line or the commandant of the advanced echelon, of which the section forms a part.

e. Operation of park sections.

100. In general, park sections are not subdivided.

If the captain commanding a park section has received an order to move his section forward to a point of resupply intermediate between the point of station of the third echelon and the point of dislocation of an advanced echelon, he obtains, before his departure, all the necessary information concerning the place where he is to

install his section, and the situation of the advanced echelon which he must resupply.

After having reconnoitered the terrain upon which he has to install his section, he establishes it, placing the vehicles at intervals sufficiently great to enable two caissons of the ammunition section to place themselves in the intervals. He places to one side all of the wagons loaded with infantry ammunition. By means of a noncommissioned officer he opens communication with the commander of the advanced echelon which he is directed to resupply, and informs this commander as to the place at which his section is located.

When a section of ammunition presents itself to be resupplied he causes the vehicles of this section to move into the intervals which he has left between his wagons, and divides them up in such a way as to enable the transfer of the ammunition to be carried out as promptly as possible.

When he has completely resupplied a section of artillery ammunition, or when more than one section presents itself to be supplied, or, finally, when he has completely emptied his caissons of infantry ammunition, he notifies the commander of the third echelon, who takes dispositions to replace the elements which have been exhausted.

When all of his ammunition boxes (at least those of artillery) are empty, he directs his unit upon the point of station of the third echelon, and receives orders relative to his resupply. This resupply is carried out from one of the echelons of the grand park. After being resupplied, the section of the park returns to the point of station of the third echelon (or to the camp of that echelon if there is one).

f. Resupply after combat.

101. After combat, resupply is continued in accordance with the principles above set forth upon the field of battle, if possible; if not, it is carried out either in bivouac or cantonment, even during the night. Issues are made first to the batteries and the combat wagons of the infantry; then to the sections of ammunition; and, finally, to the sections of park. The corps cavalry and the artillery are supplied with the small arms ammunition by the infantry ammunition sections. Except in unusual circumstances, and upon the special order of the commander of the army corps, battery caissons

and combat wagons of the infantry are not sent to the rear to be refilled.

102. New caissons which the batteries may need are furnished them after the combat by the sections of artillery ammunition; guns are furnished by the mixed section of park. Requisitions for these are addressed by the commanders of divisional or corps artillery to the general commanding the artillery, who gives the necessary orders to the commander of the park.

103. The ammunition needed by batteries belonging to divisions of cavalry during and after combat are furnished them by the nearest sections of ammunition. The sections of ammunition are bound to deliver the ammunition called for.

g. General rules concerning the delivery of ammunition.

104. During an action the commanders of troops temporarily isolated, or chief of detachments, the chiefs of infantry combat trains, the commanders of batteries, and, in their absence, the commanders of battery reserves have the authority to sign requests for ammunition. All requests for ammunition must be immediately satisfied, whatever the form in which the request is made. If a detachment of vehicles presents itself without a request for supply, the commander of the unit or detachment of supply, nevertheless, delivers the supplies asked for verbally. If possible, he obtains a receipt for the quantities actually turned over. Outside of the immediate field of battle, all requests must be countersigned by the chief of corps or detachment, and, for artillery units, by the group commanders.*

Requests must never exceed actual needs. The commanders of bodies of troops are always able to make supplementary requests if there is a necessity therefor.

105. On the day following the combat each unit infantry, cavalry, artillery or train draws up a report showing the amount of ammunition necessary to bring the supply of ammunition carried by the men or upon vehicles, up to the normal. These reports are sent through channels to the general commanding the army corps, and transmitted without delay to the general commanding the artillery. The latter consolidates these reports, and draws up a report

*"Chief of corps" as here used means battalion or regimental commanders.—*Translator*.

indicating the state of the ammunition of the corps and the requirements in matériel, etc. A copy of this report is sent to the general commanding the army corps.

106. If a body of troops, whose ammunition is exhausted, is out of communication with the parks, and finds itself near a fortified place, the governor of such a place is not authorized, in the absence of special authority from the Minister of War, to resupply the troops, except in so far as he may have a supply in excess of the normal allowance of the fortified place. He immediately reports to the Minister of War the transfers of ammunition which he has made and asks for their immediate replacement if there is a necessity therefor.

II. *Operations of the Grand Park of Artillery of the Army.*

a. Resupply of the Army Corps and of the heavy artillery of the Army.

107. Requisitions for resupply of the artillery of the army corps and of the heavy artillery are sent to the director of the line of communications, who fixes, in conformity with the instructions of the commander of the army, the days, hours and points of delivery of ammunition and of matériel. He notifies immediately and directly, the commanders of army corps, and of heavy artillery, the proper authorities of the line of communications, and the director of the grand park of the dispositions to be made for the resupply.

108. The resupply of the parks of the army corps takes place either by echelons upon the roads or by the mobile railroad trains, or by both means together. The resupply of the sections of ammunition of the heavy artillery is carried out by means of the mobile railroad trains or automobile convoys. The movements of the echelons upon the roads and of the mobile railroad trains are regulated by the director of the line of communication, in accordance with instructions from the commander of the army.

The director of the grand park is notified at the same time as the commanders of the army corps as to the points where the echelon on the road will gain contact with the units of the park of the army corps. He transmits the orders of execution to the commander of the echelon upon the road, adding thereto his own instructions. Normally, considerable movements to the rear by vehicles of the army corps are avoided, and the resupply in ammunition is

made by vehicles of the echelon upon the road from the rear toward the front.

The detachments of the parks of the army corps which present themselves to be resupplied, pass temporarily, in so far as concern this duty, under the orders of the director of the grand park.

The resupply by the mobile railroad trains takes place at the stations at which these trains arrive; the parks of the army corps send their vehicles to this station. The same is true for the sections of ammunition of the heavy artillery.

In certain cases, automobile convoys, auxiliary convoys, or convoys of any kind, may be employed in the resupply of ammunition. Whatever the mode of resupply employed (road or railroad), the labor which is necessary in the delivery and transfer of the ammunition or of the matériel is effected by detachments taken from among those who are normally assigned to the service of the two first echelons of the grand park.

b. Resupply of the echelons of the grand park of artillery.

109. Normally, ammunition consumed in the different echelons of the park is replaced from the echelons placed immediately in their rear.

The resupply of the echelon on the road is effected by means of the mobile railroad trains. The resupply of the echelon of the regulating station is arranged by the representative of the service of artillery at that station, who reports to the commander of the station with a view to obtaining from the magazine station the necessary ammunition to keep the supply in the mobile railroad trains up to the fixed amount. In all that concerns the ammunition for heavy artillery, the director of the grand park requests the commander of the arsenal to send supplies to the magazine station. In urgent cases and when a deficiency in the supply of the mobile trains sent forward from the regulating stations is foreseen, new mobile railroad trains loaded with ammunition may be formed at the magazine station, and sent direct to the stations at which the resupply is to take place. The supplies of the magazine station and of the arsenal are always kept up by artillery agents in charge of these echelons. The supply of the echelon of the arsenal is kept up in conformity with orders given on this subject by the Minister of War. These orders must be requested if there is necessity therefor.

Supply in matériel within the grand park are carried out according to the same principles as is the supply in ammunition.

SUB-CALIBRE PRACTICE.

BY CAPTAIN E. D. SCOTT, 6TH FIELD ARTILLERY.

WITH NOTE BY CAPTAIN OLIVER L. SPAULDING, JR., FIELD ARTILLERY.

A number of Militia officers have asked me to publish an account of the system of sub-calibre practice used in my battery, C, 6th. Perhaps it may be useful to some in the Regular service. In the absence of any prescribed system, it is at least a guide, and contrary to the expressed opinion of some, it proves that sub-calibre practice is very valuable in teaching the mechanism of fire and in developing fire discipline. There are few batteries in either service so situated that they can not use the system to its fullest extent. The general idea is not original, I got it from Battery A, of the Fifth,—Captain Corey—but many of its features are.

The first requisite is a piece of ground about 100 by 300 yards, with water, a hill, unoccupied country or other bullet stop beyond one end. Hard or sandy soil is best, as then the strike of bullets is easily seen. The targets are reduced size, to give the appearance real targets would present at artillery mid-ranges. A section of artillery is a board 5 by 12 inches, painted olive drab, with a peg nailed on its back, and projecting about three inches below its lower side. This enables it to be set upright. The scale of this, three inches to the yard, is used in all other targets, and also in spacing them on the ground. A flank caisson is half the width of a section. Infantry are pieces of cardboard about 5 by 2 inches, tacked on the edge of a strip of board at two or three inch intervals. A convenient size or unit is a squad or eight. These can be grouped to represent any desired formation.

Cavalry and mobile artillery are similarly represented by pasteboard. Machine guns are about two inches by three, and short wooden pegs stuck in the ground about, represent the kneeling gunners.

Suitably arranged groups of targets mounted on low sleds drawn by light rope, furnish any desired form of moving target. The targets being light, one man furnishes the motive mower, and any direction can be given either by direct pull or through a directing pulley.

All this equipment can be made at trifling or no expense by battery mechanics. Appearing and disappearing targets can be easily arranged if desired, and miniature earthworks constructed and

manned, which adds to the interest, if not to the main purpose of the practice. One end of the field is planted with targets for a depth, say, of fifty yards. As stated above, the scale is that of the targets. Thus, 20 yards is equal to 5 feet, the distance from center to center of the sections of a battery.

The guns of the firing battery are placed at the opposite end of the field, side by side, about one foot between hubs. This is necessary that the deflection differences may approximate those that would be used if the targets were real and at mid-ranges, and the guns at the normal twenty yard interval. It would be better still if the guns were hub to hub, but their service demands a little play, and it is sometimes necessary for the members of the detachment to pass between.

From the guns the field presents a front of about 300 mils. Field glasses are necessary for picking up the targets and for observation of fire. Indirect fire is conducted as in service practice, except that a false angle of site is used. It is desirable that the cannoneers be practiced in setting their instruments throughout the scale of ranges. All the various mechanisms of fire except the use of the corrector can be practiced. On level ground an angle of site of 250 will require ranges somewhere between 2,000 and 3,000 yards, etc.

In direct fire the ranges are likely to fall between 400 and 600 yards, and this must be borne in mind in changing from indirect fire, lest the bullet stop be overshot.

In moving targets it must be remembered that the time is also in miniature. For example, a line of infantry will move about 100 yards a minute—which is represented by 25 feet on the ground—calling for very slow walking by the man doing the hauling. Similarly cavalry at the gallop, 400 yards per minute, would move but 100 feet on the ground in that time. It is very important that a close approximation be made in these times, particularly in the case of targets moving across the field, in order that the operations at the guns may be as nearly as possible those of firing with service ammunition against real targets.

If the sub-calibre tube and drill cartridge were in one, the setting of the fuze and loading for each round would add greatly to the value of the practice, not only in the training of Nos. 2, 3, 4, and 5, but in checking undue haste and giving the gunner and No. 1 correct ideas of the time at their disposal—not to mention the officers,

who are apt to develop erroneous ideas of time, leading to impatience when the slower work of handling service ammunition begins.

The following is given as an example of the use of the system; A battery to the right front is designated as the objective. The battery commander selects an aiming point, calculates firing data, gives the necessary commands, and fires at 2,000 yards. Senses right and short. Corrects for direction and fires at 2,400 yards. Over, and distribution poor. Corrects for latter and fires at 2,200. Senses over. Fires at 2,100—short. Continues for a finer adjustment. This being fairly established—it can usually be had to 25 yards—he steps aside and another officer takes command. An infantry line to the left front is designated. He measures the angular distance, gets a 200-yard bracket quickly by salvo or volleys, and sweeps the bracket with volleys at successive ranges. Another officer takes command and switches the fire to a machine gun platoon, concentrating on it. His successor is directed to fire on a certain trench. He opens the sheaf, brackets the target, and sweeps its length. Mobile artillery appears elsewhere, is enclosed in a 400-yard bracket, and the latter is swept by rapid volleys at successive ranges, and so on.

Skill in calculating firing data, in handling the mechanisms of fire, facility in giving commands, familiarity with the best means of attacking different classes of target, good fire discipline, may be acquired, not only by the commissioned, but by the enlisted personnel, for the latter see the actual result of the things they do, and are certain to bring intelligence to bear.

NOTE.—In connection with the above paper, it may be worth while to remark that the same principle has been applied by me to simulated fire, for the instruction of Militia field artillery officers, with very good success.

I have used improvised targets, whatever happened to be at hand; small camp stools are good, so are canvas watering buckets. To mark the shots a tin disc is used—white on one side for air bursts, black on the other for grazes—attached to the end of a light stick. An infantry target marker would be good. A field telephone is run from the firing point to the targets so that the marking officer can hear all firing commands. The instructor acts as marking officer if necessary, but better results are obtained if another competent officer is available, as this leaves the instructor free to go wherever his presence is required.

The scheme can be worked, exactly like "terrain board" firing, if there be present only the instructor, one firing officer, and two men to run the telephones. But a consderable number of men can be kept busy, as will appear from the following description of actual exercises conducted by me.

The number of officers and men taking part is as follows:

Officers:—1 marker.
1 battery commander.
1 reconnaissance officer.
1 battery officer.

Enlisted men:—1 first sergeant.
2 scouts.
3 signal men.
1 sergeant, assistant to battery commander.
4 gun sections, each consisting of 1 chief, 1 gunner, 1 No. 1, 1 No. 3.

The party assembles, dismounted, not more than half a mile from the ground selected beforehand for the exercise. If horses are available, a few more men are added for horse holders, and the assembly is farther away. The "battery" is formed up with actual road space, the battery commander with his reconnaissance party ahead, the "sections" at about forty yards distance from each other. The instructor, acting as both director of the exercise and battalion commander, goes forward with the marker and the scouts, directing the battery commander to follow in, say, ten minutes; he posts the scouts as required to mark his route, directing them to report back to their battery commander when the battery overtakes them. On reaching the selected ground, he places the targets, and leaves the marker, with his marking staff, concealed near them; he then returns to meet the battery. In his capacity as battalion commander, he calls up the battery commander to locate his targets and select his position; the battery commander brings in his "guns" as he thinks best, and the first sergeant places a flag or staff to represent the position of the limbers, afterwards returning and reporting to the battery commander.

The battery commander places his "guns" two yards apart, the chief of each section sitting on the ground, his three men in front of him with sight, quadrant and hand fuze-setter. The battery officer and first sergeant take post in rear of the "guns" and check the

settings of all instruments. The battery commander prepares his firing data; the calculations are checked by the instructor, but no further attention is paid to the matter of their accuracy.

The signal detail runs a telephone line from the battery commander's station to the target.

The battery commander now gives his initial commands for firing. The marker assumes complete firing data as correct, using figures a little different from those received by telephone. He then marks shots precisely as he would on the "terrain board."

If the targets are placed so as to cover a front one-tenth as broad as in reality, at a distance of about 300 yards from the firing point, assumed ranges may be anything from 2,500 to 3,500 with practically no error in angular measurements. A mil will be equal to about a foot, which makes the marker's calculations simple.

OLIVER L. SPAULDING, JR.,
Capt. F. A.

GENERAL ORDERS No. 142, WAR DEPARTMENT.

JULY 13, 1909.*

Section 4, paragraph I, and section 3, paragraph II, General Orders, No. 23, War Department, February 2, 1906, in so far as those sections relate to light and horse batteries of field artillery with reference to the arms and equipments of enlisted men, horse equipments, and the method of packing and transporting the service kit, are rescinded and the following substituted therefor:

1. Arms and equipments:

a. For each enlisted man—

1 revolver.
1 reolver holster.
1 revolver cartridge belt and fastener.
1 first-aid packet (Med. Dept.)
1 pouch for first-aid packet.
1 waist belt.
1 revolver cartridge box.
1 artillery knapsack.§
1 canteen.
1 meat can.
1 cup.
1 knife.
1 fork.
1 spoon.
1 shelter tent, half.
1 shelter tent pole.
5 shelter tent pins.
1 identification tag.

b. For each enlisted man individually mounted, in addition to *a*—

1 saddle, cavalry, complete.
1 saddle cover.
1 saddlebag.
2 spurs.
2 spur straps.
1 curb bridle, complete.
1 currycomb.
1 horse brush.
1 canteen strap.
1 link.
1 watering bridle.

c. For each driver, in addition to *a*—

1 currycomb.
1 horse brush.
2 spurs.
2 spur straps.
1 canteen strap.
1 saddlebag.
1 watering bridle.¶

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*Published in response to numerous requests for information concerning carrying of kits.

§Replaced by surplus kit bags.

¶No longer used for team horses.

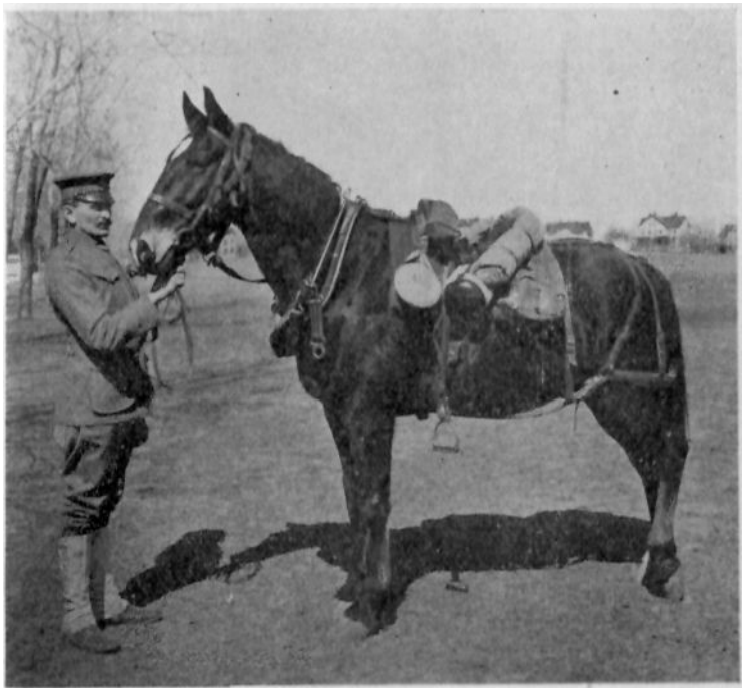
d. For each cannoneer, except mounted cannoneers of horse batteries, in addition to *a*—

1 haversack. 2 canteen-haversack straps.

e. For regimental and battalion noncommissioned staff officers, in addition to *b*—

1 cavalry saber and scabbard. 1 saber knot.
1 saber attachment and slide.

The revolver cartridge belt will be provided with loop for saber attachment.



f. For drum major, in addition to *e*—

1 waist belt enameled leather,
1 saber attachment and slide scarlet.

g. For bandsmen, in addition to *b*—

1 waist belt, enameled leather, scarlet.

h. The following horse equipment is prescribed for each horse:

1 saddle blanket. 1 nosebag. 1 horse cover.
1 halter, complete. 1 surcingle.

2. The following changes in equipments are announced:

a. All artillery saddles will be equipped with the rings, staples, and coat strap slots now provided on the cavalry saddle.

b. Coat straps will hereafter be furnished instead of thongs for all saddles.

c. Coat straps, each thirty-three inches long, will be provided as follows: Two on the pommel of the saddle for each off horse; three on all other saddles.

d. One coat strap forty-five inches long, to be attached to the center of the cantle, will be provided for the cantle of each saddle.

e. A coat strap sixty inches long will be attached to each saddlebag strap ring, and secured so that the buckle is about three inches from the ring.

3. The articles provided for in paragraph 2 will be supplied by the Ordnance Department without requisition, but requisition will be submitted for all other articles needed to complete the equipment under the requirements of this order.

4. The service kit comprises the field kit and the surplus kit.

a. The field kit comprises, in addition to the clothing worn on the person, the following articles:

CLOTHING, ETC.

1 overcoat.	1 housewife.	1 stockings, pair.
1 blanket.	1 slicker.	1 toothbrush.
1 comb.	1 soap, cake.	1 towel.

ARMS AND EQUIPMENTS.

As prescribed in paragraph 1 of this order, excepting—

1 waist belt.	1 saddle cover.
1 revolver cartridge box.	1 horse cover.

AMMUNITION.

20 rounds revolver ball cartridges.

RATIONS.

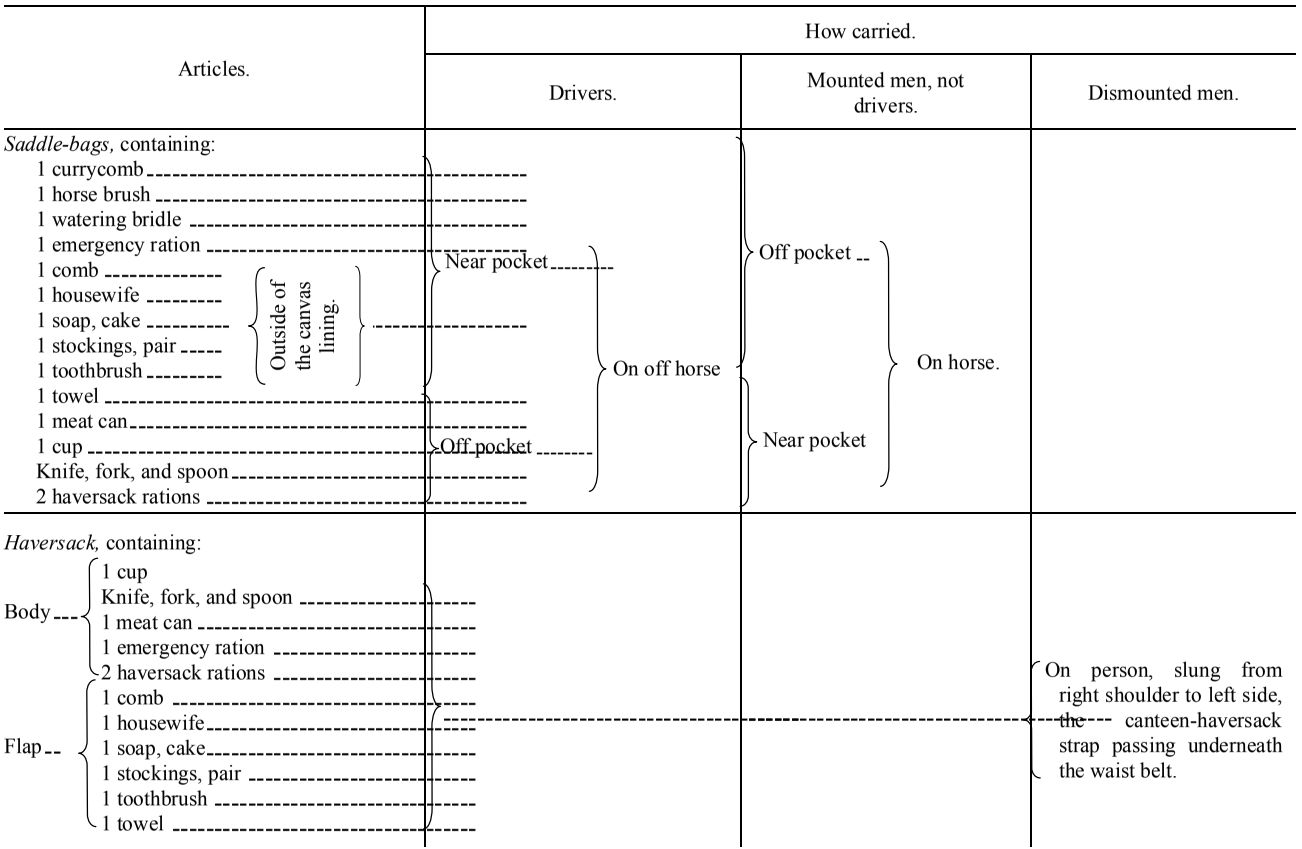
2 haversack rations.	1 emergency ration.

b. The surplus kit consists of:

1 drawers, pair.	2 stockings, pairs.
1 shoes, marching, pair.	1 undershirt.

5. The service kit is packed and transported as shown in the following tabular form:

Service kit for horse and light artillery.



Service kit for horse and light artillery—Continued.

Articles.	How carried.		
	Drivers.	Mounted men, not drivers.	Dismounted men.
Knapsack, containing:			
Body { 1 drawers, pair 2 stockings, pairs 1 undershirt	In kit wagon	In kit wagon	In kit wagon.
Flap----- 1 shoes, marching, pair			
Overcoat or *slicker*	Worn on person; folded square and placed between body and flap of knapsack; or, rolled and strapped to pommel of off saddle.	Worn on person; folded square and placed between body and flap of knapsack; or, rolled and strapped to pommel of saddle.	Worn on person; folded square and placed between body and flap of knapsack; or, folded and placed under paulins on limber chest.
Blanket O. D. *Shelter half, pole and 5 pins*	Rolled and strapped to cantle of off saddle.	Rolled and strapped to cantle of saddle.	Rolled and strapped on limber chest.
Canteen	On near pommel ring, off horse.	On near cantle ring	On person, slung from left shoulder to right side, the canteen-haversack strap passing underneath the waist belt.
Saber		Attached to saddle	On person

Service kit for horse and light artillery—Continued.

Revolver *Revolver holster* *Revolver cartridge belt and fastener* 24 *rounds revolver ball cartridges* *First-aid packet and pouch* *Identification tag*	On person	On person	On person
Spurs and straps	On person	On person	
Saddle *Saddle blanket* *Curb bridle* *Halter*	On each horse	On horse.	
Link		On horse.	
Surcingle	Strapped over saddle on each horse.	Strapped over saddle.	
Nosebag	Two nosebags tied together, slung over off saddle, and secured to near quarter strap on either side by means of a coat strap.	Slung by its strap from off cantle ring and riding under off saddle bag.	

a. Overcoats and slickers.—If the season of the year is such that overcoats will probably not be needed, they are left in garrison or at the base of operations, to be brought up when needed. When overcoats accompany the command, the commanding officer decides whether they shall be worn on the person, carried on the saddles, or on the chests in place of the slicker, or carried in the kit wagon.

If the overcoat is worn, or is carried on the saddle or chest, the

slicker is carried in the knapsack in the kit wagon. Otherwise the slicker is habitually carried with the soldier.

b. The blanket roll for mounted men.—To make the roll: Spread the shelter half (model 1904) on the ground, roll straps underneath, and fold over the triangular part on the rectangular part. Turn under the roll-strap edge of the shelter half so that the width of the fold will be eight inches. Fold the blanket once across the longer

edges and lay the blanket on the shelter half, folded within one inch of the roll-strap edge of shelter half. Fold the sides of the blanket and of shelter half inward, width of folds about eleven inches. The shelter tent pole and pins are now laid on the blanket at the edge farthest from the roll-strap edge, pole on one side, pins on the other, thus leaving what will be the middle of the pack free to bend.

Roll tightly, using hands and knees, toward the roll-strap edge, and bring over the entire roll the part of the shelter half which was

turned under, thus binding the roll. Buckle the two available roll straps about the roll, passing them around twice.

The roll should be about forty-four inches long and about six inches in diameter.

To pack the blanket roll on the horse, three coat straps are used, one to fasten the middle of the roll to the middle of the cantle of the saddle, and one at each end to fasten the end of the roll to the

saddlebag strap ring. The coat straps are passed twice around the roll before being buckled. (See plate.)

In the case of the driver's pack, the straps which secure the ends of the roll also secure the nosebags in place, the strap being carried from the saddlebag ring under the rear quarter strap, then around the nosebag and twice around the blanket roll.

c. The blanket roll for dismounted men.—To make the roll, lay

the shelter half on the ground and fold over the triangular part on the rectangular part.

Fold the blanket in six thicknesses, as prescribed in the Drill Regulations for folding the saddle blanket, except that the first fold is made across the length of the blanket instead of across its width.

Lay the folded blanket on the shelter half so that one of its shorter

sides will be about eight inches from the edge of the shelter half furthest from the triangular part. Across the other short side of the blanket place the shelter tent pole and pins.

Fold over the sides and ends of the shelter half which lie outside of the blanket, causing the ropes and straps to be included within the folds.

Commencing at the end where the pole and pins were placed, roll the pack, using the hands and knees to insure the roll being made as

light as possible. Just before the roll is completed, open out slightly with the hands the pocket formed by the eight-inch fold of the shelter half, and then draw the pocket over the roll, thus binding it. Be particularly careful to draw the canvas over the ends of the roll so as to prevent rain from entering the inner portions of the roll. The roll should be about twenty-two inches long and about seven inches in diameter.

The roll is secured to the limber chest of the carriage, to which the soldier is assigned, by means of the straps provided for the purpose The rolls carried on any one limber chest are evenly disposed on either side of the door lock. (See plate.)

d. To roll the overcoat.—Spread the overcoat on the ground, inside down, skirt buttoned throughout, sleeves parallel to the middle seam, collar turned over on the shoulders.

Turn the tails of the coat under about nine inches, the folded edge perpendicular to the back seam. Fold over the sides to form a rectangle not more than thirty-four inches across, according to the size of the coat. Roll tightly from the collar with the hands and knees and bring over the whole roll that part of the skirt which was turned under, thus binding the roll.

e. Saddlebags.—To prevent the saddlebags from pounding the horse while moving at increased gaits, the saddlebag straps are passed through the *cincha rings* and drawn tight before fastening

f. Nosebags.—(1) For the individually mounted man: Draw the nosebag up under the off saddlebag, the ventilating piece of the nosebag outward and just concealed by the bottom of the saddlebag. Pass the nosebag strap through the off cantle ring, taking a turn around the ring to prevent slipping, and then buckle the strap into its buckle.

(2) For the driver: Fasten the two nosebags together by means of their straps so that the mouths of the nosebags will be about twelve inches apart. If grain is carried in the nosebags, take a turn around the nosebag with its strap before fastening. Sling the two nosebags over the off saddle so that a bag will rest on either side of the saddle, and bring the ends of the blanket roll over the nosebags On either side of the saddle secure the end of blanket roll, and the nosebag underneath it, to the rear quarter strap by means of the coat strap attached to the saddlebag ring.

NOTE: The middle of the broken pack should be strapped to the cantle so that it will clear the horse's back. The nosebags should be locked down with the ends of the pack so as to prevent pounding.

SOME FIELD EXPEDIENTS

BY CAPTAIN E. D. SCOTT, 6TH FIELD ARTILLERY.

PACKING HARNESS

In preparing for possible field service I did some experimenting to determine a suitable method of packing a harness in a paulin for shipment. It seemed desirable that harness pertaining to a carriage should be in a single paulin. This required that the bundle should be shapely, compact, and secure, as otherwise on account of its weight it would be very difficult to handle. Also it must be so made up that the more vulnerable parts of the harness as collar pads, collar faces, etc., should be protected against deformation, scoring, etc. The following system was developed, and will be used by this battery. It fulfills the above conditions fairly well. The terms north, south, etc., refer to the sides of the paulin as it lies on the ground, and are used merely for convenience of description. A person standing at one side of a paulin facing it, would call that side south, the opposite side north, the side to the right east, and that to the left west.

TO PACK HARNESS IN A PAULIN.

Spread paulin on ground, marks down. Place near swing collar in center of paulin, face up, top north, near wheel and lead collars on right and left of it face up, tops south. Place saddle blanket of each horse on his collar, folded in twelve thicknesses. (Just as it is folded for placing on harness peg.) Place off collars on blankets, faces up, headed opposite to the near collars. Off blankets as above. Place near saddles on blankets, headed north and south, attachments folded across seats. Off saddles upside down across near saddles, attachments under. Lay bridles between bars of off saddles. Fold near and swing traces and lay them on the pile, lengthwise. Place the neck yoke on the ends of the off blankets on one side of the pile, wheel traces folded once, in the corresponding place on the other side of the pile.

Fold east and west sides of paulin over ends of pile, then north and south sides. Pass a picket rope around center of bundle, turn it once on itself, then take a turn around the bundle near the end with both free ends, cross these ends over ends of bundle, roll the

bundle over, pass the ends of the rope along the other side of the bundle, taking a turn around the binding parts of the rope in passing, and engage the hook in the ring. Or, lay the picket rope on the ground, its center forming a U, the sides of which are about two feet apart. Spread the paulin over this, and proceed as before. After the bundle is folded, the tying up is somewhat easier than in the first case, but the bundle will not be quite so secure (two turns instead of three), and there will be an excess of rope. Tying a knot in such heavy rope is difficult.

TO MAKE A WATERING TROUGH.

Place two caissons back to back and about two yards apart, trails on ground, brakes set. Spread a paulin on the ground. Lay two spare poles (or any other poles of suitable strength) on the paulin parallel to each other and about four feet from the sides. Carry these two sides over the poles to the center and tie them. Turn the whole over, so that the tied edges are under. Place the ends of the poles in the wheels of the caissons below the spokes that are at the height of the hubs. This will allow the paulin to rest partly on the ground. Tie the middle of the ends of the trough so formed to the spokes above the hubs.

This trough will hold safely 30 cubic feet of water, enough for sixty animals. It can be made in a few minutes.

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REGULAR ARMY.

1*st Regiment* (*Light*).—Col. S. D. Sturgis: 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. Lucien G. Berry: Texas City, Tex.

5*th Regiment* (*Light*).—Col. Granger Adams: Fort Sill, Oklahoma; Bty B, Fort Snelling, Minn.

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. J. H. Sherburne: 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. J. B N. Corey and Lieut. Harry Pfeil, Inspectors, New York City.

New York.—1st Regiment, Col. N. B. Thurston: 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. L. T. Boiseau, 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 A, Birmingham; Btry B, Montgomery.

Louisiana.—Washington Artillery, Maj. Allison Owen: H. Q., Btries A, B and C, New Orleans.

5*th Inspection District*.—Lieut. Albert L. Hall, Inspector, Indianapolis, Ind.

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, Capt. Eugene O. Sanguinet: St. Louis. Btry B, Capt. H. M. Boyer, Kansas City.
Kansas.—Btry A, Capt, W. A. Pattison: Topeka.
Texas.—Btry A, Capt. F. A. Logan: Dallas.
8*th Inspection District*.—Lt. B. M. Bailey, 5th F. A. 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. E. H. Yule, Inspector, Oakland, 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.