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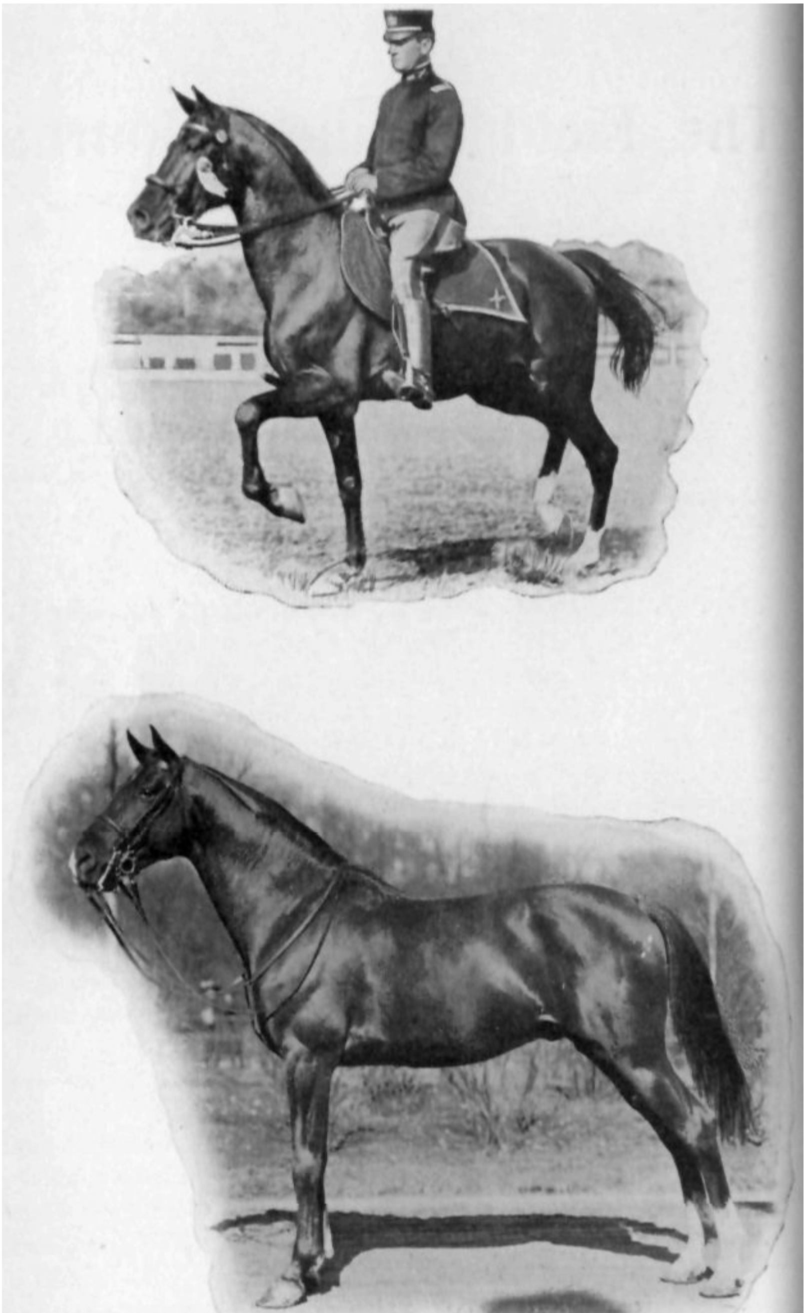

"ARTILLERY"

The Field Artillery Journal

Vol. I APRIL-JUNE, 1911 No. 2

"ARTILLERY"

CHESTNUT STALLION, 16 HANDS, 7 YEARS OLD; WEIGHT, 1100 LBS.

		"Nimr"	"Maidan"	"Leopard"
			"Nazli"	"Naomi"
	"Khaled"		"Haidee"	"Seglawi Jedran"
	(Arab)	"Naomi"	"Yataghan"	
"Artillery"			"Glenelg"	
	"Yuma"	"Glengyle"		
	(Thoroughbred)			
		"Terror Mare"		

This horse, owned by First Lieutenant Frank B. Barrett, First Battery, Field Artillery, National Guard of New York, was exhibited in 1909 and 1910, and has to his credit twenty-three ribbons (twelve blues, six reds, and five yellows), having won them in military, saddle, model, and best trained classes. In the charger classes, his record is unequaled in this country. In the thirteen times he was exhibited he won ten blue ribbons and two reds. He was unplaced the thirteenth time, due to the judges requiring jumping, a condition that was unexpected, as it had never before been required. Two of the blue ribbons were won at the National, two at the Syracuse State Fair, one at Long Branch, one at Spring Lake, Sea Girt, two at New Haven, one at Morristown, and one at the Atlantic City horse shows. One of the reds was won at London International and one at Durlands, New York.

"Artillery's" sire, "Khaled," being of the Seglawi Jedran strain of the Arab, shows royal blood and breeding, being closely inbred and is pedigreed back to the desert, from the most desired family of five of the Arab horse. "Khaled's" sire, "Nimr," was known as one of the finest Arab horses in this country and his mounted skeleton now stands in the New York Museum of Natural History besides "Sysonby," as a model type of the Arab. "Khaled's" dam, "Naomi," was one of the best mares brought out of the desert, and was of the Seglawi Jedran family. "Artillery's" dam "Yuma," was a thoroughbred mare by "Glengyle," by "Glenelg," out of a Terror mare and won ribbons as a jumper and hunter in the National Shows.

SHRAPNEL FIRE

[Report on Firing conducted at Fort Riley, Kan., October, 1996, to determine efficiency of the Frankford Arsenal Shrapnel with 21-sec. Combination Fuze. Published by permission of the War Department.]

I. Information Sought, Methods Pursued, Ammunition Used, Etc.

1. Information as to the effect produced by the shrapnel was the special object of the tests.

Incidentally, however, data have been sought as to the extreme and mean errors of the gun and fuze, as to fuze setting a function of range, and as to the general performance of the projectile and fuze.

2. *Targets and accessories*.—Eight board targets were constructed, each 40 yards wide, 2 yards high, and of 1-inch lumber.

The arrangement and the difference of level of targets and firing points is shown in figure herewith. (See Fig. 1.)*

Telephones were used throughout the tests between the firing and observing parties.

3. *Procedure*.—Ranges were accurately measured, sights and quadrants carefully adjusted.

The fire was first adjusted on an auxiliary target 100 yards to the flank of the third target, and then shifted to the board target.

At the guns an officer verified each sight, quadrant, and fuze setting; and another measured the height of burst and the deviation by means of the B. C. telescope, and kept record of the atmospheric data.

At the targets, as soon as a round was fired, a separate detail for each two targets scored the effect produced, plotted the hits on a form provided for the purpose, indicating by conventional symbols whether the bullets perforated, imbedded themselves, or merely dented the target; a noncommissioned officer and two men used pasters to cover up the hits. The pasters were put on with a good allowance of good starch paste, and careful observation leads to the belief that errors were not caused by recording the same hit more than once.

At the observing station one officer measured the height of burst by means of a graduated screen; while another estimated the interval

* Note.—All illustrations are omitted.

of burst—distance flags having been placed 25 yards apart at the targets for his assistance.

All references in range, deviation and height of burst are to the center of the third target.

4. *Ammunition*.—Thirty rounds were fired at the targets at each of four ranges, viz: 1,900, 2,800, 2,700 and 4,259 yards.

The ammunition fired at these ranges was all of one lot, shipped to the board for the purpose of this firing. The boxes were marked as follows:

"SMOKELESS POWDER N. C."

I. S. P. & Dyn. Co. Lot 1, 1906, for 3″ field model 1902
Charge for 3″ field shrapnel Amm. 24¾ oz.
Vel. 1700 f.s. Pressure 30,600 lbs.
110 gr. percussion primer & ¼ oz. black powder igniter.
Shrapnel 15 lbs 3″ field.
Bursting charge 2¾ oz. black powder.
Fuze: combination, 21 seconds.
Packed, July, 1906."

The data secured for the longer ranges from the foregoing firing, not being regarded as sufficiently complete, additional firing at the same targets was carried out at a range of 3,500 yards. For this purpose 41 rounds of shrapnel, out of a lot recently shipped to the board for experimental purposes, were used. The boxes containing this ammunition were marked as follows:

"POWDER, SMOKELESS N. C."

C. P. W. Co. Lot 1, 1906, for 3 in Field Rifle Mod. 1902.
Charge for 3 in. Field shrapnel.
Amm. 23¾ oz.
Vel. 1700 f.s. Pressure 31,000 lbs.
110 Gr. Percussion primer & ¼ oz. black powder, igniter.
Bursting charge 2¾ oz. B. L. Rifle powder.
Fuze: Combination F. A., 21 sec.
Packed Oct., 1906.

5. *Records*.—The following records accompany this report as separate enclosures:

Plates I, II, III, IV, V.—Tabular records at each range of the firing data used, the atmospheric conditions prevailing, the observations of the range, party, etc., etc.

Plates VI, VII, VIII, IX, X.—Plotted records of the effect produced by a well-adjusted shrapnel at each of the ranges used.

II. Effect Produced by the Shrapnel

Only the bullets which perforated the target, or imbedded themselves in it, are regarded as effective. Bullets which merely dented the targets are regarded as ineffective, though it is thought that many of them would have put a man out of action.

The complete record of hits scored by each round is shown on plates VI, VII, VIII, IX and X.

The plotted record of hits scored by a single well-adjusted shrapnel at each of the different ranges is shown on plates XI, XII, XIII and XV. The number of effective hits scored on the eight board targets by each of these shrapnel is shown in tabular form as follows:

TABLE I.

Range yds.	Height of Burst mils	Interval of Burst yds.	Point of Fall yds.	–100 1	–50 2	±0 3	+50 4	+100 5	+150 6	+200 7	+250 8	Total
1900	3	–95	0	....	32	58	41	29	13	8	2	183
2800	3	–48	+22	....	....	36	47	30	21	9	1	144
3500	3	–95	–50	....	49	32	29	3	1	....	....	114
3700	1	–10	+54	....	....	......	30	40	15	7	....	92
	22			....								
4259	3	–80	–16	....	32	20	9	3	....	....	....	64

The data in the foregoing table is not in convenient form for comparing the effect at different ranges, for the reason that the trajectories were not all adjusted upon the same point; moreover, in the second and fourth cases the point of fall did not happen to be at any one of the targets but at some intermediate point. By plotting a curve in these cases, however, we may deduce the probable effect on a target at the point of fall and at different distances in front and rear of the same.

The data pertaining to all the rounds may then be arranged with reference to their points of fall. The results are shown in Table II.

TABLE II.

	±10	+50	+50	+100	+150	+200	+250
1900	32	58	41	29	13	8	2
2800	16	52	41	24	14	4	0
3500	0	49	32	29	3	1	0
3700	0	30	40	15	7	0	0
4259	0	35	26	13	4	0	0

Examination of the foregoing table, and study of the plotted records of all the rounds, leads to the following conclusions as to the effect produced by the *single* well-adjusted shrapnel:

1. The front (or width) of target effectively covered is between 20 and 25 yards.
2. At ranges up to 3,000 yards, the depth effectively searched is about 200 yards; i. e., about 50 yards in front of the target and about 150 yards in rear of it.
3. At longer ranges (from 3,500 to 4,500 yards), the depth effectively searched is about 125 yards; i. e., about 25 yards in front of the target and about 100 yards in rear of it.

The most favorable distribution of the effective bullets over the front of the target is secured by the perfectly adjusted shrapnel just considered. But, due to the various errors of gun, fuze, etc., the perfectly adjusted shrapnel is infrequently obtained, even after the mean point of burst has been properly established. Shrapnel which burst at considerable distance from the mean point of burst produce little or no effect on the target. This loss of effect must be compensated for by firing a group of shrapnel instead of a single one; and hence it is the effect of the average shrapnel in a group which it is important for us to determine. To deduce this, Table III has been prepared. It shows the number of effective hits made on the several targets by each one of the group of rounds considered; and likewise the total and the average effect.

At the *1,900-yard* range the effect produced by 20 shrapnel is shown. Of these 1 burst on graze, 19 in air. The mean height of burst of the latter was 3.2 mils. The range to mean point of fall of the shrapnel case was 1,923 yards; that is, the fire was adjusted on a point half way between the third and fourth targets.

At the *2,800-yard* range the effect produced by 25 shrapnel is shown. Of these 5 burst on graze, 20 in air. The mean height of burst of the latter was 4.9 mils. The average range to mean point of fall of the shrapnel case was 2,826 yards; that is, the fire was adjusted on a point half way between the third and fourth targets.

At the *3,500-yard* range the effect produced by 28 shrapnel is shown. Of these 7 burst on graze and 21 in air. The mean height of burst of the latter was 4.8 mils. The range to mean point of fall of the shrapnel was 3,470 yards; that is, the fire was adjusted on a point about half way between the second and third targets.

At the *3,700-yard* range the fire was not sufficiently well adjusted to afford reliable results. The firing was prolonged over a whole day and changing atmospheric conditions materially affected the adjustment.

At the *4,259-yard* range the effect produced by 19 shrapnel is shown. Of these 7 burst on graze and 12 in air. The mean height of burst of the latter was 3.4 mils. The range to the mean point of fall of the shrapnel case was 4,229 yards; that is, the fire was adjusted on a point about half way between the second and third targets.

TABLE III.

No. of round	Number of effective hits scored by individual shrapnel on targets 50 yards apart in depth															
	Range 1900 yards								Range 2800 yards							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
6	..	...	....	...	...	...	...	...	..	...	95	59	35	3	1	...
7	..	...	...	...	...	...	...	...	..	...	250	7	8	...	...	...
8	..	...	...	...	...	...	...	...	..	...	54	42	20	9	3	...
9	..	...	...	...	...	...	...	...	..	...	7	...	4	1	1	1
10	..	...	...	...	...	...	...	...	..	...	...	...	2	1	...	...
11	..	...	106	88	63	33	7	4	..		65	...	...	3	...	...
12	..	...	102	59	29	15	8	2	17	10	18	15	4	...	...	...
13	..	...	93	64	58	17	6	4	..	...	n	e	n	e	...	...
14	..	32	58	41	29	13	8	2	17	5	7	7	5	5	2	1
15	..	...	104	64	45	16	7	7	1	21	13	9	5	6	2	2
16	..	...	84	57	52	22	2	5	..	27	33	29	15	2	3	6
17	..	...	127	72	58	19	10	4	18	15	17	15	8	3	...	3
18	..	...	93	57	58	27	7	3	..	...	250	58	42	15	4	...
19	..	...	68	82	71	37	8	2	..	...	2	27	26	22	13	8
20	..	1	61	40	41	15	4	5	..	12	10	17	12	8	5	3
21	..	...	...	7	8	3	1	2	..	...	8	45	39	22	7	3
22	..	20	47	23	17	13	...	..	...	...	36	47	30	31	9	1
23	15	23	17	17	8	9	...	...	..	...	...	175	65	46	17	4
24	2	45	54	11	2	...	...	...	..	23	22	7	20	17	2	...
25	19	24	17	8	5	...	...	...	..	2	18	21	36	10	5	8
26	..	37	43	28	22	8	1	2	..	...	...	35	55	53	18	11
27	..	...	55	52	26	32	8	2	..	...	16	18	19	23	4	5
28	..	1	56	38	30	17	6	4	..	...	...	28	35	41	14	10
29	..	...	70	37	58	18	12	5	..	...	21	21	24	23	5	7
30	..	...	46	43	34	19	10	2	..	...	26	14	20	12	8	3
*	40	183	1301	895	723	335	105	55	53	115	968	696	529	336	123	76
†	2	9	65	45	36	17	7	3	2	5	38	28	21	13	5	3

* Total effective hits. † Average per shrapnel.

TABLE III (Continued).

No. of round	Number of effective hits scored by individual shrapnel on targets 50 yards apart in depth															
	Range 3500 yards								Range 4259 yards							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
12	..	...	....	...	...	...	...	...	1	15	10	6	2	...	2	...
13	..	...	....	...	...	...	...	...	..	...	n	e	n	e		
14	..	17	16	15	7	...	2	...	5	15	12	7	5	5	3	1
15	1	12	7	5	5	1	...	1	..	116	12	10	9	...	...	...
16	8	6	2	2	1	...	...	...	17	5	6	8	3	3	1	...
17	..	49	32	29	3	1	...	...	..	...	n	e	n	e	...	...
18	11	3	10	5	2	1	...	...	..	...	n	e	n	e	...	...
19	..	26	23	10	1	...	...	..	...	39	12	5	1	1	...	...
20	..	33	22	18	4	...	...	...	...	...	83	17	16	5	...	...
21	1	15	13	7	2	1	...	...	..	21	13	17	7	1	...	...
22	12	12	9	10	1	...	...	...	..	...	...	2	...	...	...	...
23	..	21	12	14	7	1	...	...	..	25	...	...	...	...	...	...
24	..	25	10	11	5	...	1	...	..	31	17	7	2	1	...	...
25	..	12	5	4	6	1	...	...	..	...	n	e	n	e	...	...
26	..	...	....	...	1	...	...	...	..	...	40	29	3	3	1	...
27	..	...	2	...	...	...	...	...	..	...	72	10	9	5	1	...
28	..	...	1	1	...	...	...	...	..	...	49	7	6	3	...	...
29	..	...	26	5	2	2	...	...	..	32	20	9	3	...	...	...
30	..	...	n	e	n	e	...	...	..	...	not	rec	or	ded		
31	..	...	n	e	n	e	...	...	..	...	...	...	...	...	...	...
32	..	...	n	e	n	e	...	...	..	...	...	...	...	...	...	...
33	..	3	25	16	11	3	...	...	..	...	...	...	...	...	...	...
34	..	...	14	4	7	5	1	...	..	...	...	...	...	...	...	...
35	1	7	3	3	5	5	...	...	..	...	...	...	...	...	...	...
36	..	2	16	9	5	4	3	...	..	...	...	...	...	...	...	...
37	..	2	11	11	8	4	...	...	..	...	...	...	...	...	...	...
38	..	3	11	11	1	1	1	...	..	...	...	...	...	...	...	...
39	..	10	24	17	6	1	...	...	..	...	...	...	...	...	...	...
38	..	...	....	2	...	...	...	...	..	...	...	...	...	...	...	...
41	..	...	29	4	3	2	...	...	..	...	...	...	...	...	...	...
*	34	258	323	213	93	81	8	1	23	299	346	234	66	27	8	1
†	1	9	12	8	3	1	...	...	1	15	18	7	4	1	...	...

* Total effective hits. † Average per shrapnel.

Putting the data of Table III in convenient form for comparison as was done above in the case of the single shrapnel, we have

TABLE IV.

	–50	0	50	100	150	200	250
1900	31	55	40	26	13	5	2
2800	16	34	25	16	8	4	2
3500	4	16	10	5	2	..	..
4259	5	21	13	5	2	..	..

At the 3,500-yard range the efficiency shown at 0 and at 50 yards is believed to be somewhat less than the average; this is due to the fact that few low bursts close to these targets were obtained. Such bursts were obtained at the other ranges and served to materially raise the average effect at these two points. Otherwise, the figures are believed to give a fair estimate of the performance of the shrapnel.

It is to be noted that at the short range the effect produced by the average shrapnel of a group is about equal to that produced by a single well-adjusted shrapnel. At the mid-range the effect of the average shrapnel is somewhat less, while at the longer ranges it is markedly less than the well-adjusted shrapnel; this is especially due to the fact that, as the range increases, a much larger proportion of bursts on graze are obtained, and these are almost wholly ineffective.

The figures of Table IV may be taken as indicating *a law* of decrease in effect as the target is removed from the mean point of fall. It is shown that at the short and mid-ranges at least a small error in range (25 yards) is not of great importance, when a deep target is considered, but that it is always greatly preferable to have the range too short rather than too long.

A better understanding will be gained, both of the efficiency of the shrapnel and of the most appropriate methods of using it, if we employ the foregoing data to show the density of fire produced that is, the number of effective bullets per square yard of vertical surface.

To do this, let us assume the fire properly adjusted upon a target of service dimensions; for example, a target 100 yards wide and 1 yard high and offering in consequence a vertical surface of 100 square yards. As this target is just half the height of the target actually used in the firing from which the foregoing data was secured, the average number of hits per shrapnel upon it should be one-half those shown in Table IV. Thus, for the 2,800-yard range, each gun should make 3,417 hits per shrapnel. If all four guns were directed at the target and a battery salvo fired, they should make 17×4=68 hits per salvo, or 68 hits per salvo per square yard of target. This is the density of fire upon a target on which the fire is perfectly adjusted. Upon other similar targets within the field of fire, but removed from the targets just considered, by successive increments of 50 yards in front and rear, the density of fire, due to the same salvo, may be similarly deduced. The results are tabulated in Table V for the different ranges considered.

TABLE V.

Range	No. of effective hits per salvo per sq. yd. of vertical target at the mean point of fall (0) and at increments of 50 yds. in front and rear of same.							
Yards.	–100	–50	±0	+50	+100	+150	+200	+250
1900	....	.62	1.10	.80	.52	.26	.10	.04
2800	....	.32	.68	.50	.32	.16	.08	.04
3500	....	.08	.32	.20	.10	.04	....	....
4259	....	.10	.42	.26	.10	.04	....	....

The above figures give us a measure of the density of fire in a shrapnel-swept zone, 100 yards wide, due to a battery salvo of one round per gun. They indicate that if at least *two* rounds per gun are fired we can expect to cover with considerable intensity a zone 100 yards wide and 250 yards deep at the short and mid-ranges, and a similar zone 150 yards deep at the longer ranges.

The data of Table V will be of great assistance in discussing methods of fire and in determining the number of rounds which should be fired in order to cover different areas effectively. From the point of view of the efficiency of the shrapnel, the striking deduction to be drawn is as to the small effect produced at long ranges, even at 3,500 yards. This low efficiency especially impressed itself upon an observer watching the fire and examining the targets. The reasons therefor are discussed below.

The total percentage of ineffective bullets is no greater than at the short ranges. The explanation is rather to be sought in the high angle of fall and the consequent small danger space. The average effect is also greatly reduced on account of the increased number of bursts on graze, which result from the errors of the fuze combined with the small interval of burst.

Until a greater efficiency per shrapnel at the long ranges is secured, the necessary density of fire must be obtained by firing at these ranges a greater number of rounds than would be needful to produce the same effect at the shorter ranges.

III. Extreme, Mean, and Probable Errors of the Gun

The extreme and mean errors for the different ranges are shown in Table VI.

TABLE VI.

Measured Range	Sight Elevation	Range corrected for atmospheric conditions	Errors in Range: Extreme	Errors in Range: Mean	Errors in Range: Number of rounds considered	Errors in Direction: Extreme	Errors in Direction: Mean	Errors in Direction: Number of rounds considered
Yds.	Yds.	Yds.	Yds.	Yds.		Yds.	Yds.	
1900	2000	1948	+36	±14	24	11.2 R	±2.5	24
2800	2800	2808	+46	±21	27	6.7 L	±2.3	27
3500	3700		+83	±16	31	9.2 L	±2.1	15
3700	3650	3611	+43	±20	20	8.8 R	±2.2	20
4259	4150	4113	+55	±20	22	14.7 R	±5.2	22

From the information thus obtained and from that afforded by previous firing conducted by the board, it is considered that the probable errors of the gun may be taken as follows:

TABLE VII.

Range	Probable error in range	Probable error in direction
Yds.	Yds.	Yds.
2000	12.	2.0
2500	13.5	2.5
3000	15.	3.0
3500	16.	3.5
400	17.	4.0

IV. Extreme, Mean, and Probable Errors of the Fuze

Table VIII shows the extreme and mean errors in point of burst of various groups of shrapnel fired with the same fuze setting. For purposes of amplification the record of four groups fired at Sandy Hook is added to those fired at Fort Riley.

TABLE VIII.

Fuze Setting	Range to mean point of burst	Mean time of flight	Errors in Range: Extreme	Errors in Range: Mean	Errors in Time: Extreme	Errors in Time: Mean	No. of rd. considered	Number of bursts in air and on graze for same fuze setting	Mean temperature	Mean barometer
Secs.	Yds.	Secs.	Yds.	±Ys.	Secs.	±Scs			0	in.
3.8	1726	4.04	....	34	......	.04	4	4 in air............		
								1 on graze	50	29.70
4.0	1844	4.153	–61	28	+.09	.09	9	all in air..........	....	....
4.1	1822	4.216	....	27	......	.11	6	all in air..........	....	....
6.0	2613	6.68	....	35	......	.18	4	4 in air............	....	....
								1 on graze	63	29.45
6.2	2736	6.826	–131	52	+.37	.16	14	all in air..........	....	....
8.6	3467	9.0	....	50	......	.14	5	5 in air............	....	....
								2 on graze	....	....
								1 failed to	....	....
								burst................	80	29.30
8.8	3614	9.45	....	59	......	.21	4	4 in air............	....	....
								1 on graze	....	....
9.0	3655	9.48	....	45	......	.17	5	all in air..........	....	....
9.1	3372	9.38	+98	49	+.40	.20	4	all in air..........	....	....
9.2	3384	9.53	114	40	+.31	.15	21	21 in air	....	....
								2 on graze	....	....
9.3	3418	9.5	–78	47	.26	.21	4	4 in air............	....	....
								5 on graze	....	....
11.0	4161	11.62	112	45	+.38	.17	15	15 in air	....	....
								11 on graze	71	29.40
Sandy Hook: May 25—June 5, 1906; Fuzes marked 5 F.										
5.8	2372	5.79	–172	68	.40	.167	9		69	29.99
10.6	4129	11.41	+156	55	+.45	.19	9		69	29.89
18.6	6184	20.24	–69	28	+.73	.23	9		73	30.
22.	7080	23.12	–151	66	.55	.25	8		70	29.98

The errors tabulated in Table VIII cannot be regarded as furnishing altogether an accurate estimate of the performance of the fuze: First, because they are not usually determined from a given fuze setting, only the bursts in air being considered—while as a matter of fact in most of the groups considered a certain proportion of the shrapnel reached the ground before bursting. Thus the extreme dispersion for a given fuze setting is not always reckoned upon in computation.

The figures are believed, however, to give a fair approximation of the errors involved. They indicate that the mean error in time of burning increases at first with the range, but that, owing to the compensating effect of diminutation in velocity of this projectile, the error soon becomes practically constant, or tends to decrease, as the range is still further increased. If we take the *mean* error as .2 sec. for all ranges, it is thought that we will be on the safe side and not far wrong. The probable error would then be 1.69 sec.

Accepting this as the probable error, we may deduce what percentage of the shrapnel may be expected to burst on graze when the mean burst of a group is at the normal height. This information is of special value as affording a check on the adjustment of the height of burst during shrapnel fire.

To do this, first compute the burst interval for the normal height of burst at the different ranges. Then, by the use of probability factors, determine what percentage of the bursts would have occurred on the trajectory prolonged, if impact with the ground had not intervened.

The results are shown in Table IX, worked out both for a height of 3 mils and for a low burst of 1 mil, the latter being specially applicable in the preliminary fire for adjustment.

TABLE IX.

Range Yds.	Probable error Yds.	Burst-interval h=3 mils Yds.	Per cent on graze Per cent.	Burst-interval h=1 mil Yds.	Per cent on graze Per cent
1000	68	118	12	39	35
1500	62	97	15	32	37
2000	58	83	16	27	38
2500	54	73	18	24	38
3000	52	66	19	22	39
3500	49	61	20	20	39
4000	46	56	21	19	39
4500	44	51	22	17	40
5000	42	48	22	16	40

That is, while adjusting the fire a little more than one-third of the rounds should be on graze; while firing for effect the following proportions of burst on graze should prevail:

At the short ranges (up to 2000 yards).. 1/8
At the mid ranges (2000-3500 yards) 1/6
At the long ranges (3000——yards).. 1/4

V. Fuze Setting as a Function of Range

Table X gives the data available for plotting a curve of fuze setting. Column 3 in this table shows the range to mean point of burst corrected for atmospheric conditions; columns 4 and 5 show the tabular times of flight for the actual and for the corrected mean ranges; and column 6 shows the *observed* mean time for flight. It will be noted that the observed mean time for flight agrees in most instances quite closely with the tabular time for flight for the corrected range.

The last two entries in the table are taken from records of firing conducted at Sandy Hook, and no firing at extreme ranges has been had by the board. The uncorrected ranges are used as the conditions were practically normal. The firing took place June 5, 1906, with fuzes marked 5 F.

TABLE X.

Fuze Setting	Range to mean point of burst	Range corrected for atmospheric conditions	Tabular time of flight for actual mean range	Tabular time of flight for corrected mean range	Mean observed time of flight	Excess of mean time of flight over fuze setting
Secs.	Yds.	Yds.	Secs.	Secs.	Secs.	Secs.
3.8	1726	1746	3.96	4.03	4.04	.24
4.0	1844	1869	4.30	4.35	4.16	.16
4.1	1822	1851	4.24	4.31	4.22	.12
6.0	2613	2623	6.61	6.66	6.68	.68
6.2	2736	2695	6.98	6.85	6.83	.68
8.6	3467	3354	9.35	8.98	9.00	.40
8.8	3614	3483	9.86	9.41	9.45	.65
9.0	3655	3523	9.89	9.55	9.47	.47
9.1	3372	3540	9.02	9.60	9.38	.28
9.2	3384	3526	9.05	9.55	9.53	.33
9.3	3418	3574	9.20	9.71	9.50	.20
11.00	4161	4045	11.86	11.42	11.62	.62
18.6	6184	....	....	....	20.25	1.65
22.	7080	....	....	....	23.12	1.12

TABLE XI.

Range	Fuze setting for full range	Interval of burst for h=3 mils	Δ X for Δ T=2 sec.	Set back necessary for burst in front of target 3 mils high	Corrected Fuze Setting	Actual fuze setting obtained with corrector %
Yds.	Secs.	Yds.	Yds.	Secs.	Secs.	Secs.
500	1.1	300	95	.6	.5	....
600	1.3	...	..	..	.7	....
700	1.5	...	..	..	.9	....
800	1.7	...	..	.5	1.2	....
900	1.9	...	..	.4	1.8	....
1000	2.1	117	83	.3	1.8	.4
1100	2.3	...	..	..	2.0	....
1200	2.3	...	..	..	2.2	....
1300	2.7	...	..	..	2.4	....
1400	3.0	...	..	..	2.7	....
1500	3.2	97	74	.3	2.9	1.6
1600	3.4	...	..	..	3.1	....
1700	3.7	...	..	..	3.4	....
1800	3.9	...	..	..	3.6	....
1900	4.1	...	..	.2	3.9	....
2000	4.4	83	68	..	4.2	3.2
2100	4.7	...	..	..	4.5	....
2200	4.9	...	..	..	4.7	....
2300	5.2	...	..	..	5.0	....
2400	5.5	...	..	..	5.3	....
2500	5.8	73	64	..2	5.6	4.8
2600	6.1	...	..	..	5.9	....
2700	6.4	...	..	..	6.2	....
2800	6.7	...	..	..	6.5	....
2900	7.0	...	..	..	6.8	....
3000	7.4	66	62	.2	7.2	6.4
3100	7.7	...	..	..	7.5	....
3200	8.0	...	..	..	7.8	....
3300	8.3	...	..	..	8.1	....
3400	8.7	...	..	..	8.5	....
3500	9.0	61	59	.2	8.8	8.2
3600	9.3	...	..	..	9.1	....
3700	9.7	...	..	..	9.5	....
3800	10.0	..	..	..	9.8	....
3900	10.3	...	..	..	10.1	....
4000	10.7	56	55	.2	10.5	10.1
4100	11.0	...	..	..	10.8	....
4200	11.4	...	..	..	11.2	....
4300	11.7	...	..	..	11.5	....
4400	12.0	...	..	..	11.8	....
4500	12.3	51	52	.2	12.1	12.0
4600	12.7	...	..	..	12.5	....
4700	13.0	...	..	..	12.8	....
4800	13.4	...	..	..	13.2	....
4900	13.8	...	..	..	13.6	....
5000	14.2	48	50	.2	14.0	14.1
5500	16.0	45	48	.2	15.8	16.2
6000	17.8	41	42	.2	17.6	18.3
6500	19.5	37	36	.2	19.3	20.1

In Table XI the fuze settings shown in the second column were obtained from a curve plotted with the date of Table X. The fuze settings which we desire to know, however, are the ones which, for each range, will cause the shrapnel to burst in front of the target and the normal height, and column 4 the change in range to point of burst if a setback of .2 sec. is used. Column 5 shows the setback which is recommended, and column 6 the fuze setting corrected for setback.

The corrected fuze settings here given are slightly different from those contained in the preliminary communication of the board on this subject dated November 14, 1906. The difference is due to the facts that more complete data have become available and that ranges have been corrected for atmospheric conditions.

In the last column of Table XI fuze settings are shown as obtained by the use of the present fuze setter, using the Krupp scale and corrector *30*. It will be noted that these fuze settings differ so much from the desired fuze settings that it will be necessary to correct the range scale of all fuze setters.

VI. Notes

1. *The fuze*.—It may be said that the time fuze acted with a considerable degree of uniformity. Four very erratic bursts were noted.

The error of the fuze is, however, much too great. It has been shown that at mid-ranges, after the height of burst has been properly adjusted in front of the target, about 20 per cent of the shrapnel will reach the ground before bursting. They are then, as a rule, quite ineffective. Moreover, about ten or 15 per cent will burst so high as to be almost wholly ineffective. Thus, due to the error of the fuze, about 30 per cent of the shrapnel are practically wasted.

Artillery efficiency is measured by its ability to burst effective shrapnel at the target. For this purpose the whole expensive plant in men, animals and material is maintained. Assuming that the personnel were capable of performing its part perfectly, the measure of efficiency would still depend upon the accuracy of the fuze. The importance, then, of securing of most perfect fuze cannot be overestimated. It is the present weak point in the system.*

2. *The shrapnel case*.—The new shrapnel case appears to be of satisfactory construction. Out of the 161 shrapnel fired very few cases broke up. It was not possible to determine the exact number, but it is believed that the number did not exceed 5 per cent.

None of the shrapnel broke up in the gun.

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* The "hooded vent" fuze, with a reduced error, has since been adopted.

3. *Bullet pattern*.—Taken as a whole the plotted records show the bullet distribution to have been quite uniform. The following minor points are noted:

(a) When the case broke up the pattern on the targets was markedly irregular; it did not compare favorably with patterns made by shrapnel whose cases did not break up.

(b) Some of the patterns showed evidence of unfavorable bunching of the bullets. All of the bullets picked up were flattened somewhat where they had been in contact with neighboring bullets in the case; in a good many instances groups of them apparently remained together for a portion of their travel after being ejected from the case.

(c) Absence of effect at the center of the sheaf was frequently noted, due presumably to the centrifugal velocity which the bullets had at the moments of burst. This was not excessive, however, and when a group of shrapnel are fired, is compensated for by the error in direction.

4. *Percentage of ineffective bullets*.—As has been stated, only those bullets which perforated the target, or remained imbedded in it, were regarded as effective. Bullets which dented the target were considered ineffective, even though many of them penetrated more than one-half inch of wood before rebounding. Such bullets, striking a man in the head or other vital places, would undoubtedly have put him out of action. It was necessary, however, to establish a definite rule for the scoring officers, and if an error is made it is at least on the safe side.

As indicating to some extent the general efficiency of our gun and shrapnel, it will be interesting to determine what relation the ineffective hits has to the total hits, and how this relation varies at different distances from the mean point of fall. Table XII has accordingly been prepared. It shows, for the groups of shrapnel heretofore considered, the total hits and the ineffective hits, and the relation which the latter have to the former, expressed as a percentage.

TABLE XII.

Range Yds.	No. of total and of ineffective hits on vertical targets 50 yards apart, with percentages of ineffective hits per total									
	1	2	3	4	5	6	7	8	Total	
	45	218	1382	1056	1106	753	262	152	4974	Total hits.
1900	5	35	112	161	384	418	167	97	1379	Ineffective hits.
	.11	.16	.08	.15	.34	.55	.64	.64	.27	% Ineffective.
	69	178	1081	883	917	770	389	212	4499	Total hits.
2800	16	63	81	186	384	429	255	136	1550	Ineffective hits.
	.23	.35	.07	.21	.41	.55	.66	.64	.34	% Ineffective.
	36	227	417	283	241	132	73	27	1486	Total hits.
3500	2	19	95	70	148	101	65	26	526	Ineffective hits.
	.05	.07	.22	.24	.61	.76	.89	.98	.35	% Ineffective hits.
	23	333	427	218	206	129	41	11	1389	Total hits.
4259	....	36	81	87	138	92	33	10	477	Ineffective hits.
	....	.10	.19	.39	.67	.71	.80	.90	.34	% Ineffective.

Table XII indicates that *at all ranges*, about one-third of the bullets are ineffective.

To show how the above percentage compare at different distances from the mean point of fall, the data may be arranged as shown in Table XIII.

TABLE XIII.

	+0	+15	+100	+150	+200	+250 yds.
1900 yds.	8	15	34	55	64	64%
2800 "	7	21	41	55	66	64%
3500 "	7	22	24	61	76	89%
4259 "	10	19	39	67	71	80%

The rapidity with which effect in depth falls off as the range is increased beyond 2,800 yards, is again markedly in evidence here.

5. *Decrease in effect as the range is increased*.—A fair idea of the rapidity of decrease is obtained by comparing the total and the average number of *effective* hits scored at different ranges by the groups of rounds heretofore considered. Thus:

Range	Total effective hits	Average effective hits per shrapnel	No. of rounds considered
1900	3595	185	20
2800	2949	115	27
3500	960	34	28
4259	912	46	18

From this it appears that the effect holds up very well until a range of about 3,000 yards is reached; beyond that it falls off quite rapidly. The number of ineffective bullets is about the same at all ranges; so the loss in total effect is not especially due to lack of striking velocity of the bullets which actually reach their targets. It is rather to be explained:

(a) By the actual failure to score hits on vertical targets due to the high angle of fall and the small danger space of the bullets.

(b) By the increased number of ineffective bursts chargeable to the error of the fuze. Bursts on graze are most numerous, due to the smaller burst-interval, and are almost wholly ineffective; high bursts are more ineffective than at short ranges, due to the fact that the bullets, having a lower velocity, have a much smaller effective range.

The remedies for these causes of ineffectiveness may at least be easily pointed out, viz: (a) to secure greater terminal velocity of the projectile at the longer ranges; (b) to improve the fuze.

The latter is a plain proposition which stands by itself. The former raises at once the question of increasing the initial velocity of the gun, and hence affects the whole system of field artillery construction. It is not now taken up for discussion. The point to be noted is that, until greater shrapnel efficiency at the longer ranges is secured, effect must be sought by firing at these ranges a greater number of rounds than would be necessary to produce the same effect at the shorter ranges.

6. *Effective range of shrapnel bullets*.—From the data of Table XII we may deduce:

(a) That, at the short and mid-ranges, 35 per cent of the bullets are still effective at a distance of about 300 yards from the point of burst.

(b) That at ranges from 3,500 to 4,500 yards, 35 per cent of the bullets are still effective at a distance of about 200 yards from the point of burst.

7. *Influence of height of burst on effect*.—The normal height of 3 mils give the most favorable distribution of effect, when targets of all kinds are considered; that is, the density of fire approaches most nearly to one hit per unit of surface.

A lower height of burst gives a very dense effect over a restricted area, but the bullets are not used economically; two or three bullets are expended to do the work of one.

A greater height of burst increases the width and depth of the bullet pattern and permits utilizing the full effective range of the bullets; but the density of fire decreases, and the proportion of ineffective hits increases, very rapidly as the height of burst increases. Hence, the area is not effectively searched. It is to be noted, however, that against broad deep targets it is preferable to have the mean height of burst a little high rather than too low, as the former gives a better distribution of the effect.

8. *Bursts on graze*.—The small effect produced by shrapnel bursting on graze was strikingly illustrated in these tests. The conditions of ground and slope were quite favorable, and yet unless the projectile struck short of a target and within 10 yards of it, little or no effect was secured on that target. Scattering hits were produced on targets 100 to 200 yards in rear, but they were always ineffective.

It was noted that at 3,700 yards the projectile still ricochetted, and burst after graze was obtained. But at 4,259 yards the projectile did not ricochet, but entered the ground and burst after penetrating about two feet. A large crater resulted, but *no* effect was produced on the targets.

DIFFICULTIES OF A NATIONAL GUARD FIELD ARTILLERY COMMANDER

BY MAJOR T. M. WORTHAM; 1ST BATTALION F. A., VIRGINIA VOLUNTEERS.

The question of the maintenance of national guard field artillery is perplexing, not only to the War Department, but to those who represent that arm in the States.

At the Field Artillery School at Fort Riley, Kansas, last June, when the question of forming a Field Artillery Association was brought up for consideration, those of us who represented the national guard had an experience meeting. As the speakers were from almost every State in the Union, many hard-luck and a few good-luck stories were heard, the majority being just betwixt and between; but there was not one told that did not carry the conviction that the man telling it had been fighting for the financial life of his battery so long that it had become second nature with him. Those listening, seemed to take this as a matter of course, for each one knew from long experience that every officer of the national guard field artillery must assume this burden, so little understood by the other arms of the service.

The difficulties of financing, single-handed, an expensive and important arm of the service, when you are in the smallest kind of a minority and the majority against you does not know what is needed and sometimes appears not to want to know, is little appreciated by the other arms. You do it because you want to serve your State and because you love the light battery. The novelty wore off years ago. You know there is nothing in it for you but hard work anxiety, and responsibility.

But constant care and responsibility of this kind will set a mask on a man's face that will be very apt to cause those meeting him to turn and look at him again. That night last June in the lecture tent at Fort Riley, when the formation of the association was under consideration, the field artillery officers wore this mask, and it mattered not whether they came from the North or the South, the East or the West, responsibility had made them all kin. On reporting at the school each man had a serious, thoughtful look on his face, and almost without exception spoke quietly and very little. Not one of them seemed surprised to find those from other States pretty much his own kind. Seriousness and thoughtfulness seemed naturally to accompany the uniform they wore.

There are about fifty batteries of field artillery in the United States National Guard; but the fact that they, such as they are, are in existence at all, is the achievement of the battery commanders and not that of the national government or the States.

The instructors at the Fort Riley School found that there were a great many things the student officer knew very little about; but I have often wondered if they ever took the trouble to find out the one thing he has never known, viz: when he was whipped in this every-day struggle for existence.

The field artillery materiel we now have is a very new thing in this country. The piece used is as far in advance of the one used during the war with Spain as that was in advance of the old muzzleloading rifle used at Gettysburg. Is it strange, therefore, that the State authorities and even the other branches of the militia should be uninformed as to the needs of field artillery of the present day? To the usual legislature, even with a sprinkling of civil-war veterans among its members, a piece of artillery means only the old cannon on the state-house green that may have been there since the war of 1812 and certainly has been there since 1865. The old cannon has been painted from time to time, and even though exposed to the weather both winter and summer, it will last for years. To fire it on the Fourth of July, it is only necessary to get a few pounds of black powder at the nearest store, a ladle to pour the powder into the muzzle, plenty of brown paper for wads, a bucket of water to swab out the piece after firing, and a red-hot poker to set the charge off. It is a perfectly good gun. It held the heights at Gettysburg, or did gallant service at Appomattox. So, when our State authorities are importuned for money for the care and preservation of material or for the hire of mechanics and horses, those who make the request are looked upon at first with pity and if the request is pressed at all are told to go about their business. If the request is addressed to a committee, old Colonel Blank is usually the chairman. He was in the artillery from 1861 to 1865, and, of course, knows more about what is needed than can a mere militiaman who never smelled powder; and any contention or explanation is an insult to him which he will not hesitate to resent. "Why, my boy," he will condescend to say after the first explosion is over, "In the Wilderness, Grant had one of those things you are telling us about. They put great dependence upon it, and placed it in position against Lee. They tried to fire it, and the thing busted, sir! After they fell back I went over and looked at it. It resembled a pile of scrap iron. It had killed the whole detachment!"

The State authorities are not bad fellows; but they simply do not know, and it will take time, tact, and diplomacy to teach them. When once they understand and appreciate the fact that just so many guns are necessary for every thousand bayonets, and that, owing to the changed conditions and the fact that the army of every other country to-day has this proportion of guns per thousand bayonets, that unless we maintain the same proportion ourselves, our thousand bayonets will be practically useless—then the State authorities will do all in their power to help the field artillery. But to teach them this requires hard work, much patience, and lots of printer's ink; and the things printed must be made attractive enough to get a busy public to read them.

We, in Virginia, have tried to teach our people, and, thanks to some of our leading newspapers, I believe that today the 3-inch field artillery materiel and its needs are as thoroughly understood in this State as anywhere in the country. But it has taken five years of hard work to bring about this condition, and, lest the people of the State forget what they have been taught, we are still working. We are using everything we can find in the way of literature bearing on the subject, dressing it up with a little local color so that it will appeal to our people. We try to keep before the public all the time. For instance: Captain O'Ryan, of New York, gave out last summer a most excellent interview about work with his battery at his farm. I saw the New York newspaper containing the interview, and found that most of the work described was very much like that done at the Fort Riley School with batteries of the regular army. My battalion was about to leave for Gettysburg, and I told a newspaper reporter that the work described was so much like that which we would do at Gettysburg that I could not improve upon the description. He published nearly all of it, giving Captain O'Ryan credit for what he was doing in New York, but telling the people of Virginia that it was exactly what my batteries from Richmond, Norfolk, and Portsmouth would be doing in Pennsylvania a week later.

The service papers do good work, and we of the national guard owe them much. But, unfortunately, they only reach the already converted. It is the daily paper that our State authorities, city fathers, merchants, bankers, citizens generally, read regularly and *believe;* and, more important still, it is the daily paper only which is seen by the young fellow we want to reach and interest so that he will enlist in the battery, find out with us how to use sights, to drive, to calculate firing data, to learn to love it all, and finally, to have the field artilleryman's mask of serious thoughtfulness placed on his face so that one of these days he will help to carry the field artilleryman's burden here in Virginia and be proud of his load.

EXTRACTS FROM

REPORT OF THE FIELD ARTILLERY BOARD

ON A

TEST OF THE EFFICIENCY OF MODERN FIELD WORKS WHEN ATTACKED BY THE LATEST TYPES OF FIELD CANNON DESIGNED FOR THE UNITED STATES ARTILLERY

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Chapter I

HISTORICAL

In September, 1907, there took place at Fort Riley, Kans., an experimental attack and defense of a redoubt which had been constructed the previous year by the engineers and details from the infantry commands present at the maneuver camp. This redoubt (to be known as Redoubt No. 1 in this report) was intended for a battalion of infantry with machine guns, and was attacked by the fire of the 3-inch field gun, the 5-inch siege gun and the 7-inch howitzer.

In its report on the results of this firing the board of officers detailed to conduct the test recommended that another redoubt, designed to resist the more powerful guns and howitzers about to be supplied the field artillery, be constructed; and that in the construction of such a redoubt the following modifications of the design of Redoubt No. 1 be made:

1. The ditch to be made deeper and the wire entanglement to be fully covered by the crest of the glacis.
2. The overhead cover for both bombproofs and galleries to be 7 feet of earth and 10 by 10 inch or 12 by 12 inch timbers.
3. If machine guns be used in the defense, to have suitable emplacements designed for the service type of guns.
4. The parados or interios traverse to be 25 feet thick instead of 18 feet.
5. The angle at the salient to be 150º instead of 120º.

This recommendation for the construction and test of a stronger type of redoubt was concurred in by the Board of Ordnance and Fortification at a meeting held October 1, 1908, and it was recommended by them that the General Staff prepare a program for a series of experiments such as proposed, employing the guns then in process of fabrication.

* * * * * * *

On July 3, 1909, First Lieutenant R. P. Howell, jr., Corps of Engineers, reported to the board with twenty-one enlisted men of the Third Battalion of Engineers, to begin the construction of the new redoubt (to be known in this report as Redoubt No. 2). Lieutenant Howell, under the supervision of Major Flagler, took personal charge of the building of the field works, which were constructed by contract, and also made the necessary repairs on Redoubt No. 1.

* * * * * * *

Chapter II

THE FIELD WORKS, ENGINEERING FEATURES AND TARGETS

The questions proposed for solution in connection with type redoubts were:

1. Fort Riley Redoubt No. 1, having resisted the direct fire of the 3-inch light gun at all ranges, with a large factor of safety, what resistance will it offer to other cannon of the new type?

2. Taking Fort Riley Redoubt No. 1, as a type capable of resisting light guns, what modification of trace and profile should be made in planning a redoubt designed to resist heavy field ordnance of which the 4.7-inch gun and the 6-inch howitzer are types?

For the solution of the first question, Redoubt No. 1 was put in order.

* * * * * * *

The earth forming the surface of the knoll upon which this redoubt is located consists largely of clay and humus with some sand and some disintegrated limestone, and weighs about 100 pounds to the cubic foot. It was of such earth that the parapets were constructed.

In repairing the work for this test, 350 sand bags were used for revetting, and the work was cleared out and repaired by civilian labor, under an engineer overseer, in eight days.

The overhead cover varies from 4 feet of earth and 6 inches of timber in the case of bombproofs to 3 feet of earth and two layers of 2-inch plank in the case of the galleries. There is but one defensive parapet, giving a single line of fire, extending entirely around the work, including faces, flanks and gorge. The command is about 4 feet, the relief about 8 feet. The work is symmetrical, the faces being 50 yards long, the salient angle 120º, and the flanks semicircles 20 yards in diameter.

* * * * * * *

The ditch is very shallow, the bottom of the counterscarp being only 2 feet below the surface of site. There is no glacis, all the earth excavated from the ditch being used in the parapet.

The redoubt was designed for a battalion of infantry, with machine guns.

About three years had elapsed between the construction of the redoubt and this test, so that the earth of the parapets and traverses had become consolidated and somewhat grown over with weeds and grass.

Redoubt No. 2 was constructed during the summer of 1909 by hired labor, under the supervision of an engineer officer and twenty-one engineer soldiers.

* * * * * * *

The Board desired to obtain a "bracket" for penetration by shell. The capital traverse, being the main target for shell attack, was therefore made of graded thickness, increasing from 7 feet at the line of the interior crest to 11 feet at the rear end. The overhead cover of bombproofs and passages was 12 inches of pine timber throughout, with 5 feet vertical earth cover on the right half of redoubt, 7 feet on the left half, and graded from 7 feet to 11 feet over the capital bombproof. This cover was loose earth taken from the excavation for the bombproofs, and freed as far as possible from pieces of rock.

* * * * * * *

The redoubt was designed for a battalion of infantry, supposed to consist of 400 men, with four machine guns. It is of a heavier type than would generally be expected of a field redoubt intended to resist only light field artillery. It is what might be called a semipermanent field work, of a type likely to be constructed around important strategic points in the theater of war, where time and materials are available and the labor of civilians can be secured, using ordinary contractor's outfits for excavating and grading.

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It was assumed that this redoubt would form one of a line at intervals of 500 to 1,500 yards. The garrison would be quartered in rear of the redoubt, partially in bombproofs, which would also be used for reserves in case of attack. The front trench of the redoubt will hold 72 men, the support trench 36 men, the flank trenches 38 men and the gorge trench, when occupied, 88 men. The machine gun emplacements hold 16 men. The bombproofs and passages will shelter 200 men sitting down, allowing 9 square feet per man, and leave 110 squire feet for ammunition, etc. The support trench was not intended to be used by a firing line unless the front trench were rendered temporarily useless by damage to the parapet. The crest of the support trench was made 18 inches higher than that of the front trench to prevent the heads of men in the latter being skylined to the attack. It was assumed that the reverse trench would never be manned unless the line had actually been penetrated in the vicinity of the redoubt.

All interior slopes and the vertical faces over the entrances to bombproofs and galleries were revetted with sand bags; except on the left flank of the work where the parapets were wholly or partially revetted with plank. The reverse trench was not revetted at all. All sand bags were laid as headers. The sand bags weighed about 60 pounds each; the sand used, 100 pounds per cubic foot.

The timber protection was the same throughout, 12 inches of pine over all galleries, bombproofs and entrances. * * * The widths varied, being in the clear 8 feet for bombproofs and 5 feet for passages. * * *

In addition to the redoubt itself, 250 feet of standing trench was constructed to the left front of the redoubt. * * * In this trench and on the left face of the redoubt, head and overhead cover of various types were constructed as a target for shell and shrapnel fire, as follows:

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The targets for the long-range firing with the 4.7-inch gun against infantry were 364 box figures made of 1-inch pine, representing a battalion of infantry in different formations. The individual box figures were approximately 5 feet 6 inches in height, 12 inches in breadth and 12 inches in depth and were placed in an erect position. Individual figures, squads and companies were placed at normal intervals and distances. Box figures were used so as to determine the penetration of shrapnel bullets at these long ranges. * * *

A limber was used for a target in a test to determine whether the high explosive shrapnel could be detonated by a direct hit. This target was a wooden limber of an obsolete type, one of a number furnished at a previous date by the Chief of Ordnance for experimental purposes. The chest of this limber was extended to the rear and its interior arranged so as to hold twenty rounds of high explosive shrapnel, which were placed in position with their points toward the firing point.

There were also constructed by the engineers for test in the firing two stone walls, each 6 feet thick, 6 feet high and 20 feet long. These walls were used to determine their resistance to direct fire from smaller calibers, the 3-inch and 3.8-inch guns. (Photo 10.)

In previous tests by the board, it was found that walls 4 feet thick did not effectively resist the 3-inch high explosive shrapnel, so that the thickness of the walls in this test was fixed at 6 feet.

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Chapter IV

MATERIAL—ORDNANCE FEATURES

The field cannon used in these tests were the following: 6-inch howitzer No. 1, M. 1906, mounted on pilot carriage, M. 1905; 6-inch howitzer No. 1, M. 1908, mounted on carriage No. 1, M. 1908; 4.7-inch howitzer No. 4, M. 1907, mounted on carriage No. 3, M. 1906; 3.8-inch howitzer No. 1, M. 1908, mounted on carriage No. 1, M. 1908; 3-inch mountain howitzer No. 1, M. 1907, mounted on carriage No. 1, M. 1908; 4.7-inch gun No. 3, M. 1906, mounted on carriage No. 4, 1906; 3.8-inch gun No. 1, M. 1905, mounted on pilot carriage, M. 1904; 3-inch gun. M. 1902, mounted on carriage, M. 1902.

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As the tests were confined to the general program prescribed by the War Department, no opportunity was afforded for test as to the mobility of the material, except such as was obtained by taking the guns from the gun sheds to the firing point each day. With the exception of the mountain howitzer the carriages were drawn to the firing point by teams taken from Battery "A," Sixth Field Artillery, and equipped with the harness provided for the 3-inch field guns.

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No difficulty was experienced in getting the heavier cannon to the elevated points from which they were fired during the tests. Mobility and durability tests with those calibers of the new material that are to be finally adopted for the service should be made.

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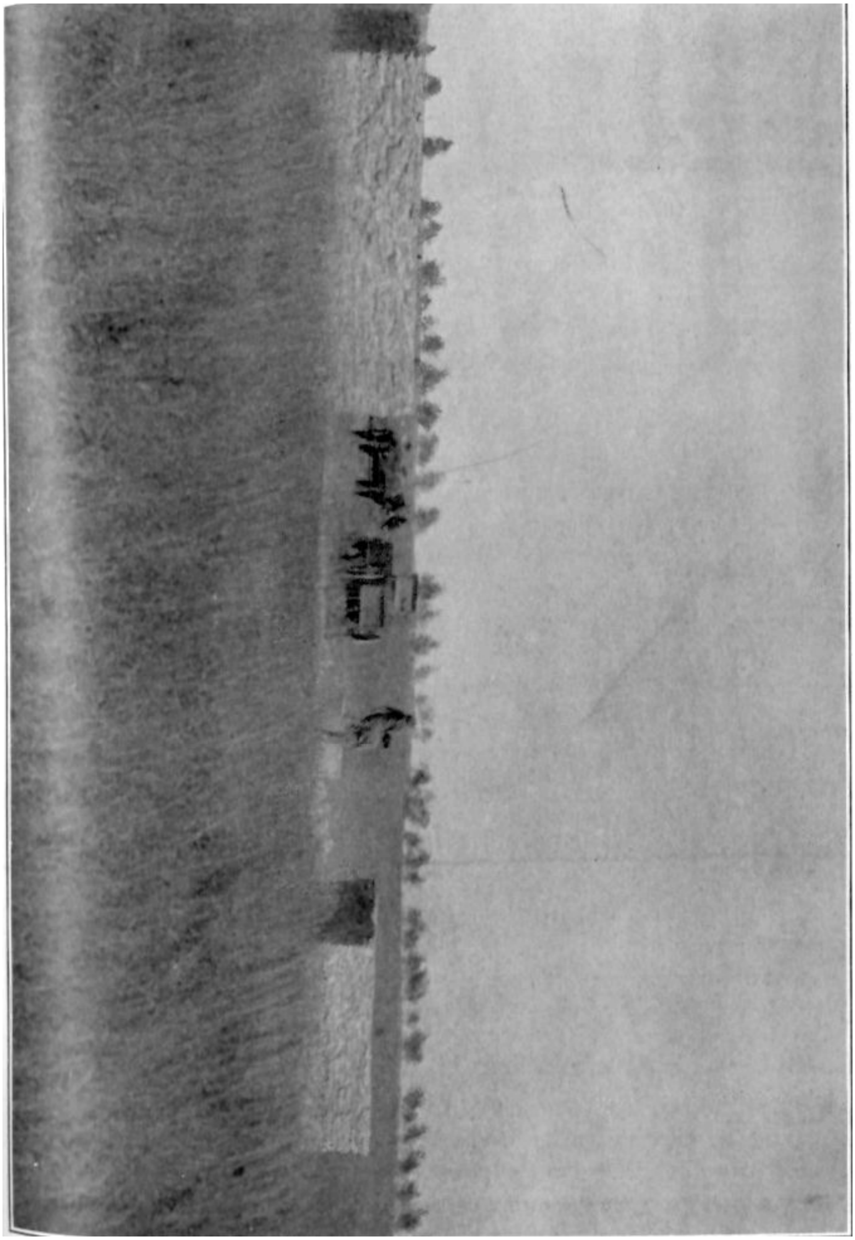
Throughout the firing the observation telescope was used by the officer in charge of the gun. This telescope proved to be of great value for the purpose of observing the effects of fire of the larger calibers at extreme ranges. The ability of the officer conducting the fire to observe closely with this instrument at long ranges is considered to have greatly increased the effectiveness of fire. Aside



from the utility of this observing telescope for other purposes, it became apparent that it will be a necessary and an extremely valuable part of the equipment of such heavy field artillery.

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Ammunition.—The three kinds of projectiles used in these tests were the following: common shrapnel, high explosive shrapnel and high explosive shell.

There were 26 varieties of ammunition for the seven types of cannon used in the firing.

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At the beginning of the firing the observers at the target frequently recorded "no burst" for the shell with delay action fuze, but upon investigation it appeared that they were in error, because the projectile penetrated so far in the hard ground before bursting that the sound of the explosion was completely muffled and no earth or stones were thrown in the air. However, the ground was generally so upheaved that it was certain that a detonation had occurred. In only two cases is it certain that a shell failed to explode.

Except for the 3-inch field gun all shrapnel, both common and high explosive, were equipped with the Frankford Arsenal 31 sec. combination fuze. The shrapnel for the 3-inch gun were equipped with the 21 sec. combination fuze.

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The high explosive shrapnel mentioned above is a projectile now undergoing trial in our service, and therefore merits some description. It is what is known as a single type projectile, that is, it is designed to be used either as a shrapnel or as a high explosive shell. This is accomplished in the following way:

The matrix in which the shrapnel balls are embedded, instead of being an inert substance, or merely a smoke producing material, as in the common shrapnel, is, in itself, a high explosive. This high explosive, however, is very insensitive, so that when the shrapnel is discharged in the air by the burning of the small black powder charge in its base the high explosive is not detonated or exploded. In order to cause the detonation of the matrix when the projectile bursts on percussion, the head of the projectile has a chamber containing a charge of high explosive. When the projectile strikes a resisting object, the percussion element of the combination fuze detonates this charge of high explosive, which, in turn, detonates the high explosive matrix. If the projectile bursts in the air, the head is blown off, and on striking, acts as though it were a small high explosive shell.

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Chapter V

PROGRAM OF FIRING AND ARTILLERY FEATURES

In accordance with the general scheme adopted by the War Department, the following detailed working program was prepared, which was printed for the convenience of observers:

FORT RILEY, KANSAS, October, 1909.

GENERAL PROVISIONS

The objects of the test are, in general:

1. To determine the efficiency of the different types of field cannon proposed for adoption in the U. S. service, at ranges corresponding to the type of gun used.

2. To determine the resisting power of modern field works and trenches against such field cannon.

3. To determine the relative and actual efficiency of projectiles adopted and proposed for adoption with such field cannon.

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As the test was for the purpose of determining, *inter alia*, whether the redoubts could resist the shells from the various calibers, the firing which had this point in view was controlled from the observation point; in all other firings, against personnel, the limber and the stone walls, the firing was controlled at the gun, and furnished a test of all the elements which would enter such problems under service conditions.

The two weeks' work furnished every variety of wind and weather, from clear, calm days to snowy days with high winds. The weather was not allowed to interrupt the test, except when the target became so obscured as not to be visible from the gun.

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Chapter VI

SUMMARY OF RESULTS

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Special results

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One 4.7-inch shell (No. 26) cut through crest of support trench obliquely, burst in rear of trench, scattering fragments all along trench. This shell after cutting the crest penetrated the banquette and came out on the banquette slope. The strong tendency to turn to the right after penetration was remarkably shown in this case, for the shell, after coming out of the slope, still turned 10° to the right, crushing a groove in the slope on that side, even though its left side was in the air with no resistance.

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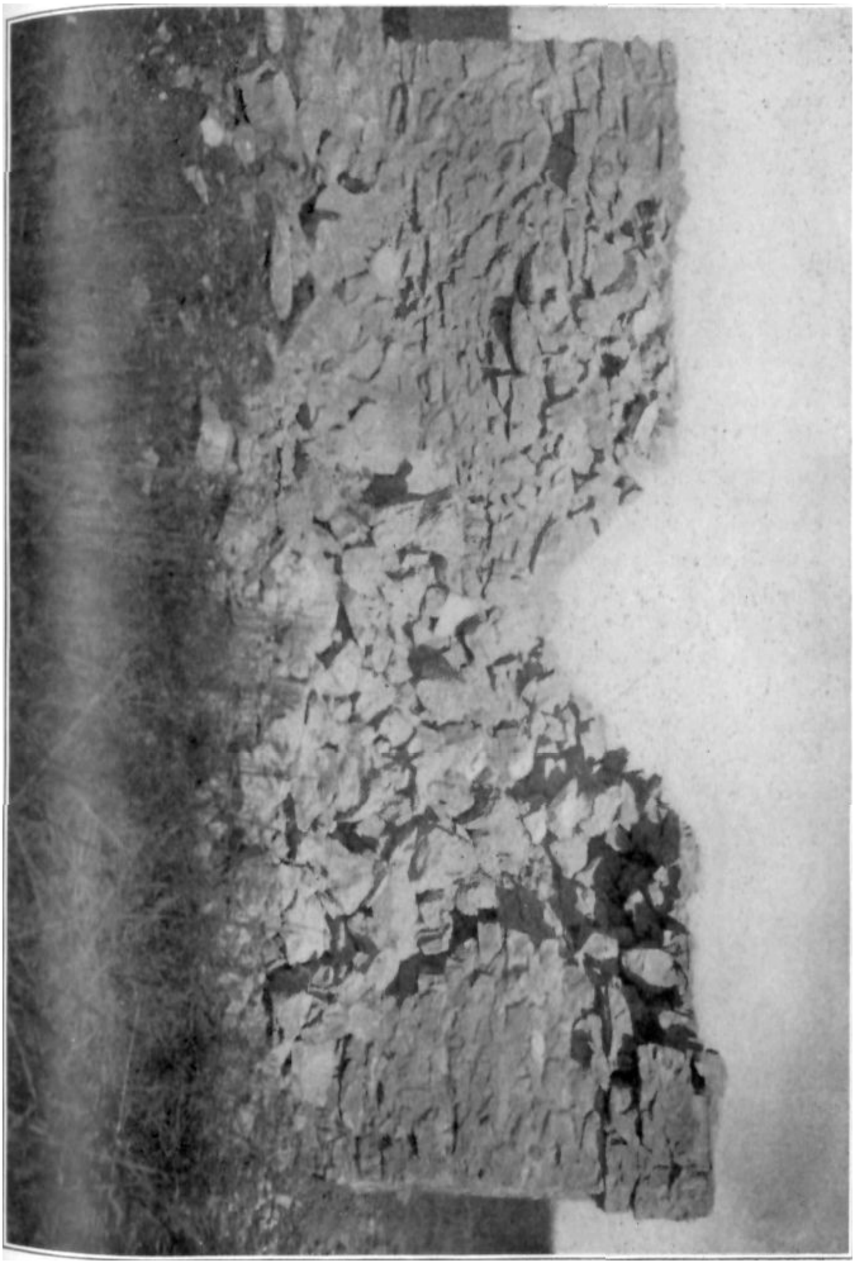

5. October 6, 1909, 3.8-inch gun, direct laying. Range about 2,200 yards. Target, a stone wall 6 feet thick.

10 rounds of H. E. shell with non-delay action fuzes were fired, of which 6 were hits. * * *

The fifth hit broke completely through the wall. (Photos. Nos. 10 and 17.)

6. October 6, 1909, 3-inch gun, direct laying. Range about 1,100 yards. Target, a limber with 20 rounds of 3-inch H. E. shrapnel in the chest.

Fifteen rounds of H. E. shrapnel were fired, of which 6 were hits.

The limber was demolished and set on fire and the ammunition was scattered about. Some of the propelling charges were burned, but there was no detonation of the ammunition, although one of the rounds was struck on the point of the fuze. (Photo. No. 18.)

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8. October 8 and 11, 1909, target, 364 box figures, direct laying. Range about 7,000 yards. * * *

The individual target consisted of a box open at the sides, made of 1-inch pine lumber, 5 feet 6 inches by 12 inches by 12 inches. For the first part of the test they were arranged to represent a battalion of infantry in column of route marching in the direction of the line of fire; * * * for the second part they were placed in line of company columns, with intervals of 25 yards.

The following were the results of the firing with the 4.7-inch gun at the infantry in column of route:

The 15 H. E. shell made 9 effective hits, causing 34 casualties, with 3 hits directly in the column. (Photo. No. 19.) The characteristic travel of one of these shells which did not burst on impact is shown in Photo. 20.

Fifteen H. E. shrapnel, 613 hits, with 240 figures hit, a percentage of 66.

Fourteen common shrapnel, 972 hits, with 233 figures hit, a percentage of 64.

No hits were made with the 15 H. E. shell on the targets representing infantry in line of masses.

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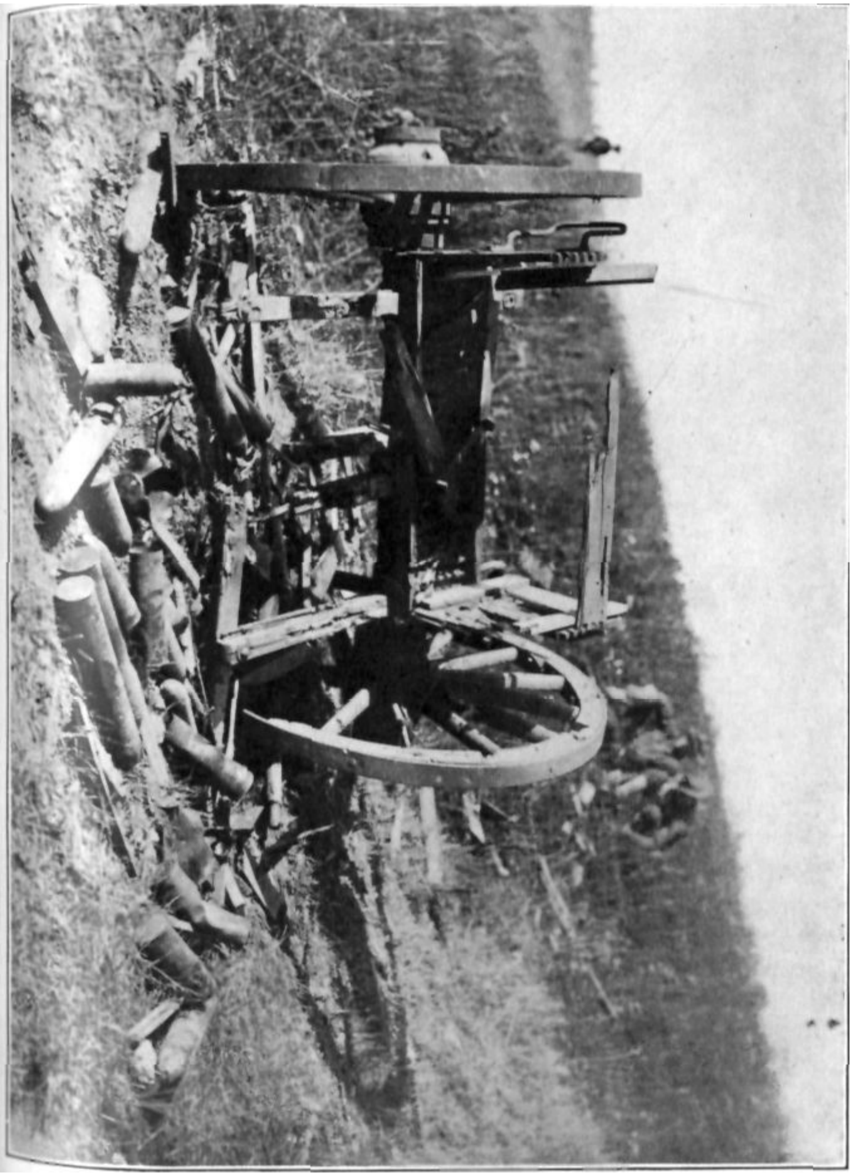
Chapter VIII

CONCLUSIONS

After a careful analysis of all the data connected with the test and the results obtained from the firing, the board has arrived at the



following conclusions concerning the questions proposed for solution by the test.

These questions were:

"1. Fort Riley Redoubt No. 1, having resisted the direct fire of the 3-inch light gun at all ranges, with a large factor of safety, what resistance will it offer to other cannon of the new type?

"2. Taking Fort Riley Redoubt No 1 as a type capable of resisting light guns, what modification of trace and profile should be made in planning a redoubt designed to resist heavy field ordnance of which the 4.7-inch gun and the 6-inch howitzer are types?

"3. Assuming that in future wars strongly intrenched lines with key points consisting of field works of the deliberate type must be carried by assault, what types of cannon and projectiles should be adopted for our field artillery in order to enable it to give the best support to the infantry advance?

"4. What are the most effective types of cannon and projectiles for use against troops in field works: (1) without head-cover; (2) with head-cover; (3) with overhead-cover; (4) in preventing the movement of troops, in close order, beyond the effective range of light field guns?

"5. What are the most effective projectiles in use for demolishing parapets, walls and other obstacles by direct fire?

"6. Will it be possible to simplify the ammunition supply of the light field guns by adopting a single type of projectile?"

These questions will be considered in the order presented.

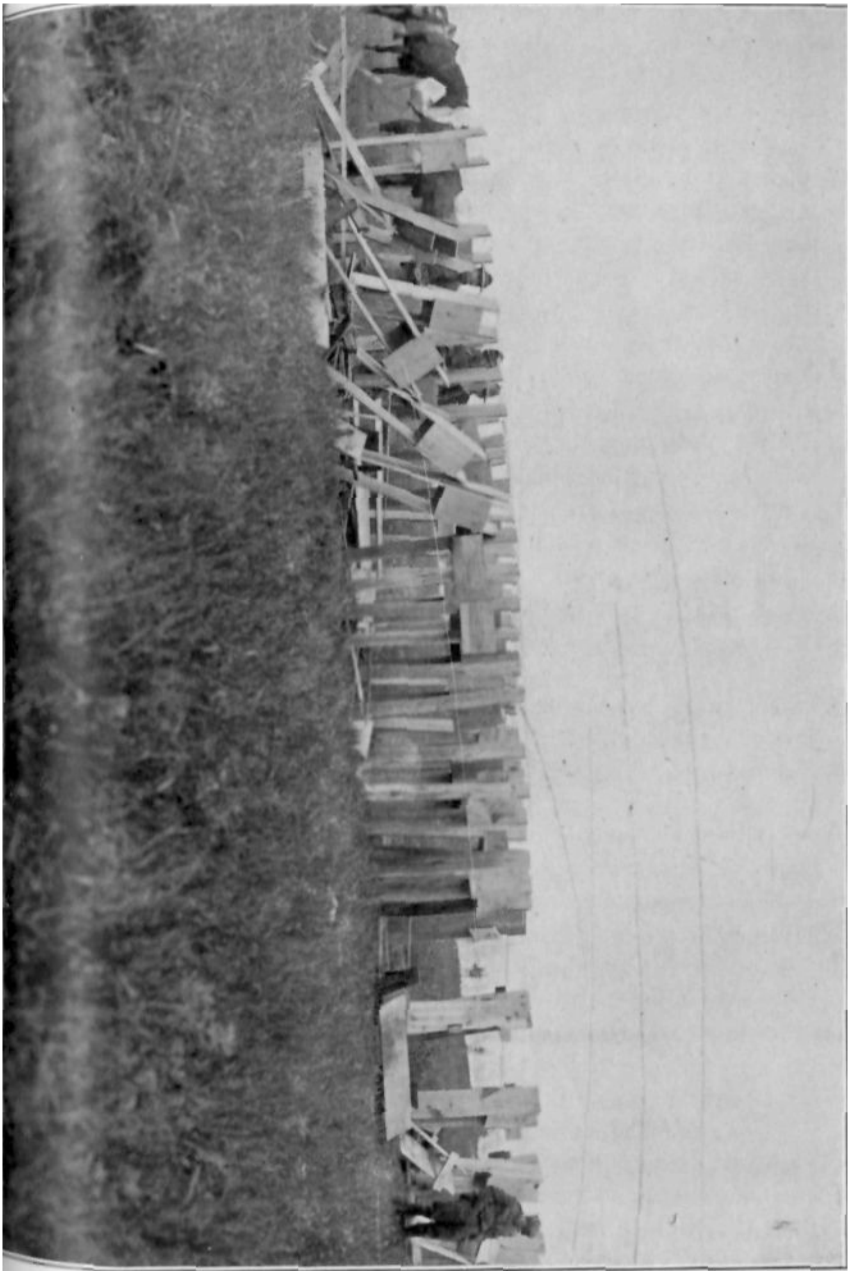
"1. Fort Riley Redoubt No. 1, having resisted the direct fire of the 3-inch light gun at all ranges, with a large factor of safety, what resistance will it offer to other cannon of the new type?"

In the opinion of the board, the test shows that a redoubt of the type of Redoubt No. 1 gives perfect protection against the 3-inch mountain howitzer, the 3-inch field gun, the 3.8-inch rifle and the 3.8-inch howitzer. The 4.7-inch gun and the 4.7-inch howitzer would make it untenable, and the 6-inch howitzer wrecked it.

"2. Taking Fort Riley Redoubt No. 1, as a type capable of resisting light guns, what modification of trace and profile should be made in planning a redoubt designed to resist heavy field ordnance of which the 4.7-inch gun and the 6-inch howitzer are types?"

Concerning this matter, the board called on Major Flagler, C. E., as consulting engineer, to submit his opinion, which follows:

"A light field redoubt of the type of Redoubt No. 1 is a sufficient



protection against light artillery and is easily susceptible of construction by the troops with ordinary field equipment. It is practically useless against the heavy field artillery of the present type of 4.7-inch caliber and upwards.

"Works of the type of Redoubt No. 2, would be very difficult of construction by troops and should be confined to provisional fortifications around cities or other strategic points, constructed by civilian labor with ample time and materials available. The casualties and the doubtless extreme moral effect that would be produced by the explosion of even a single high explosive shell of large caliber in a bombproof makes it essential that the redoubt should be strong enough to resist any possibility of penetration. Men must feel secure in a bombproof. To secure this, if 12-inch timber cover is used over bombproofs there should be a uniform overhead cover of 10 feet of earth. This could be reduced with sand, and also with additional timber cover or with the use of concrete, steel rails, plates, etc. It is apparent that the framing used for bombproofs in Redoubt No. 2 should be modified to give greater lateral strength.

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"3. Assuming that in future wars strongly intrenched lines with key points consisting of field works of the deliberate type must be carried by assault, what types of cannon and projectiles should be adopted for our field artillery in order to enable it to give the best support to the infantry advance?"

In the consideration of this question, mountain artillery will not be regarded. It is a special type of field artillery to be used in special cases, and has no place in the attack of a fortified place, if anything better can be obtained.

The special purpose of the 3-inch field gun is attack on personnel. Its projectile is the shrapnel. This gun does its work well. Its fire is deadly up to 3,500 yards and its specific use in an attack of a field work of a deliberate type is to keep down the infantry behind the crest of the work, so that our infantry can advance sufficiently near the work to make its final rush with some prospect of success. The 3-inch H. E. shell, as shown by the test, demolishes and breaks down overhead and head cover, and makes it practicable for shrapnel thereafter to be effective.

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The 4.7-inch rifle is a powerful and effective weapon at all ranges where its effect can be observed. Its accuracy is great and

PHOTO 20. UNEXPLODED H. E. SHELL FROM 4.7-INCH GUN; MAN KNEELING AT POINT OF ENTRANCE.

its shrapnel bullets effective at the longest ranges. * * * This gun picks up the work of the 3-inch field gun, where the latter must stop for lack of range and power, and continues that effective work up to the extreme limits of range possible with the present carriage.

The excellent work done by the 4.7-inch gun at a range of 7,000 yards points to the conclusion that much more might be gotten out of this gun by using it at greater ranges.

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This gun, while unable to get through a redoubt of the type of Redoubt No. 2, is effective against a field work of the type of Redoubt No. 1, while in the support of an infantry attack against any semi-permanent field work, it would destroy head cover of practically any type and keep down the defending infantry at ranges from which other guns could not be used. Its adoption for our artillery is of the first importance.

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The 6-inch howitzer is the most powerful and efficient field artillery weapon known to the board. The results of its use during every stage of the test were impressive to every observer, and the Ordnance Department is to be congratulated in having evolved a weapon which outclasses every other weapon of the same or nearly the same caliber used by any other nation and known to the board. This weapon wrecked Redoubt No. 1, and got through the massive protection of Redoubt No. 2. Its shrapnel fire was as efficient as its shell fire at the most extreme ranges, which efficiency permits its proper tactical use at ranges beyond the power of the ordinary heavy field artillery. Its adoption for the use of the field artillery is of equal importance with the adoption of the 4.7-inch rifle.

As to the types of projectiles which should be adopted for the artillery to play its part in the attack on a field work of the deliberate type, the conditions vary with the tactical use of the different calibers.

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"6. Will it be possible to simplify the ammunition supply of the light field guns by adopting a single type of projectile?"

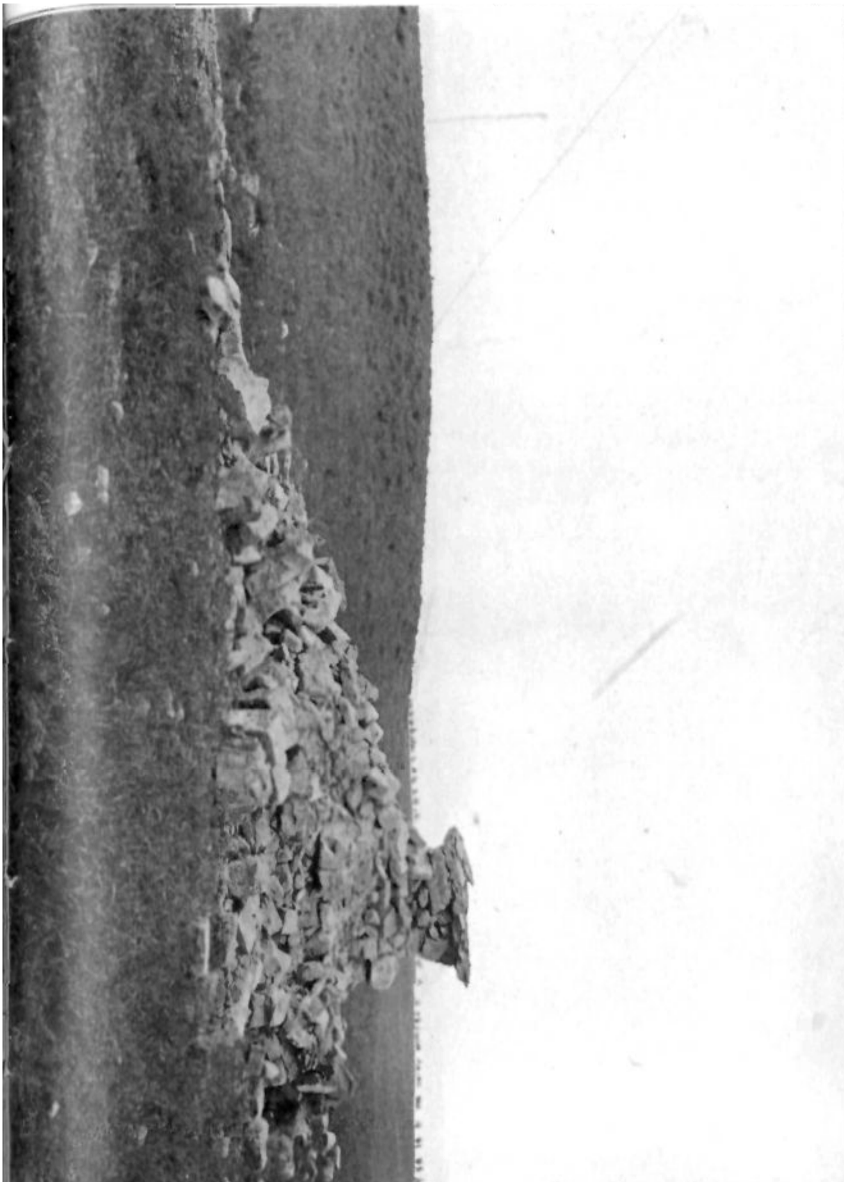
The purposes for which the fire of the light field guns are used are

(a) The attack of personnel.

(b) The destruction of material.

(c) The destruction of walls and obstacles other than parapets and bombproof cover.

The first is accomplished by use of shrapnel and the other two by shell fire.



A 3-inch single type projectile combining the functions of shell and shrapnel was experimented with on previous occasions.

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The single-type projectile offers the following advantages:

1. Its employment would increase the availability of a given ammunition supply for use either as shrapnel or shell.

2. The question of relative proportion between shrapnel and shell, which is always more or less incapable of exact determination, would be eliminated for light field guns.

3. The problem of ammunition supply on the battlefield would be greatly simplified.

4. With this projectile, while firing against the personnel of a battery in action, hits on the carriages and shields made by the high explosive head will be effective.

5. Percussion bursts with the common shrapnel except on rocky ground are almost devoid of shrapnel effect, whereas the high explosive shrapnel bursting on impact on ordinary ground has considerable effect.

It is concluded, therefore, that the ammunition supply can be simplified for the light field guns by the adoption of a single type projectile, and that its adoption for such guns is desirable.

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6. *The lack of personnel to handle the new field cannon.*—While the value of and the necessity for powerful heavy field artillery of the types of the 4.7-inch gun, the 4.7-inch howitzer and the 6-inch howitzer were fully demonstrated by these tests, this report would not be complete without some exposition of the condition of the field artillery arm with regard to handling them. Guns are worth nothing without the men to man them. Men are worth nothing as field artillery in time of war without prolonged preliminary training. The introduction of the modern system of indirect laying has increased markedly the amount of training required to make a field artillery officer of any value at all. The necessity for these special large caliber field cannon is manifest to all trained military men. No modern army except that of the United States is without them. Our present field artillery, however, has no men to handle them.

There are now in our field artillery: One regiment of horse artillery, two regiments of mountain artillery, and three regiments of light field artillery.

The first two classes are special arms, and are at the minimum. The light field artillery, which must accompany the infantry and work with it, is entirely too small in numbers already to furnish its proper quota to the infantry divisions which would be formed in time of war from our present authorized strength of infantry. There are absolutely no officers or men available for the manning of these new heavy guns. This matter is one of serious national concern, as it is inevitable that we will be confronted in time of war by artillery armed with guns and howitzers of similar calibers, and it is equally certain that we cannot improvise such regiments after the outbreak of war.

The Secretary of War, in his annual report, 1909, states (p. 62):

"It is particularly important that the field artillery be provided for, if practicable. Recent wars have enhanced its importance immensely. Foreign governments are increasing the proportion of guns in their armies. The General Staff has considered that the proportion of guns which should be provided in the American Army should be 3.35 per thousand bayonets. It is estimated, further, that there should be about 2.5 guns per thousand sabers, to act with cavalry in time of war. This is less than in most foreign armies. Accepting the proportion of 3.35 guns per thousand bayonets, however, it would require 288 batteries of field artillery for the present force of infantry of the organized militia. There are in existence but 48 batteries. The regular field artillery is only one-half of what is necessary to supply the proper proportion of guns for the present authorized regular infantry and cavalry. The bare statement of these numbers indicates the very unsatisfactory state of the field artillery question."

The condition of affairs set forth by the Secretary of War is emphasized by the appearance in the field of the powerful guns and howitzers which have been the subject of these tests. If the United States is to reap the advantage of the use of such powerful and efficient weapons, officers and men must be provided for by law in time of peace, so that they may be trained to handle them. Not to provide them would be to seriously handicap our forces in any important war in which we might be engaged.

THE CLASSIFICATION OF FIELD ARTILLERY

BY MAJOR WM. J. SNOW, 5TH FIELD ARTILLERY.

As there seems to be more or less confusion as to the classification of field artillery, the following thoughts on this question are set down for what they are worth.

Most of the difficulty seems to come from a confusion of the terms "siege artillery" and "heavy field artillery," which are taken to be synonymous while in reality they are not. A large part of this confusion arises from failure to know or to recognize the fact that heavy field artillery is a product of almost the last decade only, while siege artillery is a very old designation and has now largely lost its significance.

In separating the field artillery from the coast artillery in 1907 Congress decreed that "the field artillery is the artillery which accompanies an army in the field, and includes light artillery, horse artillery, siege artillery, and mountain artillery," thus uniting under one caption all the varieties of mobile artillery at that time in our service. This definition, therefore, also indicates the scope of the duties of the field artillery.

It should be noted that the significance of the word "field" is here considerably extended and is made general instead of referring to a special class of artillery. When "field artillery" is spoken of abroad that artillery armed with the 3-in, or 75-mm. gun is meant; in other words, it is a specific class, whereas with us the term is a general one, including a number of varieties.

Mountain Artillery

The name indicates the use. This artillery, primarily intended for rough country impracticable for wheels, is packed on animals. The gun is light, weighing about one-third as much as the standard light battery gun, but firing a projectile of about the same size. From these two conditions it necessarily follows that the range is short, not over one-half that of the light artillery gun. While, as stated, normally the battery is transported by pack transportation, in many countries shafts are also provided in order that the animals may be relieved when practicable by utilizing draft. This is, of course, easier on the animals, but many officers in our service do not believe in having any draft for two reasons: First, when using packs, the shafts, which must also be packed, catch on trees, vines, etc., and interfere with movements; and, second, if it is feasible to use draft or wheeled transportation, light artillery should be substituted for mountain. Our mountain artillery is at present equipped with the 2.95-in. Maxim-Nordenfeldt gun, but this weapon will be replaced by a 3-in. mountain howitzer firing a 15-lb. projectile. In this class of artillery the weight should not exceed about 300 lbs. for each pack animal.

Light Artillery

This designation, which is one of long standing in our service, corresponds to the special designation, "field artillery," in use abroad. In all countries this artillery is very similar, the projectile weighing about 15 lbs., and the range being about 7,000 yards. But in speaking of the range, it must be borne in mind that what is most needed in war is not extreme range but the most effective range, and that the effect of shrapnel falls off quite perceptibly beyond 3,000 yards. Beyond this range the guns shoot almost as accurately as below it, but many things combine to make long-range firing more or less ineffective. With the field gun, as the range increases, more and more ammunition is necessary to produce the desired effect. This is due to the great angle of fall and also to the small remaining velocity making the shrapnel more and more local in its effect while at the same time the difficulty of observing and adjusting the fire increases with the range, and accurate observation is essential to prevent waste of ammunition. In our service, light artillery is armed with the 3-in. rapid-fire gun, throwing a 15-lb. projectile and having a weight of about 4,200 lbs. behind teams of six horses.

Horse Artillery

Horse artillery is primarily designed to accompany cavalry. All the personnel are mounted on horses. It is readily seen that if the guns are to keep up with the cavalry, every effort must be made to lighten the weight behind the teams, and hence the cannoneers, instead of riding on the carriages, are provided with saddle-horses. In time of peace the casual observer sees little difference between light and horse artillery, but every war brings out the distinction clearly. When the ammunition chests are full, the forage scant, the roads bad, and the work continuous, the difference in mobility between these two classes of artillery is at once apparent. Horse artillery is, therefore, designed not only to accompany the cavalry but also to reinforce parts of the battlefield as quickly as possible The Franco-German war shows many cases where the horse artillery due to its greater mobility, arrived at critical times several hours ahead of the light or field artillery, and in the recent war in the far East the lack of horse artillery on the Japanese side prevented them from ever converting a Russian retreat into a rout. In some countries the horse artillery is provided with a lighter gun and carriage than has the light artillery, and the gun fires a projectile weighing slightly less. In our service the horse artillery has the same gun as has the light artillery, thus avoiding the complication in ammunition supply which would be caused by the introduction of another caliber. Whether, however, the gun is sufficiently mobile is a question that has not yet been determined. The English have the latest-adopted horse-artillery gun, which fires a 12½-lb. projectile. They seem to be very much pleased with their horse-artillery gun. One solution that has been suggested in our service is to use the present gun and carriage but to carry less ammunition, thus reducing the weight behind the teams. The experience of all wars has shown that the work of horse artillery is arduous, and that upon returning from any expedition the horses are badly in need of rest. In our service it is, therefore, wisely provided that the harness and the saddle horses shall be interchangeable, thus providing some relic for the draft horses. Those authorities who advocate a special gun for the horse artillery limit the weight to about 3,400 lbs. behind a six-horse team.

Heavy Field Artillery

This is the most recent development of field artillery, and consequently the character of the material and the use to which it will be put are not as clearly worked out as with other classes of artillery. The tendency of troops, both on the offensive and defensive, to take cover, has steadily increased with the improvement in guns and small arms, with the result that in the contest between light guns and cover the latter reached a point where the former was overmatched. Theoretically, the advantage should always be on the side of cover, for there is no limit to the amount of digging that could be done while there is clearly a limit to the weight of gun; but, practically, the question of time to construct the cover enters, as well as the fact that if the position is too strong to be attacked troops will be maneuvere out of it. However, it is recognized that the works thrown up in day or two are beyond the power of the light field gun, and hence the heavy field gun becomes necessary. Such artillery is a part of every army, and foreign regulations state that its presence may be expected on every battlefield in the future. The gun is as heavy as is consistent with giving it the mobility of infantry in masses. The confusion in our service, due to the loose use of the term "siege artillery," is caused by failure to recognize that the heavy field artillery accompanies the army at all times and is used on practically every battlefield. It takes up the work where the light gun leaves off. The heavy field gun in our service is the 4.7-in. gun, throwing a 60-lb. projectile, the carriage using the same sights as those of the other guns in the field artillery, using the same methods of checking recoil and the same system of fire control, and requiring no special anchorage or platforms, and thus being truly field artillery.

Light Howitzers

The flat trajectory fire of guns must be supplemented by curved fire in order to reach defenders behind protection or for the purpose of destroying the protection; hence, both the light and the heavy field guns must be supplemented by a howitzer. The 3.8-in, howitzer now being manufactured by the Ordnance Department could be truly classified as a light howitzer. It has the same weight behind the six-horse team as has the 3-in. guns, and throws a 30-lb. projectile.

The Ordnance Department has also designed a 4.7-in. howitzer, throwing a 60-lb. projectile, which might be classified as either a light howitzer or a heavy howitzer, depending largely upon its use, this use, in turn, depending largely upon its mobility. The howitzer has 6,000 lbs, behind the teams, and if these are composed of eight horses the howitzer could be used as a light howitzer, while if, on the other hand, the teams are composed of but six horses, it would fall into the class of heavy howitzers.

Heavy Howitzers

This howitzer is designed to supplement the 4.7-in. gun. The howitzer designed by the Ordnance Department has a 6-in. caliber and fires a 120-lb. projectile. The weight behind the teams, 8,000 lbs., is the same as with the 4.7-in. field gun. This howitzer, like both of the others mentioned, has all the laying and sighting appliances of the other ordnance of the field artillery, and also uses the same fire control system, the same method of checking recoil, requires no anchorages, hold-fasts, platforms, or any preparation previous to its going into action. It is, therefore, clearly a field artillery weapon.

All the ordnance so far considered fire both high-explosive shell and shrapnel. The demolition effects of the high-explosive shell are sufficient to break up any field work that can be constructed by the labor of troops.

Siege Artillery

The term "siege artillery," correctly used, refers to artillery used in investing a besieged or beleaguered place. Such artillery would include many different calibers. But the term was used in the act separating the coast and the field artillery on account of our having in service at that time 5-in. siege guns and 7-in. siege howitzers. These pieces had long been known as "siege artillery," and dated back to a time prior to the development of heavy field artillery, and consequently, as it was intended that the field artillery should include all mobile artillery, the designation "siege" was put into the law. Since that time, however, these obsolete pieces have been withdrawn from service and are now being replaced by a slightly smaller caliber having much greater power and a weight of about 8,000 lbs. to be drawn by eight horses and thus being mobile enough to accompany infantry in masses.

This term has almost lost any definite meaning, due to the fact that in sieges the largest gun that is practicable is brought up to the front for an investment, and that with increased transportation facilities it has become possible to bring up heavier and heavier guns Thus, at Port Arthur 11-in. mortars were brought up. Such weapons do not form part of the field artillery, though it may be necessary to have this class of troops handle siege guns. There is no distinct line of demarkation between heavy field artillery and siege artillery. The term really relates more to the use to which the gun is put than to its caliber. But it is generally understood that such artillery comprises guns, howitzers, mortars, etc., that are not permanently horsed and which do not normally accompany an army but which are brought up when needed for some specific purpose by utilizing traction engines, railroads, or any similar means of moving the guns, and that platforms, not infrequently made of concrete, are built, and that when the guns are placed in position they generally stay there until the siege is over. In European armies this class of ordnance is served by fortress artillerymen, a class we do not have in the United States. Most European nations having a land frontier have constructed defensive works along the frontier, which works are manned by guns heavier than field guns and lighter than our large coast artillery guns, and these are served by fortress artillerymen. When these men are no longer needed in the fortress they move out and take with them such of the ordnance as can be transported by the methods previously stated. In other words, these fortress troops are an intermediate class between our field artillery and our coast artillery. No provision has ever been made in our service for this class of artillery, and probably none ever will be, and therefore the question as to whether the field or the coast artillery will handle such guns is one that has never been settled. There can, however, be no doubt but what heavy field artillery, including all the calibers that have been mentioned in this article, properly belongs to field artillery troops, and, under the law, must be handled by them.

FIELD ARTILLERY TRAINING OF THE ORGANIZED MILITIA

[An address delivered by Brig. Gen. M. M. Macomb, U. S. Army, before the National Guard Convention, October, 1910. Reprinted by permission from "Arms and the Man."]

Mr. President and Members of the National Guard Association of the United States:

In order that we may see clearly the necessity for giving much closer attention to the training of our militia field artillery in the future than we have done in the past, it will be well to glance first at the general military situation.

As the history of our own times unrolls before us it reveals our country taking its position as a world power, and, as time passes, current events indicate that there is a feeling spreading throughout our land that we cannot hold our place or perform our proper duty either to ourselves or our neighbors by mere bluff and bluster or by cheap spread-eagleism.

National instinct is beginning to warn us that national security depends largely upon having ready an adequate army and navy. Affairs now transpiring in the Orient show the punishment and humiliation which the world awards to those nations which persistently fail in their military duty by showing a contempt for the profession of arms.

I say "world awards" advisedly, for when the powers stand by and see a people wiped out of existence as an independent nation, and huge slices of the territory of another controlled by aliens, it is a tacit judgment that "fools must reap the reward of their folly."

A divine providence has thus far warded off such misfortune from us. At the close of the Civil War, our country possessed a highly trained, well-equipped, and efficient army—an incontestable proof of the real strength of this nation, which has never been forgotton by other powers. We disbanded this army and quickly sank into a state of military apathy from which recent events seem to have partially awakened us—for we are beginning to realize that something more tangible than past prowess is needed.

It is this feeling that brings us together here in the city of St. Louis, and which makes this assemblage one of the most representative that the country has ever seen. Here are earnest men from

North, South, East, and West, from the Regulars and from the National Guard, all united to discuss a purely national question free from sectional, professional, or political bias, and that question is "What shall we do to increase our military efficiency and make it in some degree commensurate with our position as a world power?"

As has been already said the country seems to be awakening and now the time has come when the Regular Army and the National Guard must stand together as they never have before, and devise means to give us a definite military policy and formulate a system of military training which will eventually produce an efficient, homogeneous army.

We must, therefore, consider the training of all arms, and as recent wars have shown the absolute necessity of a proper quota of artillery to help the infantry on to victory, we can no longer neglect the training of that arm and must encourage the States to do their duty in developing it, because it is beyond the power of the Federal Government alone to furnish it all in time of need. It is just as much the duty of the States to do their share in raising this arm as it is in regard to the infantry, and I hope to show in this paper how success may be attained in spite of the difficulties to be overcome.

I do not wish to overestimate the importance of field artillery, but only to make it clear how much we have underestimated it, by reminding you that we have so far provided but little over half the necessary quota for our small Regular Army, and have done but little to help the Militia. Artillery is only an accessory, but it has become a vital one, so that now the infantry and artillery must go hand in hand in war.

Germany is looked upon as a model in warlike preparation and her opinion upon military subjects carries great weight. Her idea of the importance of artillery in these days may be gained from the following figures showing the comparative increase she has made in the strength of the three arms since the war of 1870, viz:

Infantry	34 per cent.
Cavalry	9 per cent.
Field Artillery	117 per cent.
Foot Artillery	43 per cent.

Comparison of these percentages is in itself sufficient to fix in the minds of all the growing importance of the artillery to-day, without adding that France has also recently largely augmented her field artillery by providing a reserve battery for each artillery brigade, and that all other civilized nations have in recent years increased their artillery more than their other arms. Of all countries of the world, great and small, the United States has, I think, the unenviable position of having the smallest proportion of field artillery.

It would be interesting, had we the time, to trace the improvement, step by step, in the artillery gun and its projectile and to note the resulting increase in the importance of the artillery arm itself, until it has now become a vital, essential and indispensable auxiliary to the infantry. But lack of time prevents this, and we must, therefore, content ourselves with glancing at the present development of that gun and projectile which the world regards as an essential part of the equipment of an infantry division of today.

The Modern Field Gun

In 1892 General Langlois, of the French army, gave to the world his book, "Field Artillery in Cooperation with Other Arms," which book has now become a classic, and in which, from a thorough study of the battlefield and all its attendant circumstances, both ancient and modern, and from an exhaustive and scientific discussion of past development of munitions of war and the tendency of all fields of modern endeavor, he deduced not only the gun of the future, but also its method of employment. From having been looked upon as a chimerical dream, this gun became in France a reality about 1898. The principal changes, compared to guns existing at that time, lay in the carriage and the method of sighting and laying. Other nations began by pooh-poohing the gun, Germany in the lead, then passed to the state of modifying their existing equipment and ending by throwing it all on the scrap heap and building an artillery equipment on the same general lines as the French. This is the present rapid-fire gun, which the entire world, including the United States, has been forced to adopt, against its will, and at an expense of hundreds of millions of dollars. This gun has not yet been tried in war, and its proposed method of use, which is radically different from all its predecessors, has, therefore, yet to submit to the supreme test of the battlefield. It may sound strange to you, when I say that the present true rapid-fire gun has not yet been tested in campaign, for doubtless your minds at once revert to the newspaper and other accounts of the great execution caused by the rapid-fire gun in the Russo-Japanese War. But I was present as an observer at all the great battles of that struggle, and know whereof I speak when I say that the guns in use on both sides were what are technically called "accelerated-fire" guns, and not "rapid-firers." They were merely better weapons than had previously been used in war, and were much below the guns of to-day in efficiency, while their method of use was a compromise, embodying some of the features pertaining to handling the old material, and some pertaining to the since-adopted rapid-fire guns. But actually with the guns in use during the war, there was not and could not be any rapid-fire as the term is now understood; the importance of bearing this in mind will appear later when I explain the use of the gun with which the light artillery of the Regular Army and the Militia are now armed.*

The Principal Projectile

The principal projectile is called shrapnel, and is intended primarily for use against animate objects. This shrapnel has a time fuze which may be set so as to cause the projectile to burst in the air at any point in the trajectory between the muzzle of the gun and extreme range—about 7,000 yards. When it bursts, the shrapnel, which has in its rear part a propelling charge of powder, simply blows off the head and throws out to the front its contents of from 262 to 300 balls. These balls open out somewhat and form in the

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* Before leaving this subject I must trespass upon your time long enough to call your attention to the main points of difference between the old slow fire, the accelerated fire, and the present rapid-fire gun, using in illustration of each type guns with which you are already more or less familiar.

A.—Slow fire. Example, American 3.2" gun.

This was the gun with which our field artillery was armed at the outbreak of the Spanish War; an excellent piece of its kind. It fired black powder at first, but was later adapted to smokeless powder.

1.—Gun rigidly attached to carriage, both recoiling together; recoil not controlled.
2.—Sights attached to gun; telescopic or other delicate sights must be removed before firing.
3.—Gun detachment must stand aside to avoid recoil; gun fired by long lanyard. Hence shields of little use, and not provided.
4.—Gun must be run back by hand to firing position, and relaid after each shot.
5.—Ammunition in two parts, loaded separately; fuze punched by hand.
6.—No provision for indirect fire.

B.—Accelerated fire. Example, Japanese Arisaka gun, used in the Manchurian campaigns.

1.—Gun rigidly attached to carriage, both recoiling together, but recoil controlled by wheel shoes and springs in trail.
2.—Sights attached to gun; removed before firing.
3.—Gun fired by lanyard; detachment must move to avoid recoil, but only slightly. Shields not provided, but found useful, and in many cases improvised in the field.
4.—Gun is run approximately into position by trail springs, but must be relaid for each shot.
5.—Ammunition in two parts; fuze set mechanically.
6.—Mechanism provided for indirect fire.

C.—Rapid fire. Example, American 3" field gun.

1.—Gun mounted in cradle, on which it recoils, Carriage fixed after first shot.
2.—Sights attached to carriage; remain in seat during firing, constantly directed upon aiming point.
3.—Gun detachment remains at posts during fire, protected by shields attached to gun carriage and caisson.
4.—Gun does not have to be run back by hand, but returns automatically to firing position; relaying not necessary.
5.—Ammunition fixed; fuze set mechanically.
6.—Mechanism so arranged that indirect fire is as accurate and easy as direct.

air a figure approximating that which proceeds from the sprinkler of a garden hose, and when they strike the ground cover an area of dimensions varying with the range. Each bullet is about one-half an inch in diameter, and has sufficient weight and velocity to enable it to inflict a deadly wound even at extreme range. The individual shrapnel, as it approaches the end of its trajectory, might, therefore, be compared to a shotgun fired in the air, and distributing shot or balls over an area about 20 yards wide and 200 yards long, for that is what is covered by the ordinary shrapnel at battle ranges. Carrying out this conception, a battery then is a machine for sowing an area of ground with deadly missiles, and that is the theory governing the construction of the present gun and its principal projectile, which is especially designed to supply that superiority of fire which the friendly infantry needs to enable it to advance to victory.

The Modern Battery a "Firing Machine"

The characteristic of field artillery is the concentration of power in a limited space. The front of a battery in action is only about 100 yards; the battery is controlled by one man, the captain; it is capable of delivering its fire anywhere within a sector of seven thousand yards radius; there may be several shrapnel, each with its 262 balls in the air from the same gun at the same time; there are four guns in the battery; and all this volume of fire can be delivered by a single command of the captain. Such a blast is termed by the French a "rafale," and means literally a "squall"—and it appears to be well named. As it would be impossible to bring up on the battlefield sufficient ammunition (each complete round weighing 18¾ lbs.) to continuously feed such a battery it is planned to suddenly and by surprise turn such a squall on the target, and as soon as sufficient effect is produced, to suspend the fire, or turn it to some other target. Squalls of fire, interrupted by pauses, have, therefore, superceded the old idea of continuous slow artillery fire.

A battery is thus a firing *machine*, operated by the captain, who may play four lines of fire from his battery at will; this sheaf, composed of the four lines of fire, he may shift to the right or left to strike a new target, up or down vertically for new ranges; he may sweep across the range or up and down it; he may play one or more lines upon one target and the balance upon another; in short, there is the greatest flexibility to the fire action of a field artillery unit. Theoretically, all this is true. But here I want to make a statement and to lay special emphasis on it. No matter how perfect a machine may be mechanically, and no matter how efficient it may be theoretically, it is in practice no better or more efficient than the operator. The finest locomotive or automobile ever built responds only to the amount of skill possessed by the driver. A firing battery, like the locomotive or automobile, is worse than useless in the hands of inexperienced, untrained men. And training takes time, opportunity and practice. Do not imagine for a moment, that an occasional armory drill will ever secure efficiency in a battery, for it cannot. Such a firing machine as I have attempted to describe, requires thorough training and great skill in the officers, and that each enlisted man do his part accurately and quickly; everything must be practiced until it becomes almost second nature; to facilitate rapidity the work is subdivided so that each man has only one or two things to do; but on the other hand, his work is useless, if his neighbor does not do his part—this is one of the disadvantages of subdivision of labor. And in no other arm of the service is there such absolute dependence of each man upon every other, as exists in the field artillery, and in no other arm does the failure of one or a small number of individuals so disastrously affect the whole organization. Here again appears the necessity for a high degree of training, for everybody must do his part *accurately* and *quickly*—or the machine breaks down.

Having now given some idea of the essential features of field artillery of the present, we will pass on to the details of the training required to secure efficiency, giving first a few remarks on

The Requirements of Field Artillery in War

In a recent pamphlet (Actual Experiences in War, by Captain L. Z. Soloviev, of the Russian Army), treating of episodes in the great war in the far East, we find this remark:

Justice requires me to state that the first engagement in which I took part showed me most emphatically that many a thing I had to do in battle was not what I had been taught, and that many a thing I was taught is not applicable in combat.

This statement at once suggests the question, "What does the artillery do in campaign?" For it is evident that if the work to be done in the field is previously determined and instruction concentrated on it to the exclusion of what may be called side issues, we shall take a long step toward being efficient when finally tested on the battlefield.

At the outbreak of hostilities the field artillery will

1. Be moved to a rendezvous—Transportation.
2. Remain there some time—Camping.

3. Move to some other point—Marching.
4. Remain halted brief periods—Bivouacking.
5. Proceed to its firing place—Occupation of Position.
6. Fire.

And omitting minor events, the above procedure will exist in some varying order throughout the campaign. I should like to discuss these six headings fully had I the time to do so, and you the patience to listen; but under the circumstances, as time is running on and the subject of field artillery training is so large, I am forced to confine myself to narrow limits; and I am thus going to omit entirely the subjects of Transportation, Camping, and Bivouacking, merely reminding you that opportunities to gain practical experience in these is afforded en route to and from, and at the encampments now so generally held, of which most of you artillerymen have already taken advantage.

I will, therefore, begin by touching briefly on the question of

Marching

It will be recalled that the only action of artillery is fire; but it cannot deliver its fire until it gets to its proper position; it can get to this position only by marching—the importance of which is apparent. Marching in the field artillery is combined work of the men and horses. Officers and chiefs of section must thoroughly understand the management of six-horse teams; drivers must understand the management of pairs; to manage his pair, the driver must be such a good rider as not to be obliged to devote his efforts to *riding*, but rather to feel free to concentrate his attention upon his *driving*. We thus come down to the fact that the basis of all marching is good riding. This is as true, in the field artillery as in the cavalry. There is no way of learning to ride that I know of except actually getting on a horse. This leads to the inevitable conclusion that proficiency in marching can only be secured by having in each battery a sufficient number of well-trained horses for the purpose of teaching the personnel first riding and then driving. I regard it as essential that a battery have a nucleus of horses permanently with it, and I regard them as just as much a part of the material as are guns and harness. These animals are needed, not so much for the purpose of supplying trained horses for the battery when it takes the field, as for the purpose of having the means available for imparting the elements of riding and driving to the personnel before taking the field. The loss in horseflesh is so great in campaign that untrained horses are the usual ones in all mounted branches. But an untrained horse and an untrained man is a poor combination for marching—and the untrained man can be avoided by previously spending a reasonable sum for his instruction.

The time may come when motors will displace horses, but it has not yet arrived. And when we have horses, they require care. There is nothing that deteriorates faster through lack of care than does a horse, hence the necessity for the men of a battery being properly instructed in stable duty, involving feeding, watering, grooming, care of slight injuries, etc. In some encampments, the horses of State batteries are taken care of by civilians. I am perfectly willing to admit that the hired horses are not as a rule attractive subjects to work with; nevertheless, by turning over their care to civilians, a valuable opportunity to secure instruction in stable routine is lost. I think the drivers should care for their horses at encampments, the same as they will have to do in the field. For it is safe to assume that if a driver will not look after his horses in time of peace, and particularly if he has had no instruction during that time in properly caring for the animals, he certainly will not care for them properly amid the exigencies of campaign.

One of the most important requirements of marching is properly fitted harness. Misfitted or improperly adjusted harness causes galls, bruises, sores, etc.; hence the necessity for understanding the subject of fitting, especially the collar and saddle. This can be learned in an armory, particularly if a pair of horses can be occasionally obtained. If the battery owns no mounts, it ought to be possible to occasionally hire a pair for an evening, and thus secure a little practice. One or two other points I desire to mention are to invite your attention to the fact that at maneuvers the ammunition chests are empty, while in campaign every effort is made to keep them constantly filled. This increased weight behind the teams will make an enormous difference in the mobility, and while my desire is to do anything except discourage you, yet do not think that because with untrained drivers and untrained horses, as maneuvers, you are finally able to get the guns and caissons to their destination, that you can do the same in war. Add the weight of the ammunition; and much more skillful driving will be necessary than before. Another point is that true mobility consists in covering a long distance at a reasonable gait, and not a short one at a very fast gait. The gallop is spectacular, but it is a poor harness gait for covering a long distance. Men and horses should be trained to cover a long stretch of miles at an unbroken trot. These are just a few ideas expressed here, while passing along rapidly to a subject I want to lay some stress on, namely:

Occupation of Positions

This heading, as here used, is intended to include all movements and operations of the artillery from the time its commander receives orders to take up a position (designated in general terms in the order) to the complete installation of the component parts of the artillery ready for action. It is but a few years since the matter was a simple operation, but with the development of artillery material, batteries disclosing themselves are liable to an invisible attack by hostile guns from an unknown quarter before they can reply, therefore, the necessity for concealment and the ability to use indirect fire have become of capital importance. Failure to appreciate this fact was responsible for some of the Russian artillery disasters in the first battles of the late war in the Orient. Experience in war teaches us what we must do in war, and it has shown plainly that to avoid unnecessary exposure the artillery must be trained in time of peace to conduct preliminary movements with a caution and skill unknown on old battlefields.

We have thus far confined our remarks principally to the battery, for it still remains the most important fire unit, but the battalion (or group of three batteries) is now the true *tactical* or fighting unit, and, if for the sake of illustration, we assume that a battalion commander has been directed to occupy with his artillery a designated position in some tactical operation, the procedure would be about as follows:

1. He starts on a reconnaissance with his staff, noncommissioned staff, scouts, agents, mounted orderlies, and signalmen.

2. On the way, he examines the general lay of the country, determines the best position for the reserves, and possibly for the limbers and the train if the latter is under his charge, and the adjutant or sergeant-major drops off agents to guide the batteries that are following; scouts may be sent to examine anything suspicious; mounted orderlies may be sent with messages.

3. Arriving at the general position, he reconnoiters it, the enemy's position as far as it can be seen, and the intervening ground to the extent of the time available, selects the general battery positions, his own station, determines upon the sector to be assigned each battery,

or special mission to be given it. The adjutant has the ground thoroughly scouted in the immediate vicinity, especially on the flanks. The sergeant-major receives the battalion commander's directions as to the establishment of communications, which the signal details then establish under the sergeant-major's direction. The adjutant, in the meantime, has, by means of his scouts or agents, or both, gained contact with the adjacent friendly troops, and so stations his scouts, or other available men, as to guard the position against surprise, if necessary, pending the arrival of the batteries. The adjutant may then make a panoramic sketch, if conditions would make it useful.

4. In the meanwhile, the battery commanders arrive, having either accompanied the major or been sent for by him, an agent conducting them in the latter case to the position. They then determine the exact location of their guns, observing stations, have their communications established, start their reconnaissance, officers to compiling ranges, firing data, and if necessary, making panoramic sketches. In the absence of instruction from the major, the captains pick out positions for the limbers.

5. The batteries are subdivided and prepared for action, the battery trains are probably consolidated by the quartermaster-sergeant and taken to the place designated; the reserves are probably consolidated and taken by a lieutenant to the place designated; the firing batteries are met by their captains and placed in position. All this involves more work for the agents.

6. The entire field will next be as completely organized for the combat as the time available admits. For instance, the artillery may seek by fire to develop the enemy to the extent of giving the commanding general some notion as to how the enemy is occupying the ground, a clear idea of which can be obtained only by an advance of part of the infantry; to protect this infantry as well as to keep the artillery informed of the developments, it will be necessary for an artillery officer to accompany the advance sending back word by telephone of what he finds. This involves work for the signalmen of the battalion.

If the battalion commander controls the fire in addition to directing it, the adjutant, sergeant-major, and assistant will have to manipulate the telescopes and plotting instruments, so that the data needed by each captain may be promptly supplied him.

Now, practically all the details which constitute a battery's part in the occupation of a position, can be learned by the officers of a national guard battery, with the expenditure of very little money, but of much time and patience. The basis of this training is ability to read maps—such knowledge being absolutely essential. Assuming this ability, which is easily acquired in an armory—positions are occupied on the map; routes by which the battery can reach the position unseen by the enemy are selected, the points at which the agents will be stationed, the instructions given to them as well as to the scouts, can be determined from the configuration of the country as shown by the map, the location of the guns and of the observation stations can be selected, etc. Independently of this map work, the signal details can establish telephonic communication in or around the armory, can be practiced in transmitting firing data and can learn the care and repair of the lines and field telephones. When all these specialists (scouts, agents and signalmen) have thus learned the rudiments of their duties in the armory, they can next be practiced in them out of doors. A ride on the trolley or surface lines of transportation will take these men out into open country, where in the autumn, after crops have been harvested, farmers will generally allow the men to walk over the ground, and here the work previously done on a map in the armory can be repeated on varied terrain. Guns and horses are not essential—in fact, these specialists can be better trained without them than with them—it is merely necessary to take along such instruments (phone, etc.) as can be carried easily by hand on the cars.

We come now to the culmination of all battery instruction—the delivery of an effective

Fire.

This subject is so large that volumes have been written upon it. The few moments remaining to me are only sufficient to touch briefly on salient points. I again call attention to the fact that fire is the only action that artillery has; if ineffective in this, it has no reason for existence. No amount of excellence in marching, camping, or reconnoitering, no perfection in all artillery duties up to the time of opening fire, is of any use whatever if the battery cannot hit. It is equally certain that a battery will be unable to hit in war, if unable to do so in peace. Bear in mind that the battlefield subjects a man to strange emotions, and recall my statement earlier in this paper that a battery is a firing machine operated by the captain, and please remember that it is an effective machine only when everybody in it, high and low, does his part accurately and rapidly. And it is evident that each man will perform his function in battle only when he has previously been so well drilled that he can now do it in spite of the distractions of the battlefield. Hence the necessity for *thoroughly* instructing the enlisted men in the armory in all that appears in our Drill Regulations under the headings of the Cannoneer, the Gun Squad, and the Firing Battery. The latter (Firing Battery) may not be practicable in all armories, but the two former, certainly are. But an occasional drill can never accomplish the result—persistent repetition is essential until the mechanism becomes second nature to the personnel.

The officer who operates the firing machine must be a master of his business. It is generally conceded that indirect laying will be very largely, if not almost entirely, used in the future. This is the method of aiming in which the guns are under cover, and the men at them do not see the target. The captain prepares the firing data for his battery and the men at the guns, using the data, set their sights upon a tree, house, or other object, in rear or in any other position, and in so doing direct their guns upon the desired object without seeing what they are shooting at. The captain, or his reconnaissance officer, alone see the results of the shots, so that, to use a slang expression, it is clearly "up to the captain." Manifestly, the officers must *thoroughly* understand the computation of firing data. Facility in this can be secured by practicing with a pad, pencil, and ruler in an armory, assuming certain information, such as ranges and distances, the angle from the aiming point to the target, etc., making a rough diagram to show the relative position of the guns, aiming point, target, and observation station, and then computing the data under various conditions.

I will not attempt to give illustrations here of these computations, but will briefly remark that to deliver indirect fire requires a hasty triangulation to be made by the fire commander which will enable him by rapid solution of the triangles to deduce from his observations the data which the men at the guns must have to bring the line of fire to bear upon the invisible target by merely directing the sights upon the designated aiming point. This requires every field artillery officer to have an elementary knowledge of algebra, geometry, and trigonometry, as without it, he can never learn to make the necessary computations understandingly or correctly. Therefore, any man whose education is defective in these respects should remedy it before aspiring to be an officer in a militia battery, otherwise he will be unable to play his part as a *fire commander*, either upon the target range or the battlefield.

Elementary Instruction at Home Stations

Having acquired facility in computation of data in the armory, the Battery Commander's telescope can be taken out in the country in the same way as was indicated for the scouts, signalmen, and agents, and positions selected on the ground for the target, aiming point, and battery. The quantities before assumed in the armory can now be actually measured and firing data computed. If, in addition, a tripod with socket is made to hold a panorama sight (and this would be quite inexpensive) this sight can be set up to represent the right gun of a battery, and will serve to check up the firing data, as calculated; two such sights and tripods representing the right and left guns of a battery, will, with the single exception of setting off the angle of site (and they could be constructed to do this also), answer just as well in all this work as would the actual guns, and have the advantage that the sights and tripods can be carried in a trolley car, without extra expense.

An immense amount of very valuable instruction can be secured by the officers and specialists working out in the open country in the way I have indicated. This instruction can be further supplemented by practicing the Indoor Conduct of Fire at the armory, but lack of time prevents my going into this further than to state that it is fully set forth in General Orders, No. 183, War Department, series of 1909; that the practice cannot be held without a thorough knowledge of the "Preparation and Conduct of Fire" as laid down in our Drill Regulations, and that to the best of my knowledge of National Guard batteries (with a few exceptions) have not yet received this instruction. It is worth noting here that in Holland this practice is so highly esteemed as to be extended to an outdoor conduct of fire by using smoke bombs on different lengths of poles, the firing position being connected by telephones with the target, and the bombs or small charges of powder being ignited at the exact points the actual projectiles would have burst.

Now, gentlemen, I have tried to briefly indicate to artillery commanders, how much important work can be accomplished at the home station with the facilities they now have in their armories, supplemented by out-of-doors work. A careful carrying out of the exercises I have indicated, or in other words, taking full advantage of the facilities already available would go a long way toward fitting batteries to progressively carry on their work upon arrival in camps, the principle being that it should be unnecessary to devote any part of the short encampment to elementary work that could just as well have been previously done at the home station. If this were made the rule, it would obviate much of the present adverse criticism as to the unpreparedness of batteries upon arrival in camps.

Bearing in mind the present tremendous shortage in field artillery existing in both the Regular Army and National Guard, and the unsatisfactory reports that are made as to efficiency for field service (for we cannot correct a deficiency until we frankly recognize its existence) I think that this arm will have to be supplied with competent instructors, taken from the Regular Army, and will have to be fostered a great deal more in the future than in the past. It does not strike me as good business policy for the United States to supply a State with an $85,000 battery and then not furnish the necessary instructors, nor insist on any degree of proficiency whatever in its use. The burden must be partly carried by the Federal Government and partly by the individual States, and the latter will have to recognize that it costs much more to maintain a battery than a company of infantry.

Requirements To Be Fulfilled

I can merely add that before readiness for field service can be obtained, I am satisfied that ultimately the following requirements will have to be fulfilled, and these are what your Association should strive to obtain for the militia field artillery:

(a) A nucleus of trained men and trained horses as part of the permanent establishment of each militia battery.

(b) Larger and more suitable armories designed especially to give facilities for indoor instruction in the conduct of fire.

(c) More adequate financial support both from the Federal Government and the States concerned, and a definite and distinct allotment of funds exclusively for field artillery instruction.

(d) A system of appointment which will secure officers of suitable education.

(e) Competent instructors from the regular field artillery, permanently on duty in each State which possesses organized field artillery units, whose especial duty it shall be to impart to the officers a good fundamental knowledge of gunnery and of their duties in connection with the preparation and conduct of fire.

(f) Attendance of militia officers at a regular field artillery school of fire (or if this is impossible, at a suitable post), where they can see regular officers handle regular units, and themselves receive technical instruction in the preparation and conduct of fire.

(g) Encampment and target practice, under competent supervision, upon a properly equipped range, constituting a summer school of fire for militia organizations handled by their own officers, affording them an opportunity for giving these units a reasonable amount of instruction in maneuvering as well as firing.

Conclusion

In conclusion, I wish to state that the War Department, recognizing the necessity and importance of assisting the militia field artillery in its struggle to attain efficiency, did three things this year which mark an era in the development of the arm:

1. By establishing a camp of instruction for officers of militia field artillery in June last at Fort Riley, Kansas, under the supervision of one of the very best and most experienced field artillery captains in the Regular Army. The total attendance was 90, and 19 States were represented. These officers, one and all, expressed themselves in the most enthusiastic terms of the practical benefit derived by them from their experience at this camp.

2. By organizing a summer school of fire at Sparta, Wisconsin, in July, in which thirteen batteries of five of the neighboring States participated and had their target practice under the same conditions as did the regular troops—competent regular officers supervising the work.

It is worthy of note here that the shortage of officers with the regular units still further increased by the detail of instructors to help the militia considerably interfered with the schedule of instruction laid out for the regular troops, and it is not believed that this strain upon the regular contingent can be kept up without ultimate detriment to the service. The necessity for helping the militia with their training is one of the most cogent reasons for asking legislation providing for additional officers in the regular establishment.

3. By detailing a field artillery officer of extensive experience for duty in the Division of Military Affairs in Washington. This officer is well known to most of the militia field artillerymen and in him they will find a friend ever ready to assist them in their studies in any way in his power, and I would suggest to them all to call upon him for advice and assistance upon any professional questions which need explanation to make them perfectly clear.

Another step in advance has been accomplished by the regular and militia officers uniting to form the United States Field Artillery Association. It is hoped later to publish a journal and in its pages to supplement our Drill Regulations with information much needed by us all, and finally, to formulate therein a scheme of instruction, which, if followed, will make our militia field artillery a valuable asset in war.

Gentlemen, I thank you for your kind attention and I hope most sincerely that success will finally crown your patriotic efforts to give the nation an efficient army.

INSTRUCTION OF FIELD ARTILLERY

By * * * * *

The function of field artillery is to help the infantry. This fact was long lost sight of in our service, with our small disjointed army, and every arm seemed to consider itself all-important. Even abroad, at different times, writers have attempted to give to the artillery a more or less independent function, as, for instance, General De Negrier's statement in his "Lessons of the Russo-Japanese War." "In proportion as the war prolonged, it is affirmed that during the day the artillery governed the battle, whilst the infantry acted chiefly at night." All such statements must be carefully considered, or erroneous deductions will result.

It is undoubtedly true that the importance of artillery has increased, and will continue to increase, in proportion to mechanical developments, for the artillery, more than any other arm, involves machine principles and depends less on human emotions for its accurate use; but, whatever stage it may develop to in the future, it has as yet not passed that of being accessory to the infantry.

A careful examination of warfare during the past century will show conclusively that the artillery has been successful in proportion as it has cooperated with the infantry, and that artillery failures can be traced largely to a lack of appreciation of this fact. It is, therefore, a cardinal necessity that the two arms should understand this fact, and in time of peace should work in harmony, cultivating that mutual understanding so necessary in time of war. As a first step toward attaining this result, officers of each arm must be familiar with the tactics of the other. How can the artillery effectively support an infantry attack without knowing the principles underlying it and the method of their application? On the other hand, the infantry, to secure the intelligent cooperation of the artillery, must know the conditions under which the artillery can be most effectively employed, and must secure these for the artillery. We ask the infantry not to underrate our value, nor, on the other hand, to expect us to accomplish the impossible. We must understand each other, and have mutual confidence.

To revert to the field artillery, it is, therefore evident that the peace instruction to enable it to fulfill its war functions must embrace (1) a thorough tactical knowledge of all arms, especially infantry, which forms the bulk and backbone of an army, and (2) a clear and definite idea of its own work in campaign, and must then concentrate its efforts on preparing for this work.

The above statements relate to the officers of field artillery. But the enlisted personnel must also be well instructed. A modern battery is a complicated machine operated by the captain, and in order that the machine may work smoothly and efficiently, it is necessary not only that the captain understand it thoroughly and know how to use it, but the parts of the machine itself must be well adjusted to the particular part each fills, and to each other. From this latter requirement, for instance, has arisen our term "mechanism of fire," in which each man, when any particular command for firing is given, performs his own definite part, which varies in importance and difficulty with his position. But it is evdent that in any case his instruction must be carried to the point where he performs this particular operation through force of habit rather than by mental effort, for otherwise the emotions attendant on the battlefield will prevent him from doing his work with the necessary accuracy.

The object of the present paper is, however, merely to discuss the training of the officer; and even in this, the discussion is largely limited to training without the presence of troops, and therefore the training of organizations is not herein discussed.

Tactical Knowledge of Arms, and Training of Specialists

The first question here is how to impart tactical knowledge. It can be done by the solution of map problems, terrain rides, and helped by association with other arms. It must, of course, be completed by work with artillery organizations.

But to count on teaching this only by sending officers to the Leavenworth schools and Army War College, would be too slow, even were it desirable to do so. A better way is to utilize these men as instructors at the posts where they may serve after graduation. This is believed to be feasible; and by this method an immediate use can be made of the education the government has given. The matter could be arranged by a War Department order requiring the post commander to utilize these graduates as an advisory board or as instructors, or some similar plan could be adopted.

It would then be the duty of such commander, utilizing the knowledge of his assistants, to give during the school season many map problems, starting with the simplest in infantry only, and gradually increasing the size of the command and difficulty of the problem, soon taking in artillery forces. As the latter increase in size, more attention can be devoted to representing varying phases of the action, and the solution could call for the duty of the artillery at different moments to meet stated conditions.

The simple tactical problems given in some of our text-books are excellent for teaching all officers the use of infantry and cavalry, provided that during the time devoted to these problems, a study of the drill regulations (attack and defense, etc.) together with the special tactics of these arms, is carried on concurrently. But unfortunately, the tactics of the modern rapid fire gun have not yet been written in English as far as known. The most important chapter in our Field Artillery Drill Regulations (Artillery in the Field, or some similar title) has not been formulated. What appears on the use of artillery in Griepenkerl and similar works on applied tactics that have been translated, was written before the development of the present gun, and is, therefore, not in accordance with this weapon.

The solution of the artillery features of the map problems should necessitate the detailed use of all the specialists of the artillery, such as scouts, agents, signalmen; the places at which these men would be located, orders given them, duties they would perform, etc., etc.; the detailed information obtained by reconnaissance; the details of selecting positions (reasons for selection, amount of defilade, possibility of firing over intervening crest, in case of indirect laying, amount of dead space, etc., etc.), as well as the location of limbers, reserves, train, and disposition of field train; the problems should involve the amount of ammunition consumed, together with the methods of resupplying it, and difficulty and time consumed in the operation; the problems should involve marching and camping hours for service duties, computation of time and space, etc.; they should involve breeching, counter-battering other artillery, supporting an infantry attack, accompanying it, batteries in readiness, batteries in observation, etc., etc. In short, as many of the actual phases of a campaign should be represented as possible and especially should the problems set for field officers involve the features of the use of the present equipment which these officers will surely have to know in the next war, if the artillery is to fulfill its full duty to the balance of the army. For it must be borne in mind that the present artillery has enormously expanded the duties and responsibilities of field officers of field artillery. So many of the duties that were formerly distributed among a number of the subordinate personnel, as well as many new duties, are now concentrated in the battalion commander and regimental commander that constant study and application are necessary on their part to fit themselves for the work which the next war will surely put upon them.

If thought to be preferable, these problems for field officers might be prepared by some central authority, as, for instance, the officer of the General Staff having supervision of field artillery matters, and the solutions could be sent him for criticism—this is a detail that could be arranged; but the gist of the matter is to have the field officers solve the problems. This would constitute excellent post-graduate work. The annual publication of these problems, together with the different solutions, and criticisms thereon, omitting the name of the officer who submitted the particular solution, would be a great help to all.

As to the problems given captains and lieutenants, their solution should be followed by a critique, and in this great tact and judgment will have to be used to prevent discouragement or dislike for the work on the part of those solving the problems, every effort being made on the part of the commander and his assistants to cultivate interest in the work.*

These map problems should be followed by the war game, used under similar conditions. But it is believed that there is little use in giving it to officers having but limited tactical knowledge, and that above all, the umpire must be thoroughly informed, and his tactical knowledge as well as his sense of fairness must be generally recognized. Or in other words, it should not be played by too inexperienced officers, nor in any case without a specially qualified umpire. The map problems should be followed (or in case the war game is played it should be followed) or interspersed by simple terrain rides† in which the officers command (theoretical) forces, and various conditions are assumed, the officers stating their decisions to meet these conditions. The work here can be elaborated indefinitely, but it must be borne in mind that detailed knowledge is what it is desirable

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* One great advantage of this method of instruction is that up to this point, it is applicable to militia artillery also; and it is of the utmost importance to the welfare of the United States to begin at once some systematic method of instructing this class of militia—for of all branches of the state troops, the fie'd artillery is the least efficient. Map problems can be solved in their armories.

† The French having had the rapid fire gun longer than any other nation, have worked out a system of instruction adapted to the gun more fully than other nations have as yet. Terrain rides form a conspicuous feature of such instruction, and French officers have written a number of excellent works on the subject. One of the best of these is "Les Exercises de Service en Campagne dans le Group de Batteries," by Aubrat. A translation of this, or better still, an adaptation of it to American organization and terrain, should be issued to the service.

to impart, and that the smaller the forces engaged, the more in detail can the movements be followed.

These terrain rides should be simple at first, and limited to the immediate vicinity of the post; subsequently they can be extended so as to cover several consecutive marches, thus obtaining ground unfamiliar to the officers, and new and unfamiliar ground is necessary for instruction purposes.

On such a ride, the officers should be under charge of a competent instructor, who should have with him the scouts, agents, signalmen (with their equipment), battery telescopes, field artillery plotter, range finders, rulers, etc., and a few enlisted men with markers to represent batteries, targets, etc. In this way not only would the officers receive instruction, but the training of the specialists among the enlisted men would also be carried on under the best possible circumstances. And the experience of the Russo-Japanese war teaches beyond everything else, the importance of these men.

On such a ride, each officer should be temporarily assigned to a command (theoretical) or duty, as for instance, commander of the entire force that is assumed, artillery battalion commander, adjutant, battery commanders, infantry commander, etc. The instructor, who has previously gone over the route and terrain, and prepared a series of problems in harmony with it, gives out the day before starting the march problem for the following day and the assignment of officers to their various duties. The commander of the forces issues his order based on the problem. The next day the command takes the road, each representative of an organization, the actual distance from the others he would be were the organization present (same road space). All features (advance guard, main body, train, etc.) should be represented.

The march need not be a long one, just far enough to secure new terrain. A new problem could then be given, as for instance, taking up a position to meet certain conditions. This would involve the use of the scouts, agents, etc., making a sketch, etc., etc., calculations as to time available, etc., etc., and teach reconnaissance practically.

At another time, the artillery being in position, tactical situations may be assumed the artillery making its dispositions to meet these conditions, including the measurement of angles, computation of firing data, etc., which can be checked up with the other telescopes, and the cause of glaring discrepancies determined.

The above is simply a general idea of the work which may be varied indefinitely, and all parts of it teach tactics or their application, which is what the artillery needs to know. These rides are also applicable to militia batteries, but should not be undertaken prematurely there. Such batteries should wait until they have become well proficient on map problems, and the regular army has developed a sufficient number of qualified instructors. Even for the Regular Army these rides, will hardly be satisfactory at first, but a few years will suffice to make them so; it must be borne in mind that the success or failure will depend almost entirely on the instructors, and these men will have to be developed.

But the idea is thought to be sound and feasible. It is based on the fact that the officers and battery specialists must know things that the remainder of the personnel (the organized battery) need not know, and that the officers, etc., can learn these things just as well, if not better, without being accompanied by the organization, than when it is present. Those under instruction are now learning how to do things that the organization will later be ordered to do. And the student is learning it much more economically to the Government, than would be possible were he accompanied by the actual troops. In fact, the cost of such a ride would be practically nothing, as the command being small, it could in most cases camp alongside the road, and permission to ride over fields would generally be given free, after crops have been harvested. A small amount of money will be necessary to purchase fuel and forage, but the difference in cost between buying in open market at the proper time of the year and under the post contract will be very small.

Not only is the cost less, but in addition the instruction is better than would be the case, were organizations present, the handling and care of which would be a distraction. And it goes without saying that just as much of an officer's education as can be given him without troops should be so given. A large part of tactics can be so learned; and in addition, constant practice in measuring and computing firing data is necessary, in order that he may acquire a sort of mechanical habit, or otherwise he will hardly be able to measure angles, consider algebraic signs, and perform computations quickly and correctly on the battlefield, when subjected to its distracting emotions and nervous strain. The above scheme affords opportunity for much of this practice.

But the instruction so far touched upon, even if carried out under the most favorable circumstances, will still leave an artillery officer a long ways from being proficient.

All this instruction must be supplemented by work with actual troops over a varied terrain, and under various conditions. When so working, his tactical instruction should be continued at drills. This may be done by the artillery commander being present and from time to time, as he visits organizations at drill, place different officers temporarily in command and give them problems to be immediately solved. In these first problems, the instructor himself should state a tactical situation, merely calling upon the battery or battalion commander to solve the artillery part, and to give the proper commands, which the battery or battalion execute as given for carrying out the idea. In the early problems, the instructor should clearly fix in his mind beforehand, all features of the exercise and the particular points he wants brought out. Gradually the problems may be made more difficult, and the battery or battalion commanders required to assume for themselves situations, and then solve the problem complete in every detail, except the actual firing of projectiles.

It may be urged against this, that some batteries are located at posts where there is no ground to work over—where there is little except the parade. But it may be stated in reply, that limited and unsuitable as may be the ground owned by the government at some field artillery posts, it is still surrounded by other ground, upon which objectives may be imagined, that there are roads upon which scouts and agents may be trained, that there is room enough to train the signalmen in establishing and maintaining telephonic connections locating and repairing defects, etc., that much practice can be obtained in computing firing data, use of plotter, ruler, etc. In short a great deal of important instruction can be given. In any case, it is not believed that there is a post at which at least a battery cannot be made thoroughly proficient.

Firing

Here is where the field artillery officer applies not only his tactical knowledge, but also utilizes his technical field artillery knowledge The subject may for convenience be glanced at under the headings

1st. Mechanism of fire.

2d. Employment of fire.

1. Mechanism of Fire

This subject is treated in the drill regulations in Part III, Chapter 1, 2, 3, and 4. This is the final test of artillery efficiency—the ultimate object of the artillery is to deliver an effective and timely fire, for this is the only arm that has no action except fire. No amount of tactical knowledge on the part of the officers, no excellence in marching, camping, scouting, reconnoitering, etc., no perfection in all artillery duties up to the time of opening fire, is of any use whatever, if the battery cannot hit. When it opens fire, it becomes a machine in the hands of the captain, who directs its fire upon any point or area and with any desired rapidity. But it is only such a machine when each man in it fulfills his function. It is, therefore, evident that he must be drilled in his duties until he can do his part, with the greatest amount of habit, and the least dependence on thought—and can do this rapidly and accurately. Consider the men who set the range, deflection, angle of site, and fuze scales—two of these men, in addition, have to center bubbles in levels. Of course, the best men in the battery will be picked out for these positions. But the men are only human, and on the battlefield are subject to the same emotions as other men. There is a school of writers who claim that the efficiency of modern weapons is but little greater than the older ones, due to the fact that every weapon must be operated by a man, and that men, as fighters, have deteriorated with the progress of civilization, in almost the same degree as weapons have improved—that under the best of circumstances, men get just as much excited, and just as much scared as ever; that these emotions manifest themselves in a dimness of eyesight, and trembling of the hands.* Undoubtedly there is some truth in this—how much no one knows. But this much is certain, that the men who handle the above scales cannot do so rapidly and accurately under fire, unless they have had a thorough training beforehand, carried to the point of almost forming a habit; in this connection, it must be borne in mind, that in the other arms, if some of the men get too "rattled" to be of use, there are still left the cool and collected men—the loss is merely in the proportion of useless to useful men; while in the field artillery each man does a particular thing, which is dependent upon other men doing their part, so that the useless men can reach only a very limited percentage, when the whole battery becomes useless. It is this dovetailing of duties making the whole dependent upon the weakest link, that necessitates such thorough peace preparation, and prevents improvisation in war.

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* In the arms other than the artil'ery, in flight or concealment, with disinclination to advance. It is these battlefield emotions that caused muzzle loaders to be loaded more than once without firing (one musket picked up at Gettysburg had over twenty loads in it), and causes the danger space with small arms to extend from the muzzle to extreme range.

2. Employment of Fire

To properly employ fire, not only must the batteries be complete as working machines (mechanism of fire) and the officers have the tactical knowledge previously set forth in this paper, but in addition they must know the efficiency of their weapons, and the volume of fire necessary to accomplish a desired object.

The efficiency of the present gun and projectile are matters easily determined; that is, the error of the gun both in range and deflection, is known from tests, the error of the time fuze of the shrapnel is also known from tests, and the pattern and density of the shrapnel cone of dispersion of the balls is known. But none of these has been published to the field artillery. By considering these known data, the density of balls over any given area at any designated range can be determined for the average shrapnel at that range. The power and penetration of the balls at any given range, have also been determined. If now, we know the density of balls (number to the square yard) necessary to accomplish any desired purpose, it is evident we can, by combining it with the above data, determine the number of rounds necessary to accomplish our object. All the above data have been determined with accuracy because they all depend upon the tested and known mechanical accuracy of the gun and ammunition.

This information, so necessary to a field artilleryman, is on file. It should, therefore, be placed in such form as to be easily understood, and then given to the field artillery. If necessary, it can be given confidentially; but it is necessary for the efficiency of the field artillery, that its officers should know the efficiency of their weapon, as without this knowledge they are groping in the dark when they try to accomplish any particular mission. For instance, suppose a captain is told that a certain area is occupied by the enemy's infantry, and he is told to prevent any forward movement on their part. He easily determines the necessary firing data for opening fire. It then becomes a question of about how *many* shots will be necessary, and the method of distributing his fire. Will two shots from each piece do the work or will it take two hundred, or will some intermediate number be sufficient? To solve the problem intelligently, he must know about how thickly he should sow the ground with balls (number to the square yard) and from this, knowing the efficiency of his gun and ammunition and probability factors, he deduces about how many shots it will take to secure this desired density. Of course, he can keep on firing indefinitely, and thus accomplish his object;

but this would result in the consumption of much ammunition (very hard to get on the battlefield), and keep his battery from being available for any other purpose. In short, until he becomes familiar with the capacity of the weapon and ammunition, he is using guess work instead of intelligent direction. Much firing is done in European armies for the purpose of allowing such deductions as the above to be drawn. It is especially necessary with the modern equipment, and "empty battlefield," where conditions are so different from those of former times, when the battery could clearly observe the effect of its fire, and hence *know* when it had fired a sufficient number of rounds, and when, moreover, the consumption of the gun in ammunition was so much less, and the problem of its supply so much simpler.

It is not claimed that the above knowledge will allow the battery commander to predict with absolute certainty the exact number of rounds needed, but it is claimed that he is in a much better position to know roughly how many it will take and consequently the time to accomplish this particular mission, than he is now, with no data whatever upon which to base his ideas. As far as mathematical prediction is concerned, it must be borne in mind, that every weapon, as previously stated, even though mechanically perfect, is operated by a man subject to the emotions of the battlefield, and that these emotions will introduce a large modifying coefficient of effect. To determine the value of this coefficient would lead to a psychological study and investigation, for which there is not sufficient time here, and as a result of the labor, even if undertaken, there would follow only an unsatisfactory conclusion. But omitting this factor, which will, of course, leave the other deductions incomplete, the fact remains that the field artilleryman can act with judgment only when the knows the rapidity of fire and accuracy of the gun, the errors inherent in the fuze, the width and depth of the cone of dispersion of the average shrapnel, at different ranges, the percentage of ineffective shrapnel at different ranges, the percentage of ineffective bullets in the average shrapnel, the relative effects of shrapnel burst at different heights for the same range, the relative loss of efficiency with increased range, etc., etc., and this information should be published to the service.

Efficiency—Literature

The field artillery, as a separate arm, dates back only to 1907, when it was separated from the coast artillery, and officers permanently assigned to each. No longer having to learn the dual duties of field and of coast artillery there is no reason why the government should not now require the highest possible development of the efficiency of the field artillery. It is believed that practically all of the officers in this arm are anxious to become thorough masters of their profession. Where inefficiency exists it probably results from extraneous conditions. Even at the risk of giving offense, I am going to repeat plainly that the personnel (officers) consists principally of two classes: first, those men who have had no field artillery experience whatever (or practically none) before their recent assignment; and second, those who have had experience (the higher officers) with the equipments formerly in use, and but very little with the present rapid-fire gun. The employment of this gun is based on a radically different principle from former ones; while the old material was employed gun against gun, the new one is gun against space. From this new basis so many consequences flow, that the entire world is now trying to determine the details of employment, and learn the proper way to handle the arm. The tactics have been modified, and are still being changed. Therefore, it does not follow that a man who was a good field artilleryman under the old system is necessarily so under the new. The constant effort is to adapt the tactics to the weapon, so as to get the maximum efficiency from it that it is capable of. Unfortunately, there is but little modern field artillery literature in the English language; and, therefore, our field artillery has had only limited opportunity to become familiar with the possibilities and requirements of the gun.

Again, we have had regiments of infantry and cavalry in our service for many years; regimental instruction has, therefore, had a chance to develop and has been thoroughly worked out.

We have had independent batteries in our service for many years, provisional battalions for a few years, and have just begun regimental work; we, therefore, have practically nothing to guide us in our work of larger units, and yet in this arm more than in any other, combined action of several units is necessary.

Coupling all the above statements together, it is seen that the field artillery cannot reasonably be expected to be at present as efficient as we would like to have it. The officers are too new, the gun is too new, and the organization is too new.

Accepting this condition as a fact, the question at once arises "How can the arm be brought up to maximum efficiency in the minimum time?" Broadly speaking the answer is first to tell the field artillery what is expected of it, and then make it come up to this standard.

As to letting the field artillery know what is expected of it, the first requirement is to promulgate a method of instruction adapted to the arm; it has been the endeavor in the preceding pages to outline such a course—the old methods are no longer suitable. In addition to this, educating literature by means of which the officers can keep abreast of development of the arm, and place themselves in touch with what other countries, especially France and Germany, have done with this gun and are doing, should be freely issued. And while there is a dearth of English literature, there are many very valuable foreign books, especially in French, and many in German, and a continuous stream of short timely articles in the periodicals of these countries; translations should be freely published in The Field Artillery Journal; and every artilleryman should subscribe for this magazine and in addition should contribute to it his best thoughts. Such works as are especially important and too costly to be handled by the magazine should be issued by the government.

Inspections

Having, by means of publications, shown the field artillery what it should know and what it should do, the next step is to make a series of close and vigorous inspections to cause the artillery to take advantage of facilities for instruction that have been given. In other words, the idea is first to notify the artillery of the standard it must reach, giving it the facilities for reaching this point, and then to see that it comes up to this standard. The inspections now made by the officers of the Inspector General's Department, do not and cannot determine the actual war efficiency of the battery, and higher officers. The inspections determine a number of superficial things only. To get at the root of the matter necessitates field artillery inspections by field artillery officers; and even then, these officers will have to be selected with care from a very limited number.

Firing Schools

We now have schools of many kinds, but none for the field artillery. We even have a school for musketry, teaching firing,* although the infantry has shock action in addition to fire action. The artillery alone, of all arms, has no action except by fire; yet, up to the present time, there is no school for fire. It is, therefore, gratifying to note in the service papers that such a school is now being organized at Fort Sill, Oklahoma.

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* An excellent idea.

Such a school is needed not to teach the enlisted men how to shoot, but to teach the officers the observation and application of the fire of their batteries. As shown in the foregoing pages, much that a field artilleryman must know can be taught at or in the vicinity of the posts where stationed. But there comes a point where nothing except observation of the burst of projectiles can complete the officer's instruction. This knowledge he is now supposed to get at his target practice; but the very fact that so much difficulty is experienced in getting artillery ranges is the strongest argument for the establishment of this school. For this very difficulty leads to selecting ranges that are very limited in extent, and are merely *safe*. Very few of these practice grounds admit of more than short or medium ranges being used, or of varying the practice. Under War Department orders, the practice is required to be in the solution of problems, but the grounds used afford facilities for very few problems, and even these are worked out without any competent supervision; there is no instructor.

Observation of fire is a most important part of an officer's instruction. The recent war in the far East showed an enormous consumption of ammunition; no one doubts that many rounds were ineffective. It is possible with our present gun to fire away in less than half an hour, all the ammunition in the battery equipment. The captain can only use his ammunition effectively and economically when he can, by observation, form some idea as to the effect of his shots. Such a school as is proposed would give him much training in observation and in the consequent formation of a reliable judgment.

Battle

To properly use an arm, it is essential that officers should form a clear idea of a battle. This is a very difficult result to accomplish, especially when we realize that not only is every battle different from every other battle, but also the same battle has continually shifting phases. Nevertheless, there are certain features common to all, and a certain more or less regular method of procedure, and these an officer should try to grasp. It is only by having this general idea in mind that he can form a conception of what the artillery does and how it does it. The study of battle should form part of the curriculum of every officer's instruction.

Thus, he should have a conception of an army of several divisions on the march toward another army; the army preceded by the cavalry screen and having an advance guard, main body, and flank guard.

In the cavalry screen, there will be horse artillery. The formation, march and use of this screen and the consequent employment of the horse artillery that is present should be known.

In the advance guard, there will be some light batteries. The advance guard and its artillery should be studied the same way as the cavalry screen.

Back of this comes the main body with its light artillery and heavy field artillery, both classes, including big guns and howitzers.

This army thus for several days approaches the enemy, the cavalry screen being more or less engaged all the time, until finally the advance guard comes in contact with the enemy's advance guard, and the cavalry screen has disappeared as such.

Up to the present time, we have had a march of approach. Now we begin the preliminary battle of the advance guard. The deployment takes place over a front which gradually extends itself, as each side tries to get around the flank of the other. The front occupied is too extensive to be held in a long contest, but each side counts on either pushing the other back by its own unaided self or being reinforced by its main body. The struggle is one for positions, and when once a position is captured it is intrenched or fortified so as to be held as a point of support for further movements. It is in this preliminary battle of advance guards that the role of the artillery is the most diversified and difficult to fill. A special study here is most instructive to the artillery, for once the main body is deployed, and the two armies joined in the issue of battle, the mass of the artillery has to fight only in the sector of front assigned to it; and in this it may stay days in the same general position. But in the advance guard, any single battery may have several functions to perform successively, or even sometimes simultaneously. And again, up to the time the artillery of the main body is engaged, the action may be broken off; but after that time, the battle will generally proceed to its climax. A study of the use of the artillery of the main body shows the handling of the immense numbers of guns, as well as the functions of the various calibers of arms. It is a big study.

The artillery of the rear guard in a retreat is assimilated to that of the advance guard, but affords many instructive features of its own.

The artillery of the flank guard is in general somewhat of the nature of advance guards and rear guards combined.

From all of this it is seen that such a study is necessary to complete an officer's education. Almost all of the instruction that has been laid down in this paper has had for its object a method of teaching the infinite number of details that an officer must know. But with the study of battle, the object is to give a broad, comprehensive view, and to show how the detailed knowledge is applied.

There are battle studies in foreign languages, but the writer does not recall any in English. The translation of several of the European works on the subject should be undertaken, and the results distributed to field artillerymen—in fact, to all officers.

Conclusion

As this paper has progressed, it has become more and more general in its treatment of individual parts of the subject. This is due to a realization of the fact that it was getting unduly long. The writer does not wish to be understood as measuring the importance of the different parts of this paper by the amount of time or space devoted to them.

Recent War Department orders covering the instruction and training of field artillery will result in greatly increasing the efficiency of that arm. But it must be borne in mind that no amount of orders, or furnishing of facilities for instruction, is of any use unless the field artillery itself works earnestly and conscientiously. "You can lead a horse to water, but you can't make him drink."

PANORAMIC SKETCHING FOR FIELD ARTILLERY SCOUTS

BY CAPTAIN CLARENCE DEEMS, JR., 1ST FIELD ARTILLERY.

Included in the "Training of Scouts," under subhead (e) of paragraph 677, of the Drill Regulations for Field Artillery, is the requirement "To make panorama sketches of positions."

This problem will be found difficult to handle unless some systematic method of instruction is pursued, as panoramic sketching is an art mastered by few and presents great difficulties to beginners. The object of this paper is to suggest a simple scheme for the training of enlisted men whereby they may learn how to make accurate if not finished sketches, valuable particularly to artillery officers. Such sketches may be sent miles to the rear, so that all commanding officers in the column directly interested may be given at least an idea of the proposition which will confront them upon taking position, thus giving them time to plan methods of procedure.

The camera obscura, designed for this special service, provides a simple and convenient method for obtaining accurate sketches drawn to scale. It is especially valuable to the man unskilled in sketching. For military purposes, the instrument is so constructed that the tracing is most accurate, and the sketch is drawn on paper divided into squares each side of which is a convenient number of mils. The objection to its use is, that even when made to fold in a small space so as to be convenient for transportation (it need be no larger than a dispatch case), it still presents in use a bulky, clumsy and conspicuous object, especially if a large hood is used. It is necessary in the field to limit the equipment to something simple, easy to learn to use, easy to put in use, and if practicable something that may be readily improvised; and, while the camera obscura has its particular value for use by enlisted men who may have had little experience in general perspective work, it is thought that sufficiently accurate work may be secured by other means. The following is, therefore, suggested:

The equipment should consist of a light piece of board, about 6×8×¼ inches; sheets of paper ruled as shown in Fig. 2; rubber bands or thumbtacks; two sheets of blotting-paper 6×8 inches, and two pieces of carbon-paper of the same size; a pencil, an eraser, a ruler about 6 inches long, on which divisions in hundreds and tens of mils are laid off to be used in the same manner as a B. C. ruler; twenty sheets of ferro-prussiate paper in a heavy envelope inside of a tin case;

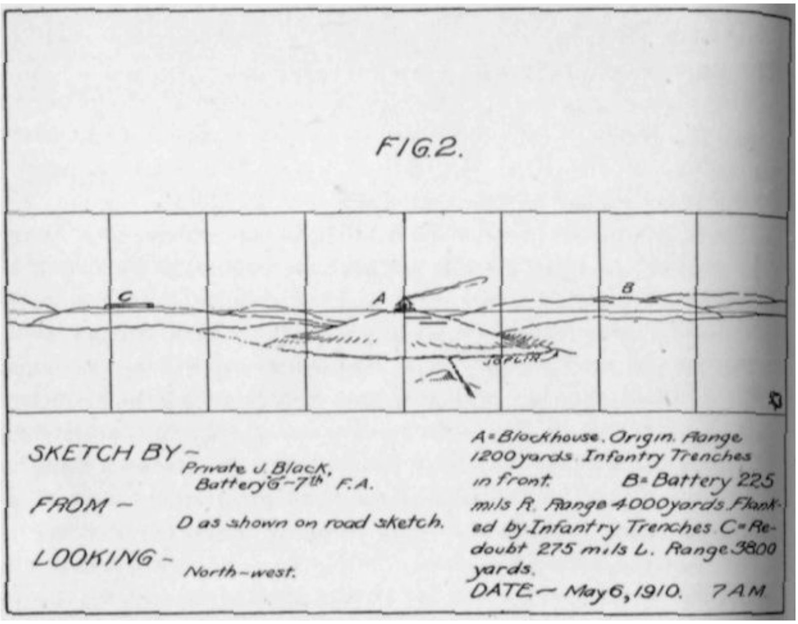


FIG 2.

and a leather case about the size of our present dispatch case, into which the equipment should be fitted in compartments. This case can be readily made by a battery saddler.

The paper should be clear bond so that it will transmit light for rapid blue-printing, but with sufficient body so that it will not be too flimsy. The ruling on the paper should be of fine lines, light in color so as not to obscure the sketch, but sufficiently apparent to furnish a ready guide and to give an origin from which distances can be readily measured in mils. The squares should be about 1 inch on a side, each inch then representing 100 mils. A sketch 8 inches long would then take in a sector of 45 degrees.

The pencil should be medium-soft, so that if desired lines may be made heavy in order to give prints of contrast.

The blue-print paper, already sensitized, should be well wrapped and kept in a tin box sealed with adhesive tape. This paper should be of medium weight. If too light it will tear when it is wet. It should be cut to the size of the paper used. It can be used to advantage if there be sun. All that is necessary to insure good prints is to make the lines distinct on the sketch, place the sensitized paper under the sketch, hold all together in position on the board by means of rubber bands or thumbtacks, expose to the sun for a minute or so, and then wash the print. A canteen of water poured into the receptacle formed by turning a campaign hat inside out forms a convenient place in which to wash the print for a few minutes. The print should be dried between the blotters.

The carbon paper should always be placed under the paper on which the sketch is made, in order to provide a copy for immediate use, which may be sent away to a distant point by a courier if needed.

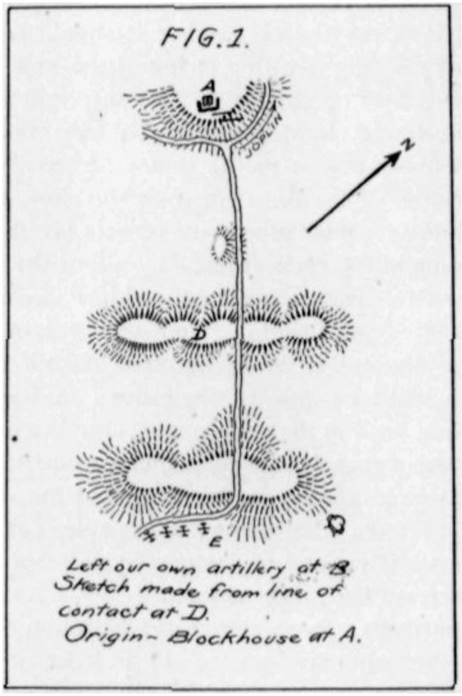
The ruler should be about the same size as the B. C. ruler, and should be graduated in mils with 10 mils as the least reading, except that the two spaces of 10 mils at either end should be graduated so as to permit a least reading of 2 mils. It should be used as is the B. C. ruler, by providing it with a string of the same length.

The operator is first taught to select as an origin some prominent point in the landscape, located within the view that his sketch is to embrace. This is drawn in the center of the sheet or at some convenient junction of the lines ruled on the sheet representing an exact hundred mils. Other prominent objects are then selected and plotted in position in the vertical plane by use of the ruler, using the ruler to measure the displacement of the object above or below or to the right or left of the origin. After the prominent objects are sketched in, the sky-line of the background and the top edges of all the hills are sketched in, also as single lines. Except occasionally, for a few shading lines in the foreground, only the bare outlines are necessary to present an accurate panorama picture.

Information should appear on the margin of the sketch as to (1) who made it, (2) from what point it was made, (3) in what direction the scout was facing, and (4) ranges to all important points with their deflection from the origin noted.

Consider a particular case: Suppose a battalion of field artillery moving along the Joplin road (Fig. 1) is halted at E, while the battalion commander goes forward to select positions for his batteries and assign objectives to them. Private Black, a scout, is with him. The battalion commander directs the scout to prepare a sketch of the enemy's front from the position which he now occupies at D.

Private Black sees the prominent blockhouse in his front, assumes that as the origin, and sketches it in at the intersection of the two center lines of his sketching paper (Fig. 2). Next, he notes a battery of the enemy at B. With his ruler he determines the center of the battery to be 225 mils to the right of the origin and 15 mils above it. Similarly, he notes the redoubt at C, the center of which is 275 mils to the left of the origin, and the top 10 mils above the origin. This he sketches in also. Next, he sketches the outline of the prominent hill in his front, and in so doing notes and draws the trenches below the house. The sky-line should be taken next, the important dips and rises being drawn in first in their proper places as measured by the ruler, and the lines joining these points put in afterward. Similarly, the top lines of all of the remaining hills should be drawn. The sketch is completed by indicating the road at the bottom of the hill. A few shade lines in the foreground add to the result.



If there be sufficient time, a rough road-sketch (Fig. 1) should be made, in barest detail, on another piece of paper or on a convenient margin of the panorama sketch, to show how the point from which the sketch was made is to be reached by the troops in the rear, and to show, also, the point from which the ranges were taken to the enemy's line.

In order that positive values in deflection might always be used in the drawing as well as for firing data, the origin could always be considered the aiming point, and the direct deflection of all of the important objects in view, taken successively as targets, could be noted instead of referring them to the right or left of the origin.

A pad of paper 6×8 inches with a rubber band to hold the loose ends down, is very convenient in size, and the piece of board may then be discarded. The center strip of each sheet lengthwise should be ruled to 1-inch squares, giving a ruled strip 8 inches long and 2 inches wide, and leaving plenty of space above and below for such notes as it is desired to record.

It would be of great convenience to have the squares on the paper the same absolute length on a side as that distance on the ruler which measures 100 mils when held at the proper distance (20 inches) from the eye. The objection to this is, that it makes the ordinary panoramic sketch on such a large scale that it is not suitable for convenient handling. If another ruler is constructed to read mils at a point closer to the eye, so that the length of 100 mils on the ruler is equal to about an inch (a convenient scale for panoramic sketching), the ruler then comes so close to the average eye as to prevent one bringing the outline of the ruler to a sharp focus while observing the distant point, and it tires the eye. So it will be necessary to assume a convenient scale on the paper, to measure accurately the displacement in mils of prominent points from the origin, and then to plot them in, in their relative positions, according to the scale used on the sketching paper. If, however, but a small angular front is desired to be covered, the actual measurements along the ruler can be transferred direct to the paper, and the paper should be ruled accordingly with larger squares.

This is believed to be as simple an equipment as is feasible to secure an accurate panoramic sketch, one that will best serve the purposes of field artillery, and which provides a method that an intelligent enlisted man can master. One great value of a sketch made in this way is, that it can have details added to it from time to time when fronting the enemy for any considerable period. For the use of artillery, when elevations and deflections expressed in mils have been determined for any one point on the sketch they may be determined for any other point by direct measurement on the paper.

In sketches of this nature, accuracy, rapidity and the barest detail should be required. The tendency is to put in too much.

Proper forms can be very cheaply printed, on thin, unruled letter-paper. The form should have space lengthwise in the center of the paper, 2×8 inches, ruled into 1-inch squares, printed in very fine lines.

The space above should be reserved for a marginal road-sketch when necessary. In the lower left-hand corner there should be printed: Sketch by............................ from............................, looking............................ In the lower left-hand corner, firing data and the date should be entered.

As there is at present no prescribed system for panoramic sketching this plan is suggested for the purpose of securing a temporary one at least.

WHAT LESSONS IN THE EMPLOYMENT OF FIELD ARTILLERY SHOULD BE DEDUCED FROM THE EXPERIENCES OF THE RUSSO-JAPANESE WAR?

BY WILLIAM NEUFFER, LIEUTENANT OF THE THIRD BAVARIAN (PRINCE LEOPOLD) REGIMENT OF FIELD ARTILLERY. (Artilleristische Monatshefts. No. 35, November, 1909.)

[Translated from the Supplement of the Revue Internationale, by Major G. LeR. Irwin, 3d F. A.]

During the closing years of the last century there existed a remarkable similarity in the field artillery tactics of all the great powers, as well as what is rare in military literature, a general unanimity of opinion regarding the fundamental principles governing the use of field artillery.

These principles corresponded generally to those of the German field artillery drill regulations. These regulations had been deduced from the experiences of the war of 1870-71, completed from the events of the Russo-Turkish war, and adapted to the artillery matériel adopted and perfected after the war of 1870.

By the introduction into service of the field piece, model 97; France, at the time, had placed herself at the head of all those occupied with the technical and tactical employment of artillery. It was then that this general agreement as to the methods of handling artillery and the placid calm that reigned in technical literature, was disturbed.

The French, by a careful study of the qualities of their new matériel, arrived at certain conclusions and deduced theoretically certain absolutely new principles for the employment of artillery; principles, in great part, diametrically opposed to methods then in vogue.

As was natural, everywhere outside of France, great distrust was shown towards principles so revolutionary in character and so contrary to what was then considered normal and as having stood the test of actual war, whereas these new developments were based on theoretical deductions and results obtained in time of peace. All looked forward expectantly to the decisive action which would try them out.

The campaign against the Boers could not settle the question. Its contribution, rather, was to render more desirable something already demanded: a closer bond of unity between infantry and artillery.

Then it was, in the midst of a general rearmament with rapid-fire guns and before the new tactical ideas had been put to practical proof, that war broke out between Russia and Japan.

It might be thought that such important military operations would decisively settle the question of the correctness or fallacy of the methods of using artillery. At first every one believed this to be so, but later, it gradually became apparent that the conclusions first drawn would have to be considerably modified.

The following reasons support this:

1. Rivers of ink have been poured out, both during and since the war, in describing the events of the campaign and the lessons to be learned therefrom, These literary productions are of quite unequal value and at times are absolutely contradictory. More than any other does this war lend itself to erroneous explanations and consequently wrong deductions.

2. This war in the east of Asia took place under circumstances so entirely at variance with conditions of Central Europe that deductions concerning maneuver and tactics must be received with reservation.

This is now generally agreed to.

3. The artillery of the two opponents had not reached the stage of excellence of that now possessed by the great European powers.

I will briefly compare the artillery of the two adversaries (for more detailed numerical information I refer to Imanuel, page 139 and following).

Ballistically the Russian field pieces were superior to those of the Japanese and, furthermore, had a greater rapidity of fire. The Russians had only shrapnel,* whilst their opponents used shell charged with "shimosite." The Russians made greater provision for supplies. The quality of the Russian fuzes and projectiles was inferior to those of the Japanese. The Japanese field pieces possessed greater mobility than those of the Russians, but so mediocre were the teams furnished them that, as soon as bad roads were encountered, the gait was limited to the walk.

Taking everything into account, the Russian guns were superior to those of the Japanese.

The organization of the Russian battery into 8 guns and 16 caissons was unwieldy as compared with that of the Japanese of 6 guns and 6 caissons.

* Later they used shell with their older types of guns.

In the Russian army, the infantry division of 16 battalions was supposed to have 48 guns, of 12 battalions, 32 guns; the independent brigade of Tirailleurs could count on 24 pieces.

There was no system of unity in the army, "artillery brigades" were composed of two or three batteries.

The infantry division of 12 battalions had 36 pieces; the reserve divisions, formed during the winter of 1904-05 had 24 pieces for 8 battalions.

In addition the first and second Japanese armies always maintained a reserve of 18 batteries for three infantry divisions.

Thus, due to its organization, the Russian army was weak in field artillery as compared with the Japanese army. From the beginning of the campaign this lack of proportion became more acutely felt, due to the fact that several of the Russian army corps were short of the number of batteries fixed.

It is true, that, as the war progressed, there was a change in favor of the Russians. Nevertheless, up to the time of the engagement at Wafankun, the 15th of June, 1904, the Japanese had the great superiority of 200 pieces to 94. After the combats around Liaoyang, these unequal proportions became gradually equalized until the advantage ended by being with the Russians. In the battles around Mukden the Russians had 1,192 field and mountain guns for about 370 batteries; the Japanese for 263 batteries, 892 field and mountain pieces. Calculations made on the number of effectives give the Russians 4.54 guns for 1,000 rifles, and the Japanese 3.72 (in Germany in 1870-71 about 3.5, at present, 6).

Furthermore, an exact consideration cannot be given to either the Japanese at the beginning or to the Russians towards the end of the war since, from the viewpoint of the artillerist, they were acting against an inferior enemy.

And then, account must be taken of the amount of instruction in artillery matters possessed by the two adversaries at the commencement of the war. While the Japanese knew their matériel perfectly and had familiarized themselves with its handling,[1] the Russians had just received their new field pieces and field regulations at the time hostilities commenced. They had even taken the new pieces from many of the European army corps, which later were called into active service, to issue them to the Siberian army corps. This led to great confusion. Eyewitnesses testify that the artillery at first

1 It is true that they also had had their new firing manual for but a short time.

had the appearance of a body of undrilled troops. It was necessary, so to speak, to learn under fire the handling and employment of the new matériel.

But in this respect also, during the progress of the war the superiority gradually passed to the Russians in proportion as the Japanese were obliged to replace casualties by men from the reserve.

In one way the Japanese retained the supremacy during the entire campaign. Profiting by their experiences in the war with China and knowing the mountainous and impracticable nature of the theater of operations, a large proportion of the Japanese artillery was composed of mountain guns (they were said to have had 540 field and 162 mountain guns).

At the beginning of the campaign the Russians had only two mountain batteries of an old model. Later on more mountain artillery was added, but, as compared with the Japanese, the proportion still remained meager.

In the matter of heavy artillery. The Russians made use of: Field mortars of 15 cms., and field howitzers of 15 cms. The field mortars were known to be out of date, whilst the field howitzers had just been introduced. During the course of the battle siege pieces appeared, in the positions around Liao Yang, at Mukden and also at the Sha Ho, these were guns of 10.67, of 12 and of 15 cms., and mortars of 21 cms. At the time of the Sha Ho their number must have reached 200 to 300.

For heavy field artillery the Japanese field army made use of howitzers of 12 and 15 cms. After the fall of Port Arthur howitzers of 28 cms., until then employed in the siege of the fortress, were also added, as well as a number of old pieces of different calibers, such as guns of 10.5, of 12, of 15 and of 20 cms., and some old bronze mortars. In all the heavy artillery thus came to about 200 pieces.

The value of these very mixed heavy field artilleries towards the end of the campaign, appears to have been about equal.

These circumstances alone show the necessity of an exact appreciation of an entire chain of circumstances in order to arrive at a logical deduction even from facts.

In order to transpose the experience of the theater of war between Russia and Japan into rules which can be usefully applied to circumstances under which our own armies may be called upon to act, it is necessary to first consider the following:

Neither the field pieces of the Russians, nor those of the Japanese were really "modern rapid-fire guns" (absolute non-recoil), as, for example, are the German, French and Austrian pieces of to-day.

Neither of the two artilleries was provided with shields.[2]

Moreover, our pieces are more mobile than those of the Russians or of the Japanese (the quality of the draft animals provided for the latter was miserable).

We can absolutely depend upon our projectiles and on our fuzes.

Our armies are provided with more heavy field artillery, distributed throughout the general organization, and more field artillery, than were the two adversaries whom we are considering.

Furthermore, according to competent opinions (reports of officers of the German General Staff) we have the right to consider the instruction of our artillery divisions to be superior to that of the two artillery combatants.

I shall now try to set forth, under separate headings and calling attention to the attendant circumstances, the principal points concerning the employment of field artillery, to show the lessons that have been drawn from the events of the war, and attempt to distinguish between the true and the false deductions.

I. Efficiency of Artillery

An exact knowledge of the effect of the arm forms the basis for the proper employment of artillery.

"Rapidity and energy of fire, the possibility of acting by surprise," are the distinctive qualities of "modern artillery pieces," foreseen by General Langlois twenty years ago. The French drill regulations, as also the German manual, place them in the front rank of their general principles of tactics.

Great things were expected from the effect of artillery fire in the war in Asia, although it was well understood that the artillery matériel had not reached the high plane of "modern artillery pieces."

The result was that, at first, the disenchantment was intense.

Even the first news of the war, as well as what was learned immediately afterwards, contained very disparaging reports of the lack of efficiency of the artillery fire of both sides, and, above all, of the want of effectiveness of the shrapnel fire. It was for this reason that the Japanese, later, showed a preference for explosive shell, and that the Russians replaced in action pieces then out of service, not having shell for their new pieces.

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[2] Towards the end of the war both Russians and Japanese improvised pieces with shields. See: Schweiz, Milit. Blatter, 1908, No. 3, and Lüttwitz, page 43.

Along the same lines, the lack of effectiveness of the artillery was proven by a comparative study of the percentage of casualties.

According to a report of 1905, the losses from infantry fire were in the neighborhood of about 86 per cent, from artillery fire about 11 per cent, and by the "arms blanche" about 3 per cent. The first percentages made public showed the artillery in an even more unfavorable light.

Calculations of this nature, above all if based on insufficient data, immediately after the war, can have no real weight. Besides, the same thing has been seen even here. The figures given are not correct, I shall return to that later. I wish to say first that, in previous campaigns the percentages have been of the same kind, or even less favorable to the artillery. In 1870-71 they were for the German army, 90.7 per cent and 8.4 per cent.

The disenchantment regarding the effect of artillery in the war in the far East undoubtedly was fostered by the exaggerated expectations growing from experiences of the target range. Here again is a fault of calculations. The efficiency of the infantry rifle has certainly increased in an equal ratio to that of the artillery. It should hardly be expected, therefore, that the percentages should change.

Finally, it is absolutely unjust to measure the importance of the artillery by the number of hits obtained. Artillery plays an important part by the moral effect it produces. "It gives confidence to the troops of its own armies and shakes the nerves of the enemy."[3]

In addition there is also an indirect attribute of artillery fire. By this I refer, to when the enemy is held to the ground, prevented from moving and smothered by its fire. This permits of movements being made on our own side. And it was just this which stands out as a characteristic feature of the struggles of Eastern Asia.

Taking into account the foregoing, I believe we may rest easy as to the performance and value of artillery fire, even if it has not been given a higher valuation. As a matter of fact, later calculations have given it greater weight. The "Vierteljahrshefte für Truppenführung und Heereskunde" (1808, I) gives the number of wounded by artillery fire as being about 50 per cent greater than in 1870-71. It gives the ratio of wounded, both for the Russians and for the Japanese, as 85; 15 per cent. The largest known loss reached 28 per cent of

[3] Witness the testimony of the Japanese Colonel Nagata, Meunier, page 460. Remark, Naturally, in addition to the moral effect there must be a material efficiency, which may be counted upon.

wounds caused by artillery fire in the First Battalion of the Fourth Regiment of the Japanese Guards at the battle of the Sha-Ho.

The "Schweiz Monatsschrift für Offiziere aller Waffen" (1908 January to May) gives some very detailed calculations. It is pointed out that frequently the statistics do not take into account the dead, where there is, generally, a higher rate of wounds inflicted by artillery. It is further pointed out that these wounds are usually more serious than those inflicted by the infantry rifle. The author of these articles concludes that a preponderating influence must be accorded to artillery fire. Since the war of 1870-71 the number of wounds by artillery fire has doubled; 15 per cent of all wounds are caused by artillery fire and they are more often serious.

As for the kind of projectiles, shell or shrapnel, opinions little favorable to either are expressed. This is less true of the shell,[4] of which little was expected from the first, than of the shrapnel. It appears to me that the two varieties of projectiles have done what might have been expected of each according to its nature.

There is certainly nothing new in the fact that troops sheltered by the terrain will suffer but little from shrapnel fire, and, further, that shell fire cannot be counted upon to drive good troops from a good position (Hamilton, II, page 98), etc.

Colonel Gertsch (I, page 138) tells of a Japanese company which was reported to have sustained an intensely heavy shrapnel fire and at the end had but few casualties to be noted. I believe that, like many other occurrences of a similar character, this example cannot in any way alter what we have just said concerning the effect of artillery fire.

Examples such as the above should be received with great caution. We cannot afford to generalize too quickly. Even on the drill ground many shots give unsatisfactory results. Is it the piece itself that is at fault? Especially among the Russians, there were faults in the handling of the arm, both from a technical and tactical point of view; the men had not received sufficient instruction, the projectiles and fuzes left much to be desired, the heavy field artillery was but mediocre and was badly handled, etc.

In concluding our first chapter we may set down the following to be true: The acceptance at first of the reported lack of efficiency

[4] The predilection shown by the Japanese for shell fire and the use by the Russians of this kind of fire with their older pieces were due to special reasons. In any case, the two kinds of projectiles were necessary and are to us, and will be until such time as a combined shrapnel-shell is introduced into service. For more detailed statements of the reported lack of effectiveness of the artillery, see Lüttwitz, page 44.

of the artillery is an error. On the contrary, artillery has gained in efficiency and even in importance. This is quite true of the state of affairs in our own armies, generally, conditions are more favorable.

An exception must be noted, however, in the case of an engagement between batteries both provided with shields. We shall speak of this later.

II. Artillery Fire

In every way the Russo-Japanese war has served to enlighten us. It has given us a very clear idea of the action of artillery fire.

The opinions originated by Langlois and the French have been confirmed by the events of the war. "The power of artillery fire will be increased or lessened with the progress of the engagement. Rapidity of rifle fire must be used to momentarily paralyze the enemy by sudden, short and violent 'rafales' or fire" (Field Artillery Drill Regulations, etc., 363). This kind of fire is necessary, first because of the tendency of the targets to remain concealed but for short intervals of time, and further, in order to husband ammunition, the supply of which would soon become impossible, due to the ever increasing rapidity of fire.

The idea of firing by "rafales" with intervals of silence has been found to be correct. Naturally these periods of silence, often too long, as well as the moments before entering into action, should be utilized for preparation of fire, in order that the effect shall be overwhelming as soon as possible. In this important respect the Japanese were masterly.

Undoubtedly it will be only by using a telemeter at such times, allowing of the instantaneous opening of a fire for effect, that surprise can be obtained.[5]

The war has also brought out another method of fire which may be deemed of equal importance with the "rafale." (Second and Third Japanese armies: artillery engagements at Mukden and at the Sha-Ho.[6]) That is when it is necessary to keep up a sustained fire as, for example, against rifle trenches when it is desired to "harass" the occupants.

If one could transpose the picture of the events of the war in Eastern Asia so as to fit it to our own surroundings, it would be

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[5] See: Règl. de manoeuvres de l'art. de camp. ch., 436. Artilleristische Monatshefte, 1908, No. 17, page 338 and following. Meunier, page 478.

[6] Opinion of Lieutenant Colonel Njeznamow Art. Monatshefte, 1908, No. 15, p. 177: "Field artillery can only prove effective by the use of rafales. Sustained fire retains its importance against reinforcements, the reserve, timbers, villages——"

found that the question of expenditure of ammunition has not yet been cleared up.

A very heavy expenditure of ammunition was counted upon in the Russo-Japanese war, but the real expenditure far surpassed all expectations, at least, as regards the Russian artillery, the only one for which data is available. I refer for that to a statement appended to an article in the "Art. Monatshefte," 1908, No. 22, which not only gives high averages but, especially, some excessively high figures, of more than 500 shots per gun per day. The article finishes by saying that, with the increased rapidity of fire and the changed tactical conditions, the expenditure of ammunition in the Russo-Japanese war cannot be considered as exorbitant, and that, in a future war, such figures will have to be counted upon. My opinion is, that, as with the Russians—and it is from them that our figures are obtained—a great distinction must be drawn between expenditure of ammunition and waste.

When the batteries of Lieutenant Colonel Paschtschenko successfully (?) fought, on the 24th of July, 1904, at Taschitschao, against a greatly superior Japanese artillery their heavy expenditure of ammunition was quite as justified as was that of the battery of Colonel Isljussarenko near Liao Yang on the 30th of August, 1904, etc.

On the other hand the Russians often wasted their ammunition over badly reconnoitered ground. It was so, on the 31st of August, 1904, a Russian battery squandered in three hours 2,500 shrapnel against an entirely unoccupied valley.[7]

According to the testimony of eyewitnesses (Gertsch, Hamilton) the Japanese must have been more economical with their ammunition. It is claimed that at the battle of the Sha-Ho they fired only 200 rounds per gun per day.

There were probably two things which led the Russians to this wasting of ammunition: First, their new rapid-fire pieces, and then, the relative facility for the resupply of ammunition due to the peculiar character of the operations. Instructions looking toward economy of ammunition would seem to have been lacking.

Colonel Gertsch, speaking in a characteristic manner on this point says: "The soldier who is accustomed to consider each cartridge as a small capital would consider he had committed a sin in underestimating

[7] Gertsch I. page 151: "The Russians fired at hazard over the rugged terrain. Sometimes their shrapnel burst on graze, others in the air at about the height of a church steeple." An absolutely wrong conception of the use of shrapnel fire and a badly understood imitation of the French method of fire.

ammunition as was the case with the Russians. These knew with certainty that there would always be a new supply of cartridges. There is nothing astonishing in their having fired so badly."

Nevertheless, it would seem that, in a future war, we must expect a considerably increased employment of artillery ammunition, especially for certain batteries. Our reserve of ammunition in Germany is far from being sufficient, it should be largely increased. But, first, we should strive to teach our officers to know how to be economical with ammunition.

III. The Artillery's Entry Into Action

Previous to the war, two opinions prevailed as to the manner of putting artillery into action.

The German regulations called for the immediate deployment of a great number of pieces in order to rapidly obtain a mass effect. It recommended in addition the local massing of batteries up to the strength of the regiment.

The French, on the contrary, advanced the idea of placing the batteries in groups, ready for action, to be placed in action according to necessity.

The Japanese put all their artillery in position, but only put into action what the case demanded, whilst those batteries that were not yet needed remained in positions of observation, limbered and ready to support their infantry or take part in the artillery combat.

It was in this way that the Japanese avoided the great danger of going into action as necessity dictated, i. e., dispersion of forces, and the risk of successively engaging a superior body of troops with an inferior force.

Our new regulations, which follow in principle the French ideas, says: "If the artillery is called upon to go into action in a decisive battle it should immediately engage a considerable number of pieces in order to obtain rapidly and in a decisive manner the object in view." Thus it was that the Japanese, by great artillery efficiency obtained by concentration of fire, were able to crush the Russian batteries in the earlier battles, and strove later under heavy disadvantages to maintain, at least for a time, their superiority of fire over certain portions of the Russian artillery.

The Russians were fatally handicapped by the local and temporary dispension of their batteries.

Tetau reports that, on the Russian side, the rule of engaging a superiority of pieces at the opportune moment, in order to crush the enemy by a concentration of fire, was scarcely ever attempted. The engagement was nearly always entered into by a few batteries or separated groups whilst the bulk of the artillery was often held out of action, in reserve, until the end of the combat.

Very often the Russians waited until their first batteries had been knocked to pieces. They were then enchanted to still have fresh batteries in reserve. Naturally when these were finally placed in action they could not escape the fate of their predecessors. This is what happened, for example, at the Yalu and at Wafankun.

Since the time of the Napoleonic wars the "artillery reserve" has been a fixed principle of Russian artillery tactics. This has borne strange fruit. Thus, at Mukden, a large part of the heavy field artillery, although in position to open fire, was held inactive "because the head of the army reserved to himself the right to make use of it." Thus, instead of lending valuable assistance, it served only to clog the retreat. It appears to me that this manner of holding the artillery in the background was due, in part, to fear of losing guns, as for instance after the battle of the Yalu.[8]

The Japanese used their artillery according to the principles laid down in our new drill regulations. The Russians incorrectly interpreted the French methods.

It is certainly difficult to properly recognize the opportune moment for putting the bulk of the guns into action.

Nevertheless, it appears to me that, taking into account the conditions of our armies, it is preferable to risk the artillery too soon, than to undertake important tasks with insufficient means. For, I believe, our guns with shields and placed under cover, have not lost mobility to such an extent as to be unable to be used for future operations.

The Japanese always took advantage of cover and concentration of fire for their positions in groups (usually by "divisions" or by regiments). The Russians, on the contrary, seldom joined their batteries (usually in groups of 2 or 3) for collective action.

It does not appear probable that, in the case of a war of maneuvers in Europe, we should be able to make such extended use of technical means of transmitting orders as was done by the Japanese in the last war.

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[8] Immanuel, page 146: "The loss of their guns at the Yalu and at Wafangou threw the Russians into a state of nervous excitement. They deliberately added a support of 1, 2 or more companies to each group of artillery. This merely served to restrict their freedom of action. When the situation became more or less critical they preferred to withdraw their batteries from fire...."

To secure against failure of the telephone and signaling devices, it is necessary to assign beforehand distinct sectors of fire, so that each chief of artillery will be able to accomplish his task in his position and with his circle of action, even without further definite orders. In order to accomplish this the first requisite is an adequate instruction of our artillery officers.

IV. The Battle Position of Artillery

The rapid destruction of Russian batteries in the earlier battles of the campaign produced on the two hostile artilleries similar impressions of the enormous power of their respective artilleries.

As a result of attempting to protect their artillery without shields against hostile artillery projectiles two novel methods resulted. But they were carried to extremes and false deductions drawn therefrom.

These two methods were: The excessive distances at which the two artilleries engaged each other, and then, the effort to obtain protection against hostile fire by making use of concealed positions.

It is possible that the nature of the terrain was responsible in many cases for the use of long ranges. Moreover, there was the fear of possible losses which led to increased ranges. To a certain extent the lack of shields serves as an excuse.

However, it is absolutely wrong to claim that an increase of 1,000 meters produces no change in the effect of artillery fire. Even the best means of observing the fire cannot compensate for the lessened efficiency of the shrapnel fire, with so great dispersion at these ranges.

General Richter has said: "When one opens fire at 5,000 meters or more, it is as much as to say—leave me alone, I am not going to do you any harm," and General Langlois declares that fire at excessive ranges is always the sign of poor artillery. Other French writers seem to regard those long ranges as necessary evils which must be taken into account.[9]

We should never forget that "the failure of the Prussian artillery on the battlefields of Bohemia was largely due to the belief that the effect would remain the same at long range."

When it is not impossible, on account of the character of the terrain, to reach the desired position without too great loss, the shields will enable us to engage at reasonable ranges. This tendency

[9] Meunier, page 457: The so-called victorious struggle against the batteries of the 2d Japanese Division at Yanselin was of no effect, from Kriegsgeschitl. Einzelschriften 41-42, page 74.

to hide from the enemy and take cover from his fire is shown while advancing into action, while going into battery and, even, while making choice of these positions.

First by the theoretical reasoning and then, even more, from the experiences of the war in the far East, we arrive at the following maxim: "Artillery seen is artillery lost." I admit the truth of this if applied to artillery in motion, provided the adversary be on the watch and understands his business. As a general rule it goes too far.

In the above case, a few minutes may suffice to effect the total destruction of a battery subjected to hostile fire while moving to the front or going into battery. As examples taken from the war, I will cite: the destruction of the Second Battery of the Sixth East Siberian Artillery Brigade at the Yalu. At Wafankun, where the Japanese had already obtained the range to intrenchments behind which two Japanese batteries had taken position, these batteries were put out of action in ten minutes.[10]

Very few instances can be found during the course of the war showing the possibility of going into position within view of the enemy. The same holds true of changes of position. I will refer to this again in the last chapter.[11] But, there is also this to be said on that subject, and that is, there are intermediate cases. There are many shades of difference between complete invisibility and the placing of a battery in action on the slope toward the enemy as was the custom of the Russians at the beginning of the war.

Heavy losses will not be risked by batteries in rapid motion appearing for brief intervals within view of the enemy. Nevertheless, I believe too much importance cannot be given to the approach under cover to a concealed position, which has been carefully reconnoitered and explored in advance.[12]

Special reasons caused the Japanese to adopt the method of taking up positions by night. Often the terrain did not afford cover, the enemy stood fast in position, the means of traction of the Japanese did not permit of rapid movements. The following axiom is safe and applicable to our service: In advancing to the front and in

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[10] From Einzelschriften 41-42, page 22, these were the batteries from Luschagou.

[11] See Artillerist. Monatschefte, 1908, No. 14, page 106, above all the remark "Extrait de mémoires anglaisses."

[12] Immanuel, page 143: "Eye witnesses, especially those observing the Japanese artillery from the Russian side, are unanimous in testifying to the marvelous skill shown by the Japanese in the occupation of concealed positions."

going into position, the order will be, without exception, "keep under cover." (Taking advantage of darkness only to be resorted to in special cases.)

As soon as pieces provided with shields have gone into battery the first and gravest danger has been overcome. Then the order is: "J'y suis—j'y reste."

I entirely endorse anything done to render more difficult the reconnaissance of our positions by the enemy, and methods of deceiving him as to their location.

In this respect also the Japanese can serve us as models. One should read the description by Hamilton of the taking of positions by the Japanese artillery at the Yalu, in order to learn to understand their prudence in this respect, their care in the preparations made for the opening of fire.[13]

In this respect there is an enormous difference between the Russians and the Japanese.

The latter were always careful to provide cover for their staff officers and observers. They avoided sending other batteries to join batteries in position, thus betraying their location. They strove to preserve to their positions the appearance of the adjacent terrain, etc.[14] Moreover, they made frequent use of masks, merely for the sake of appearance, placing in position well defined objects (as at Yalu, trees). They went so far as to make use of dummy guns and bombs to more easily deceive the enemy. (Tuminling.) And only as the war progressed did the Russians commence to imitate this.[15] During the preliminary encounters, in order to conceal their real positions and, at the same time, draw the enemy's fire, they, in addition, made successful use of decoy batteries to entice their adversaries. Later the Russians were no longer caught by this device.

The deductions to be drawn from what has just been set forth concerning the events of the war, are: That use must be made of all means at hand to render more difficult to our enemy the reconnaissance of our positions; and that, on the other hand, we must expect to find the difficulties of procuring information and reconnoitering the objective greatly increased.

To continue our interpretations, we shall call attention to the fact that cover and intrenching, without which the war in the far

[13] Hamilton I. pages 106 and following.

[14] Contrast: The Russian artillery entrenchments at the battle of the Yalu.

[15] At Tauchitschao the Japanese fired for 12 hours against unoccupied intrenchments.

East could not have been prosecuted, are quite as essential to our armies, in addition to the shields, wherever time and place permits their use.

We come now to the subject which has occasioned the greatest amount of controversy, that is, the question of which position to choose. "A defiladed position, or one in the open." "A position, neither completely defiladed nor completely exposed." Similar discourses to be found in the publications of the years 1906-07 call to mind the lively discussions that this question called forth in technical journals. Even to this day opinions are divided.

If this had been a purely technical matter concerning only the artillery and with no bearing on the other arms and the efficiency of the artillery, doubtless, this question would not have made so great a stir. Rightly or wrongly, it was thrown open to discussion as a matter of general tactics.

Partisans of the defiladed or masked positions quote the events of the war to sustain their contentions.

Let us first examine into the original story of these masked positions, which gained such vogue with both sides during the progress of the war.

I have already spoken of the effects produced by the disasters which befell the Russian artillery in the earlier engagements. What were the causes responsible for the defeat of the Russian batteries? Primarily, their inferiority of numbers and their lack of instruction; then, the errors of their tactical employment; and, finally, their positions, taken on the exterior slope toward the enemy, and entirely in the open and in view, exposed to a fire from the Japanese to which they were unable to reply. (Emplacements which can be recognized at considerable distances, do more harm than good.)

From a psychological point of view, it is readily understood why, at first, the Russians did not look further than these positions in the open to account for their misfortune. They went then to the other extreme and took refuge in positions often from 500 to 600 meters in rear of cover. The Japanese, also, often drew back from masked positions.

The two adversaries could offer the same good excuse: The lack of shields and the dispersion of the hostile fire rendered positions near the covering crest practically untenable. The Russians further claimed that equally good results were obtained by fire from defiladed positions as from positions in the open. Is there any truth in this assertion?

We are in possession of numerous instances of the action of the

Russian artillery in completely concealed position, taken during the course of the war. They mostly refer to the operations of Lieutenant Colonel Paschtscenko and Colonel Isljussarenko and are generally quoted in all writings dealing with this question.

Without intending to throw doubt on the truth of the Russian accounts, yet it seems that there may be grounds for suspecting the accuracy of some of these assertions, the more so, since the gratification expressed on account of these supposedly successful results is found only on the Russian side and, even then, at times, confined to the higher artillery chiefs.

The tinge of exaggeration contained in these accounts can be easily explained by the following two reasons: In the first place the Russians were quite satisfied with being able to make use of concealed positions. Their lack of shields makes this satisfaction easily understood. As, during the progress of the war, they gradually acquired the difficult art of indirect fire, this gratification continued to increase. Thus it followed that they grasped the advantages of masked positions without considering the bad features accompanying them.

It should never be lost sight of that, in this war in Eastern Asia, there existed special features which rendered it, so to speak, a "war of position."[16] The movements of the assailant were slow. On both sides there was comparatively little artillery for use in masked positions, often it was solely a question of groups of a few batteries, etc. So far as I have been able to ascertain, no experience was had with registered fire (fire for effect against visible hostile artillery) against small, rapidly moving targets, from masked positions.

It is very interesting to ascertain the conclusions arrived at by the two adversaries based on their experiences during the war.

The Russians vaunt their defiladed positions. On the contrary, the new Japanese drill regulations for field artillery state, "that during the war the use of defiladed positions did not prove auspicious and that their use should be avoided except under exceptionable circumstances.

The military world has arrived at different conclusions as regards the question of artillery positions. Many have thought that, henceforth, artillery could only be fought from entirely concealed positions, others hold, as formerly, to their tactics of pushing forward and using direct fire from positions in the open which the use of shields justified; the remainder struck a medium.

[16] Hamilton II, 225, "the Japanese guns—as immobile as guns of position."

Little by little opinions are becoming calmer and recognition is accorded to the relative value only of the experiences of the war. A distinction is drawn between the two extremes, between "positions in the open," where the entire man is exposed, and "masked," calling for positions 500 or 600 meters in rear of the crest.

It is not my purpose to enter into any prescribed technical discussion of different methods of obtaining concealment, but, simply to express my own ideas, which have also undergone changes in the last few years.

If artillery experts will hold fast to the dominant truth "that artillery exists solely to support the infantry," they will readily be able to form the alliance between the efficiency required of their batteries and the protection so indispensable thereto.[17]

I believe that in the future and in the majority of cases, we shall seek positions sufficiently defiladed to afford protection from registered fire and even from fire for effect with explosive shell (from howitzer fire also). It then narrows down to a purely technical question of deciding upon direct or indirect fire. It is important, however, that the battery commander should select his observation station so as to be able to control his battery by voice, and that too much time be not consumed in preparation of fire.

Usually these positions may be taken quite close to the crest, especially if the flash from the gun can be done away with, so that, when necessary, the batteries can be quickly moved up to the crest.

Such positions offer the most we can expect. The fire is simple and effective. If targets that should be seen by the gunners appear, then the pieces can be easily run forward. Should the enemy make use of explosive shell, only chance shots are to be feared. Thanks to the use of shields, a searching fire with shrapnel will be of little effect and will silence our fire only during the intervals of the most violent "rafales." There will be opportunities at timely moments to effect changes of position secure from hostile interference.

Naturally, there may be times when batteries posted far in rear of the covering crest may fulfill certain special tasks, or, where they may be forced to occupy such class of positions, as, for example, when weak in numbers, where good positions are wanting, etc. Battery commanders should be prepared to overcome the difficulties of conducting fire from distant observation stations. To be ready in such cases calls for a most thorough preparation in time of

[17] J. f. A. u. M., 1909, February, pages 137 and following: "The difference in efficiency of the hostile fire and that of our own batteries—battle fire effect."

peace. In general, such positions will be by groups of "divisions" or batteries. Care must be taken that such positions do not become the rule.

It is significant to note that a number of French writers have called attention to this danger. ("We must avoid—using our field artillery according to methods prescribed for siege warfare." Meunier, page 463.) We should always bear in mind that—even if these tasks succeed in time of peace on the target range—fire against certain targets and a great concentration of fire will be impossible of attainment during the progress of a serious engagement, from this class of positions.

From the first, the passing of batteries into the open will be the exception, unless for lack of time or want of cover. The possibility of acting in the open will increase in proportion as the "hostile fire is overcome." Nevertheless, the term "unmasked" will signify merely that, only so much as is absolutely essential to the object in view, will be exposed to hostile sight, and that the batteries will avail themselves of such cover as the means at hand permits of.

Once the batteries have arrived in position the greatest danger has been surmounted, and, even against a superior artillery, the shields permit the hurling, at opportune moments, of some volleys against the hostile infantry. It is true that these batteries will be held to the positions they occupy. Notwithstanding all the calculations made in regard thereto, it is impossible to state definitely how long these batteries can last against an accurate, adjusted fire. There, chance enters in. We must expect them to be overcome in time, especially if subjected to howitzer fire.

V. Artillery in Action

In the course of this last chapter I desire to discuss generally the subject of artillery in action. I am able to considerably shorten the discussion since many of the phases have been treated of in preceding chapters.

The principal lesson to be learned from the events of the war is not new; it has simply been confirmed and rendered complete. It can be stated in the words of paragraph 364 of our "Field Artillery Drill Regulations": "The first duty of the artillery is to effectively support the infantry. It must be separated therefrom neither by time nor space. It should be principally directed against such targets as appear most dangerous to our own infantry."

A correct deduction from the war is the affirmation of the facts that what was formerly called the "artillery duel" has disappeared. It was during the progress of this duel that one artillery endeavored to crush the other so as to be able to direct its entire strength against the hostile infantry.

The last engagement of the kind appears to have taken place at the battle of the Yalu (Hamilton, I, 110). The special circumstances under which this action was fought have been referred to several times.

It no longer became a question, during this war, of completely defeating the hostile artillery. (At Liao Yang, August 30, 1904, the artillery combat lasted over sixteen hours without the Japanese having been able to reach a decisive result.) The attainment of a positive effect against batteries concealed by the terrain had become too difficult.

Nevertheless, the Japanese used all means within their power (concentration and increased rapidity of fire, oblique fire, etc.) to obtain a momentary superiority over the hostile artillery groups, and thereby gain important chances of success.

A full appreciation of this effort is given in the new Japanese infantry regulations, as are the difficulties to be overcome. It embodies the following conclusions: "If the enemy can be kept under artillery fire the infantry need experience no difficulty in advancing to the assault; but the infantry must not await the success of the artillery combat, since it is difficult to set a time when such an effort will succeed against an enemy making use of the terrain or placed in a fortified position. On the contrary, the infantry advance should commence during the artillery combat—it is only thus that the most effective cooperation of the artillery fire can be secured.

The combatants of the last war preserved to themselves the possibility of resuming fire, by remaining well in rear of their masks. By means of our shields, this will become possible for us as soon as the batteries are protected from registered fire.

Even with greatly superior numbers and a heavy expenditure of ammunition, only momentary superiority can be obtained over batteries placed as above. And furthermore, it can be said that it will be difficult to reach an exact conclusion of the damage inflicted.

A host of examples could be cited in support of the power of resistance of artillery and the errors of the "so called" superiority of fire. I shall give one: "The resumption of fire after a change of position by the batteries of the Second Japanese Division at

Towan, after having been temporarily silenced by the superior fire of the Russian artillery, which was attended with comparatively few casualties. (Meunier, page 472.)

Naturally, quite the contrary will take place in the case of hostile batteries which have not taken advantage of cover, or, through force of circumstances (the advance of our infantry), have been obliged to move from their intrenchments. Then, sooner or later, they will be held fast in position.[18] Every effort of these batteries to resume fire should be quickly silenced by rapid "rafales" of fire. For this reason there must be batteries in readiness to instantly fall upon the hostile batteries should they show any disposition to reopen fire.[19]

The power of resistance of artillery, even when inferior in numbers, already established by the histories of former wars, has been shown to be greatly increased during the Russo-Japanese war. Probably we shall discover that our modern rapid-fire guns equipped with shields have further augmented it.

As applied to our artillery, the conclusions to be drawn from the above indicate that there will no longer be any question of "destroying" the hostile artillery. Effort must be made to obtain as great an ascendency as possible, and, from the first, the artillery commander must strive to strike a happy medium in the struggle against the artillery and hostile infantry throughout the battle, which will form the basis for his orders to his troops.[20]

As regards artillery fire in connection with the infantry combat, the Japanese General Oku has expressed himself as follows: "The fire of the artillery must support the advance of the infantry," and further: "The artillery must, so to speak, constantly feel the pulse of the battle, follow the movements of its own infantry, and so regulate its fire in consequence that the latter can bring its strength to bear against the objective."

These were the rules that the Japanese strove to follow.

French writers have truly said that in the combined action of artillery and infantry there must be an absolute "unity of purpose" and extensive tactical knowledge, or, to better express it, judgment

[18] Hamilton I, pages 111 and 112. The Russians stayed, trying to withdraw their guns. "The artillery of the Guards was upon the battery like a cat springing on a mouse, and in two or three minutes had reduced it to silence."

[19] See, L'artillerie francaise ayant succombè á Worth, 1870.

[20] Gertsch I, page 161, speaks of the manner of attack of the Japanese 2d and 4th armies at Liao Yang on the 2d of September, 1904, as being exemplary; a combat of artillery entered upon only after the reconnoitering of the hostile batteries, etc., so as to be able as soon as necessary to open up a fire for effect against them.

and well developed tactical knowledge on the part of the ranking artillery officers.

For it may happen that all our modern means of communication and transmission of orders between the different arms may fail during the battle. Certainly, during the Russo-Japanese war greater use was made of them than ever before, and the demand for their more extended use in our service is certainly justified. But we must count on the possibility of their failing, even though ample time is allowed for their installation; in that case there is only one method that can be depended upon: that is the tactical education and instruction of the higher artillery officers who, within their own spheres of action, must choose targets for attack which will most effectively support the infantry.

Based upon the events of the Russo-Japanese war, Guionic, speaking of the combined action of artillery and infantry, sets down as a principle, that every movement that might be perceived by the enemy should be supported by the fire of the army. He calls this the union of movement and fire.

Firing over our own infantry is now the rule.

Artillery fire must be used to support the attack of the infantry to the last moments of the struggle. The fire of the artillery should not slacken up to the moment of the assault. (The Japanese insisted on the continuance of fire even at the risk of losses caused by their own artillery.) This necessity, ratified by the experiences of the war, will be more easy of fulfillment by us, thanks to our perfectly constructed projectiles and due to the large number of howitzers capable of continuing a fire for effect up to the last moments.

But, although all are agreed in recognizing the necessity of supporting the infantry by artillery fire, there is still doubt as to the possibility of having portions of the artillery accompany the infantry in its attack.

Nobody can deny that such an accompaniment is most desirable and cannot be replaced by machine gun fire. This is particularly true from the moral side and this notwithstanding the degree of efficiency attained by this class of fire nor of special favorable opportunities for its use.

It was claimed at first that the war had not produced any example of a successful "accompaniment." Later some have been mentioned.[21] It would certainly be a mistake to say that because they are rare they are impossible.

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[21] Hamilton II, pages 225 and 241.

Different reasons prevented: Such as the custom of using siege artillery, which, because of the special character of the operations, had little by little become predominant; then the possibility of taking advantage of darkness to move forward; and lastly, the poor teams furnished the Japanese artillery, etc.

I believe, that in spite of the difficulties, we should make up our mind to send several platoons or several pieces to closely follow the infantry when the situation and the character of the terrain permit.

In the defense, also, there must be common action between the artillery and infantry. This should not be attempted by placing the artillery positions too close to the infantry lines. This is the method the Russians adopted at the commencement of the war and which led to such disasters that it was soon abandoned.

The critical moment for the defense is when a large portion of the artillery must be moved forward to positions free from dead angles, etc., for the purpose of repelling the infantry attack.

I have already pointed out that this is the easier of accomplishment by our pieces provided with shields than was the case with the matériel at the disposal of the opponents during the war in the far East. Nevertheless, even there, several brave batteries succeeded in moving to new positions and there maintaining themselves.[22]

As an example of a defense against infantry attack, without the support of the friendly infantry, the "Artill. Monatshefte," 1908, No. 15, mentions an episode of the engagement of the 15th of October, 1904 where 5 Russian batteries fired in 45 minutes (with an interruption of 20 minutes) 8,000 shrapnel and brilliantly repulsed the Japanese attack.

Lack of special examples prevent the drawing of conclusions regarding the employment of the artillery during the pursuit, or in retreat when pursued.

In conclusion I will restate my opinions.

It is true that the Russo-Japanese war produced no incontestable proof of the correct method of handling modern rapid-fire artillery.

It has been possible to show that there were many false deductions arrived at from this struggle as well as correct ones; that it is wrong to generalize from a few special circumstances; and that many questions are still left unsettled.

Nevertheless, this campaign has provided important data from which we can continue to build up the theory of the employment of modern artillery in European warfare.

[22] For instance, two Russian batteries at Liao Yang, Meunier, page 405.

More than ever is the artillery combat developing into a struggle of capability between artillery officers of all grades.

Happy the army whose leaders correctly understand the employment of artillery, whose chiefs of artillery have studied in a good school of tactics and whose artillery officers are technically perfect in their knowledge of the modern matériel.

All our efforts should be exerted to attain this end.

And then only will our beautiful arm become again in war, if under a different form, what it was in the time of its greatest master:

"THE QUEEN OF BATTLES."

"COURS ELEMENTAIRE DE TIR DE CAMPAGNE."

The following extracts are from Captain Treguier's book, reference to which was made in the last issue of The Journal.

THE FUZE SETTER.*

Translated by Lieutenant Colonel John E. McMahon, Sixth Field Artillery.

1. Normal Height of Burst

The maximum effect of fire delivered at mean ranges† is produced when the mean height of burst is 3 mils above the objective.

The angle of 3 mils above the objective is called the *normal height*.

It should be noted that the normal height is not a height in yards. It is an angle, always equal to 3 mils (except at long ranges).

If fire is delivered at the targets O. 0′, 0″ (Fig. 1) at different ranges, the normal bursts will be on the line CE; while the absolute heights above the ground will vary with the trajectories.

2. The Fuze Setter. The Corrector

The fuze setter is the instrument by means of which the fuze is set so that the projectile will burst 3 mils above the objective.

The fuze setter comprises (Fig. 2):

1. A movable circle C (range ring), graduated in ranges from 0 to 6,300 yards;

2. A fixed are AB, graduated from 0 to 60 mils, and called the corrector scale;

3. An index R, which can be moved between the corrector scale AB and the circle C.

The range ring C can be moved around its center, and set at the desired range by means of the index R.

The fuze setter is so constructed that, if the index R is set at the 30 mark on the corrector scale and the range ring at the given range

* The nomenclature used in the French version has been changed in the translation to correspond to our system and matériel.—Trattslator.

† It will be seen later that at long ranges a mean height of burst of about 4 mils produces the maximum effect.

D, the projectile should burst, for a range D, about 3 mils above the horizontal plane.[1]

If, for the same range D, the index R is moved 1, 2, or 3 divisions of the corrector scale, the corresponding heights of burst will be changed 1, 2, or 3 mils.

If, for example, the corrector scale be set at 32, the burst will take place 5 mils above the horizontal plane; or, it will be raised 2 mils, as was the corrector setting.

On the other hand, if the corrector scale be set at 28, the projectile will burst 1 mil above the horizontal plane; or, it will be lowered 2 mils, as was the corrector setting.

Fig.1.

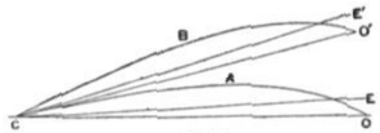

Fig.3.

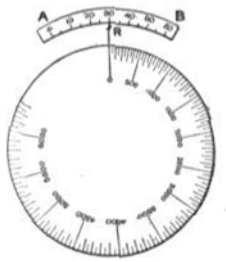

Fig.2.

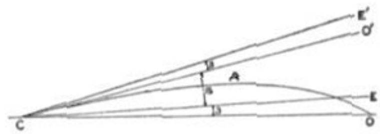

Fig.4.

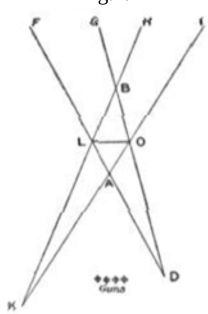

Fig.5.

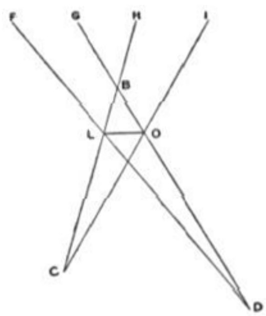

Fig.6.

To sum up: an increase of *n* mils in the corrector setting makes a corresponding increase of *n* mils in the height of burst; a decrease of *n* mils in the corrector setting makes a corresponding decrease of *n* mils in the height of burst.

[1] In the preliminary discussion it is assumed that the gun and target are in the same horizontal plane.—Translator.

Note—When it is said that corrector 30 gives a 3-mil height of burst, it is assumed that, on the day when the firing is done, the conditions of temperature, atmospheric pressure and hygrometric state of the air, all of which affect the rate of burning of the fuze, are the same as the conditions under which the fuze was constructed.

If these conditions are not the same—and they never will be exactly identical—corrector 30 will not give the normal height of burst, but the proper corrector *for the day* will have to be determined during the fire for adjustment.

3. Influence of the angle of site upon the corrector.

Let us assume that the objective is not in the same horizontal plane as the gun, but is at O' (Fig. 3.), the range D remaining the same.

It is seen that, in order to make the trajectory pass through O', it will be sufficient to add to the angle of departure for the range D the angle of site O'CO. Let us assume that this has been done.

The range setting remains the same, since the distance to the target has not changed.

The setting of the range ring on the fuze setter is not changed, since it must correspond to the setting for elevation.

The same corrector which, when the objective was in the horizontal plane through the gun, gave a 3-mil height of burst above O, will give a 3-mil height above O'. In other words, if we give to the gun the angle of site of the objective, the corrector which gives the normal height of burst is not changed, whatever may be the height of the objective above the horizontal plane.

Principle of the rigidity of the trajectory.—The above statement is easily understood by reason of the principle of the rigidity of the trajectory. This principle is the following:

The trajectory CBO' (Fig. 3), obtained with the range setting D and the angle of site O'CO, is absolutely the same as the trajectory CAO obtained with the range setting D without any angle of site. That is to say, in order to obtain the trajectory CBO', we have only to revolve around the point C the trajectory CAO through an angle equal to the angle of site O'CO, the trajectory itself remaining rigid.

Moreover, if, when the objective O is in the horizontal plane, the fuze setter be set at range D and corrector at 29 for example, the projectile will burst at a point E on the trajectory CAO, after a certain length of burning of the time-train of the fuze.

Now, considering the trajectory CBO', if the fuze setter be set at the same readings—range D and corrector 29—the projectile will burst exactly at the end of the same length of burning of the time-train, i. e., at the point E', and this point E' is where the point E would be, if the trajectory CAO were revolved through the angle O'CO.

Hence, the angle E'CO'=the angle ECO; which means, that the height of burst above the objective has not been changed.

Influence of an error in the angle of site.—But the above is not true unless the gun be given the true value of the angle of site.

If an error of 2, 4, 6, 10 mils be made in the determination of the angle of site, a corresponding correction will have to be made in the corrector.

Let us assume that corrector 30 gives a burst E (Fig. 4) at a height of 3 mils above the point O, situated in the horizontal plane through the gun. The trajectory CAO results from a range D and angle of site O.

Suppose the objective is at O', at the same distance as O, but 15 mils above the horizontal plane. Let us assume that the captain neglects this angle of site and fires with a range D and angle of site O.

The trajectory itself is not changed and, as before, the projectile will burst at the point E, which is much too low, since the captain wishes to get a burst at E' such that the angle E'CO' = 3 mils. He must, therefore, raise the burst by an angle ECE', i. e., he must increase the corrector by the number of mils contained in this angle. Now ECE' = OCO', since ECO and E'CO' are both equal to 3 mils. Hence the angle ECE' = 15 mils.

As a consequence of this, he must raise his corrector 15 mils, that is, the exact amount by which he decreased the angle of site, which was taken as O, when in reality it was 15 mils.

A course of reasoning absolutely identical would show that for an objective situated, for example, 10 mils below the horizontal plane, if the captain takes a O angle of site, i. e., an angle of site too great by 10 mils, he will have to lower his corrector 10 mils.

To sum up: for an error of *n* mils too much in the angle of site, we must lower the corrector *n* mils; for an error of *n* mils too little in the angle of site, we must raise the corrector *n* mils.

In other words for any given objective, *the algebraic sum of the angle of site and the corrector is constant*.

Practical Consequences of an Error in the Angle of Site

To determine the sense of a round, the projectile is made to burst 1 mil above the ground, so that the smoke of the burst will either obscure the target or be obscured by the target; this will indicate whether the shot is short or over.

Corrector 28, in the general case, will give this 1 mil height of burst.

If the angle of site used is greater than the true angle, the bursts of the first salvo will be too high; it will be, therefore, impossible to observe its sense.

If the correction made in the corrector be too timid, it will still be impossible to observe the sense of the second salvo.

The adjustment in range will thus be slightly delayed. On the other hand, since all the bursts are in air, the adjustment in direction will be rather facilitated.

On the other hand, if the angle of site used is less than the true angle, bursts on impact will result.

In the latter case the Drill Regulations prescribe that a change of 5 mils be made in the corrector. If the error made in the angle of site is approximately 10 mils, the bursts will still be on impact after an increase of 5 mils in the corrector, but a second corrector of 5 mils should produce bursts in air.

Percussion bursts may be very difficult to observe. If the direction has not been well adjusted, the projectile may burst in the zone covered by the fire of another battery. This causes trouble and delay in the adjustment of the latter, and great difficulty in recognizing the bursts of one's own salvos.

As a consequence, it is extremely important to determine the angle of site as accurately as possible.[1]

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[1] See F. A. Drill Regulations, 1908, Par. 337.—Trans.

METHOD OF OBSERVING FIRE BY USE OF LATERAL OBSERVERS

Translated by Major Wm. J. Snow, Fifth Field Artillery

Either one or two observers may be used. It is better to have two, one on either flank, for observations are thus more certain; but it is possible to get along with only one observer.

1. The case of two observers, D and K (Fig. 5):

Each observer (at night each should use two lanterns) faces the battery while at the same time observing the target. Each of them extends his right arm if the shot appears to him to the right of the target, and his left arm if the shot appears to him to the left; both arms if the shot appears to him correct in direction.

Assume that O L is the target.

Short Shots Included in the Zone K L O D

Each shot in the angle K A D is to the left for D, to the right for K. Both extend the arm away from the target.

Any shot in the triangle K L A is to the left for D, in line for K. The observer K extends both arms; the observer D extends the arm away from the target.

Any shot in the triangle D A O is in line for D, to the right for K. D extends both arms; K extends the arm away from the target. Thus, when both observers extend an arm in the direction away from the target, or when one extends both arms and the other extends the arm away from the target, the shot is short.

Shots That Are Over and Included in the Zone F L O I

Any shot in the angle G B H is to the right for D, to the left for K. Both extend the arm toward the target.

Any shot in the zone F L B G is in line for D, to the left for K. D extends both arms; K extends the arm toward the target.

Any shot in the zone H B O I is to the right for D, in line for K. K extends both arms; D extends the arm toward the target. Thus, when both observers extend an arm toward the target, or when one extends both arms and the other extends the arm toward the target, the shot is over.

Shots Near the Target

Any shot in a quadrilateral A L B O is in line for D, in line for K. Both extend both arms.

Doubtful Shots

Any shot in the angle D O I is to the right for D, to the right for K. One extends the arm toward the target; the other extends the arm away from the target. It is the same if the shot bursts in the angle K L F.

Thus, when both observers extend the arm, one toward the target and the other in a direction away from the target, the shot is doubtful.

To sum up: The shot is over when both observers extend the arm toward the target, or when one extends both arms and the other extends the arm toward the target.

The shot is short when both observers extend the arm away from the target, or when one extends both arms and the other extends the arm away from the target.

The shot is near the target when both observers extend both arms.

The shot is doubtful when one extends the arm toward the target and the other in the opposite direction.

2. The case of a single observer (Fig 6):

The captain is at C.

Short Shots Included in the Zone C L O D

Any shot in the angle C A D is to the right for the captain, to the left for the observer D. D extends the arm away from the target.

Any shot in the angle C A L is in line for the captain, to the left for D. D extends the arm away from the target.

Any shot in the angle D A O is to the right for the captain, to the right for D. D extends both arms.

Thus, when the observation of the captain does not agree with that of the observer D, the shot is short if he extends the arm away from the target; it is also short if D extending both arms the shot is to the right for the captain.

Shots Over and Included in the Zone F L O I

Any shot in the angle G B H is to the left for the captain, to the right for D. D extends the arms toward the target.

Any shot in the zone F L B G is to the left for the captain, in line for D. D extends both arms.

Any shot in the zone H B O I is in line for the captain, to the right for D. D extends the arm toward the target.

Thus, when the observation of the captain does not agree with that of the observer D, the shot is over if he extends the arm toward the target; it is also over if D extending both arms, the shot is to the left for the captain.

Shots Close to the Target

Any shot in the quadrilateral A L B O is in line for the captain, in line for D.

Doubtful Shots

Any shot in the angle D O I is to the right for the captain, to the right for D.

Any shot in the angle C L F is to the left for the captain, to the left for D.

To sum up: Whenever the observation of the captain does not agree with that of the observer, the shot is over if the observer extends the arm toward the target; it is short if the observer extends the arm away from the target.

If the observer extends both arms, the shot is over if it is to the left for the captain; the shot is short if it is to the right for the captain.

If the observer extends both arms the shot is close to the target if it is in line for the captain.

There is no doubt if, the shot not being in line, the observation of the captain agrees with that of the observer.

THE SCHNEIDER-DANGLIS MOUNTAIN ARTILLERY TESTED IN COMPETITION WITH OTHER SYSTEMS IN TURKEY

The following is a resumé of an article written by a Turkish artillery officer and translated from the Turkish in the October number of the Revue d'Artillerie, giving an account of the Turkish tests of this material in competition with Erhardt, Skoda, St. Chamond and Krupp. The article is really an elaborate account of the tests, but as the Schneider material showed a marked superiority over the others, the performance of that material is selected for principal comment in what follows:

Programme of Tests

1. Test for I. V., 10 shots.
2. Test for pressure, 10 shots.
3. Precision at 1,500 meters, 10 shots.
4. Precision at 1,500 meters, the gun being traversed to its extreme right or left position, 10 shots.
5. Precision at 1,500 meters, the gun being on ground with an inclination of 15° to the left, the gun being traversed to its extreme right position, 10 shots.
6. Fire on ground inclined 15° to the rear and 15° to the side, 10 shots.
7. Fire under maximum elevation on ground inclined 15° to the rear, 10 shots.
8. Fire under maximum elevation on ground inclined 10° to the front, 20 shots.
9. Fire at short range upon rocky ground, 10 shots.
10. Fire at 100 meters on sandy ground, 5 shots.
11. Fire for accuracy at 1,500 meters on a platform, 10 shots.
12. Rapid fire; (a) determination of the length of time required to fire 15 shots at 15 targets placed at 550, 650 and 750 meters, at 10-meter intervals, the gun being laid successively on each target; (b) determination of the length of time required to fire 15 shots at a target at 650 meters without relaying.
13. Regulation masked fire, 15 shots.
14. Fire for endurance, 1,000 shots.
15. Road test on wheels, 60 miles.

The Erhardt, Krupp and Skoda guns had hydraulic brakes with spring return. The Schneider gun had a hydro-pneumatic brake. The St. Chamond gun weighs only 660 lbs., the caliber being 2.56 inches. This gun was not permitted to finish the tests, on account of the light weight of the shell, imperfection of the laying arrangements, and the inconvenience of having to drive the trail spade into the ground before beginning fire. The advantage of its lightness and simplicity were nevertheless recognized.

The Schneider gun weighed 1,128 lbs., fired a projectile of 11 lbs. at an initial velocity of 1,082 f. s. The Krupp gun weighed 83 lbs. less and fired a projectile of 11½ lbs. at a velocity of 984 f. s. The Erhardt weighed 1,150 lbs. and fired a projectile of the same weight and same initial velocity as the Krupp. The Skoda gun weighed 948 lbs. and fired an 11-lb. projectile at a velocity of 984 f. s.

Results of the Tests

1. The initial velocities have just been given.
2. Pressures: Erhardt, 15,650 lbs.; Krupp, 21,333; Schneider, 24,179 lbs.
3. Precision as measured by dispersion of hits on the ground at 1,500 meters. All the results were about the same; however, the ground being soft and muddy, the Schneider and St. Chamond guns alone held fast.
4. All the material acted about alike.
5. Results about the same for all, except that there was an excessive burying of the left wheel in all the systems except Schneider and St. Chamond. The stability of the Schneider was greatly superior to all others.
6. All the guns were thrown over backwards except the Skoda. Trials on ground with an inclination of 10º to the side and 15 to the rear, all the guns could be fired, the Schneider being the most stable.

7 and 8. Schneider and St. Chamond showed great superiority. On ground inclining to the front, the Erhardt, Skoda and Krupp guns slipped from 2 to 4 inches after each shot; the spade came out of its hole, and reaiming was necessary after each shot.

9. All the guns behaved well. On a concrete platform all the guns recoiled about 20 inches.
10. All the trails bored deep in the sand, Schneider and Krupp the most.
11. All results fairly equal.

12. (a) In the first series of shots against three different targets Krupp was classed first, thanks to the automatic breech mechanism. His time was 1 m. 22 sec.; Erhardt, 1 m. 24 sec.; Schneider, 1 m. 25 sec.; Skoda, 1 m. 30 sec.

All the projectiles except 1 Schneider hit the targets.

(b) Krupp was classed first with 26 sec.; Erhardt, 29; Schneider, 37; Skoda, 43. Krupp and Skoda put 7 shots in the target; Erhardt, 8; Schneider, 15. After firing, the sights were examined, and it was found that the Krupp, Erhardt and Skoda guns had each increased their elevation about 200 yards and had become displaced in direction about 1°. The Schneider gun had not budged; its stability was perfect.

The result of these 12 tests placed the Schneider gun easily first; Erhardt, second; the Krupp, third, and the Skoda, fourth. The Krupp gun had given the greatest rapidity of fire, but this was due to the automatic breech block which on the whole was regarded as a disadvantage, since the forcible, automatic ejection of the cartridge case was a danger to the cannoneers.

The Schneider and Erhardt guns, having shown incontestible superiority over the others, were alone subjected to the endurance test. It was prescribed that this test for the Schneider gun should be undertaken without changing any part of the gun or carriage and without touching the brake, moreover, the gun was required to fire under unfavorable conditions; the requirements were 105 shots in a quarter of an hour without stopping; 275 shots in a half hour without stopping; 695 shots in series of 100 shots; after each series of 100 a stop of one-quarter of an hour was permitted for cooling the barrel and oiling the breech mechanism.

The Schneider gun was fired 1,075 times, at the end of which a minute examination was made, without disclosing any injury whatever. During the fire no part was changed and there was no incident of any sort to record, such as hang fires, broken pins, etc. After 650 shots without interruption or change of position, the ground around the spade had not been lifted, and the stability and regularity were nothing short of astonishing.

Captain Redjeb Irfan proceeds further on to state what he considers the advantages of the hydro-pneumatic brake: compressed air cannot break as may happen to a spring; its weight is insignificant; reserve springs do not have to be carried for emergencies. The action of the air does not jar the gun under fire as does a spring. The fatigue and weakening which take place in the spring do not occur with air; the springs are only protected against bullets by the thickness of the spring cylinder, whereas the air cylinder has double protection.

As to the danger of air escaping, it should be remembered that since the air is on the upper surface of the liquid, its escape is impossible as long as any liquid is left; the escape of liquid is very slight and is no greater than in other rapid-fire guns.

In sustained fire with guns having spring return, the piece often remains 15 inches out of battery. This shortens the length of the next recoil and diminishes the stability by just as much. In guns having an air return it is impossible for the piece not to come entirely back into battery after each shot. This is shown in the 650 shots above mentioned.

In spring return systems the strength of the spring is calculated so as to ensure a return to battery under the maximum angle of fire. At short distances, say less than 1,000 yards, the gun being about horizontal, the force of return is excessive. It is for this reason that spring return guns have not anything like a perfect stability when firing at distances under 700 yards. This inconvenience does not exist with the hydro-pneumatic system.

The author then proceeds to discuss the relative advantages of the panorama sight and the collimator. He prefers the latter, especially for indirect fire, and above all when using an aiming point close by. He states that if the gun moves slightly with each shot, it is in vain that the panorama sight is laid each time on the aiming point, the accuracy of the fire will be influenced and there is produced an error which it is impossible to correct. Accuracy of fire with a gun which is entirely stable does not depend on the position of the aiming point; a nearby aiming stake produces very little error. Captain Redjeb Irfan then recommends to his comrades of the Turkish artillery a close study of the French drill regulations and the methods of fire. The rules which the French artillery laid down thirteen years ago for the new artillery has stood the test of minute study and criticism. All the armies of to-day, even that of Germany, are obliged to get their inspiration from the French. The last German drill book is nothing but a copy of the French methods. All the studies and articles on field artillery from the pens of German officers, headed by General Rohne himself, recognize the superiority of the French field artillery.