

VOLUME X

NUMBER 2

MARCH-APRIL

**THE
FIELD ARTILLERY
JOURNAL**

EDITED BY

ARTHUR F. CASSELS

LIEUTENANT-COLONEL (FIELD ARTILLERY), UNITED STATES ARMY, RETIRED

**THE UNITED STATES FIELD ARTILLERY ASSOCIATION
WASHINGTON, D. C.**

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Organized June 7, 1910

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Lieutenant-Colonel (Field Artillery), U. S. Army, Retired.

PUBLISHED BIMONTHLY FOR

THE UNITED STATES FIELD ARTILLERY ASSOCIATION

BY J. B. LIPPINCOTT COMPANY

227 SOUTH SIXTH STREET

PHILADELPHIA, PA.

LONDON OFFICE: J. B. LIPPINCOTT COMPANY, 34 Bedford Street

EDITORIAL OFFICE: War Department, Washington, D. C.

Entered as second-class matter November 20, 1915, at the post office at Philadelphia, Pennsylvania under the Act of March 3, 1870.

CLUBBING ARRANGEMENTS WITHDRAWN

Because of the increased cost of manufacture it has become necessary for the U. S. Cavalry Association and the U. S. Infantry Association to withdraw from the clubbing arrangement with the U. S. Field Artillery Association; therefore, the offer of the U. S. Field Artillery Association to obtain for its members subscriptions to the Cavalry Journal at \$1 per annum and to the Infantry Journal at \$2 per annum must be withdrawn. The Secretary of the U. S. Field Artillery Association will be glad to place subscriptions to the other magazines for members, but can do so only at the regular subscription rates of those magazines. The Field Artillery Journal can be furnished hereafter to members of other Associations only at the regular subscription price of \$3 per annum.



MAJOR-GENERAL JOHN E. McMAHON, U.S. ARMY
(DIED JANUARY 28TH, 1920)

Brigadier-General Commanding 156th and 167th Field Artillery Brigades; Major-General Commanding 5th U. S. Regular Division, A. E. F., during the Sainte Mihiel Offensive.

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VOL. X

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NO. 2

An Artillery Study Made in the A. E. F.*

(Concluded)

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LESSONS OF THE WAR

15. *Field Artillery and Coast Artillery.*—This war has shown that the heaviest guns may be employed to accompany and serve the mobile army. The question of the relation of the Field and Coast Artillery has consequently arisen. It is accordingly necessary to consider to what extent the functions of these two branches of artillery are assimilated to one another.

The artillery which is to accompany the mobile army must of necessity be steadily *trained* and accustomed to work with mobile troops in order that the appropriate associations may be established for insuring combined effort. This artillery must likewise be *organized* to meet field conditions, and so as to fit into the organization of the other arms; and, finally, it must be *habituated* to marching and campaigning.

The artillery which defends our harbors is charged with placing

* This and the preceding instalment which appeared in the January-February number of the JOURNAL are extracts from the report of the Superior Board, A. E. F. This report has not yet been approved.—EDITOR.

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and operating mines, and with serving the guns of the fixed defenses. The service of mine defense is a highly specialized one, requiring an expert personnel. The service of the harbor defense guns is likewise a specialized service, the equipment to be used, the methods to be employed and the organization appropriate being all adapted to meet the particular conditions involved. Such heavy high-power guns as may be assigned the mobile army might be used for harbor defense, but they would not operate as advantageously as guns mounted in fixed defenses, manned by a personnel especially trained for the service involved, and provided with all the accessories needed for long-range fire over water.

Analysis of the duties involved in harbor defense indicate that these duties assimilate more nearly to the naval than to the military service. Our primary line of defense is the fleet. Submarines and hydroplanes form the second line of defense; while mines for channels and guns on shore constitute a third line. Submarines, hydroplanes and mines are all appropriate naval means of defense. The service of the guns of a harbor fortress may be said to differ essentially from that of the service of the guns of a ship only in that a ship is floating and a fortress is not. Both fire across water, with guns of like weight and power, to hit a ship as the target.

Upon the Navy rests already the main responsibility for keeping hostile ships from our shores. The whole responsibility may properly and logically be put on the Navy.

All of the artillery pertaining to the Army should be mobile, organized for field warfare, accustomed to field conditions, and associated closely at all times with the infantry or cavalry with which it is to fight.

16. *Organization.*—Experience in this war has shown that artillery organization must be established on a very flexible basis, since the number of guns actually serving with divisions, corps or armies have varied greatly, depending on the particular mission involved. The number of guns actually serving with our division and corps was always greater than the tabular allowance—sometimes two or three times greater—the excess being provided either from reserve divisions or else from the French General Reserve of Artillery. These conditions will undoubtedly be characteristic of any important war in which we may be engaged in the future, and our organization must consequently be adapted to meet them.

17. An appreciation of the relative functions of divisional, corps and army artillery is necessary in order to devise a suitable artillery organization.

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It is the function of *divisional artillery* to furnish close and immediate support and protection to its infantry, especially by firing upon the enemy's infantry, by destroying machine-gun nests, and by destroying material objects which interfere with the progress of the infantry.

It is the function of the *corps artillery* to neutralize or destroy the enemy's artillery, to interfere with or prevent the enemy's reinforcement or withdrawal, and to impede his service of the rear by fire directed on the important roads, supply dumps, command posts, reserve units and concentration places immediately in rear of his front lines.

It is the function of *army artillery*, using long-range guns, to fire upon areas well beyond our infantry lines, to strike great railroad junctions, concentration camps, aviation fields, manufacturing centres, thus serving to assist in paralyzing the enemy's service of the rear.

The foregoing definition of functions must be taken as general in character; in practice no sharp line of distinction should be attempted. The division may be thrown more or less on its own resources, and required to do all or part of the necessary counter-battery work, as well as a great deal of the harassing and interdiction of enemy areas. Corps artillery may be used to overcome the obstacles which immediately block the infantry; and army artillery may be used to perform some of the functions above allotted to corps artillery. But, in general, the great bulk of the artillery is assigned to divisions and to corps, and used to protect and support the infantry by carrying out missions as described above. Divisions and corps have the machinery of liaison and observation necessary to procure quick coöperation between the infantry and the artillery, and hence they should have all the guns which ordinarily work in direct support of the infantry. In order that army artillery may take any regular and important part in supporting the infantry, an additional and overlapping scheme of liaison would have to be installed. Guns of very long range are assigned to army artillery for the purpose of striking areas far in the enemy's rear where important activities are concentrated, but which are far beyond the immediate reach of our infantry. If they are to be used to amplify the work of corps guns, they are assigned, temporarily or otherwise, to the corps.

18. To the *division* should be assigned permanently a certain quota of artillery deemed capable of meeting the average minimum requirements of combat. This assignment should be permanent, so that the infantry and the artillery may become closely associated one with another. The amount, as deduced by the experience of this war, for a division of two brigades of two regiments each is a regiment of light guns to support each infantry brigade, and a regiment of howitzers to do destructive work and, when necessary, counter-battery work.

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This brigade of artillery should be an organic part of the division and should not be separated from it except when such separation is absolutely unavoidable. It is urgently necessary that it should remain with its own infantry.

To the *corps* should be assigned normally an amount of artillery deemed necessary to meet average conditions of service. Even when the warfare becomes stabilized, counter-battery and harassing and retaliatory fire must go on. In no case during important operations have our corps been provided with less than 80 guns. For breaking through long-prepared positions, we have had as many as 280 guns serving as corps artillery, while in moving warfare 85 guns have been about the average. Three regiments, of 24 guns or howitzers each, are deemed the proper normal quota of corps artillery. While these would constitute the organic artillery of the corps, it may be expected that the regiments or parts of them may be sent to reinforce other corps if necessity dictates; but the permanent machinery for handling the corps artillery should always pertain to the corps, and accompany it wherever it goes. This includes the Corps Artillery Commander and staff, a Heavy Artillery Commander and staff, the forward information centre, flash-ranging sections, and the ammunition section.

To the *Army*, no organic artillery could be assigned. There should be for our field forces a General Reserve of Artillery under G.H.Q., or at home, under the War Department, which would comprise guns of all calibres, available for reinforcing our several field armies as circumstances require. Guns of the type normally used in corps and divisions will form the major part of this reserve; but guns of special type, such as pack artillery, anti-aircraft artillery, trench artillery, anti-tank guns and super-heavy artillery should all be included. This General Reserve of Artillery should be under the superior command of the Chief of Artillery, with immediate commanders for each subdivision to attend to training, when the organizations are out of the line, and to attend to administration at all times. The Army Artillery Commander employs directly such super-heavy guns as are needed for very long range work; but he allots to corps and divisions the great mass of the reinforcing artillery assigned to the army. He is thus relieved of the administration of the affairs of this great mass of artillery and free to devote his time to his more essential duties of determining the guns and ammunition required, preparing plans for the employment of the artillery as a whole, and supervising the employment of all the artillery of the army, to insure these plans being carried out.

The size and composition of our General Reserve of Artillery at home must be determined by our estimate of the troops required, and

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the difficulties to be overcome in the most important theatres of probable operations. A rough estimate of a reserve proportioned to an army of 3 corps of 12 divisions is made in paragraph 28 below.

19. The General Reserve of Artillery should exist in nucleus in peace time, capable of expansion to meet war needs. In our peace army there should exist and function artillery of each type that is to be employed in war, so that development may go on, and so that personnel, at least in reduced numbers, may have experience in the special methods appropriate for each type.

20. *Ammunition Supply.*—The system of ammunition supply in vogue in our army during this war is, in general outline, as follows: The Chief of Artillery of an army estimates the ammunition needed for any definite project, as well as for average daily consumption, and shows the amounts to be held in army dumps, in corps and divisional dumps and with batteries. G-4 of the army has a call made for this ammunition from the rear. It is moved up to the army dumps and credits are given corps artillery commanders to cover allotments for definite projects, or to keep dumps and troops supplied up to the regular authorized allowances. Corps artillery commanders allocate ammunition to the divisional artillery commanders, and to the corps artillery, to meet their daily or extraordinary needs; and divisional artillery commanders, similarly, allocate to regimental commanders the ammunition for distribution to batteries. G-4 of the army has control of the receipts of ammunition at army depots and its issue therefrom, while corps and divisional artillery commanders have control of the ammunition in their own dumps.

As for transportation, the corps artillery commander is responsible for the movement of ammunition from army dumps, and arranges with divisional artillery commanders the details of distribution, sometimes hauling by means of corps ammunition train to corps dumps, and sometimes direct to divisional dumps, as might be most convenient. Similarly, divisional ammunition trains sometimes are required to haul from corps dumps only to divisional dumps, and then again to make the haul direct through to the batteries. Regimental combat trains have habitually drawn from divisional dumps. The whole system is necessarily very flexible, its operation depending largely upon the situation of the moment, the ruling consideration being to avoid double handling of ammunition wherever possible. Where light railways are available, the corps artillery commander arranges with G-4, and his transportation agents, for such assistance as can be given; but the movement, at least from corps dumps forward, has generally been by the trucks of the

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corps and divisional ammunition train, and by the caissons of the regimental combat train.

It has been patent to all familiar with the circumstances that our ammunition supply system has not operated very smoothly. The system itself was essentially that in use in other armies, and, as shown by their experience, was not unsound; but we did not soon enough grasp the magnitude of the task involved and provide the large numbers of skilled personnel needed for receiving, sorting and issuing this ammunition at the dumps, and for forwarding it to the guns; moreover, we did not provide an adequate number of well-equipped dumps.

21. It being assumed that it is the function of G-4, G.H.Q., to get the necessary quantities of ammunition forward to army dumps, an analysis of the essential elements involved in distributing ammunition from army dumps to guns may be made as follows:

(a) To get the ammunition deployed into corps and divisional dumps so as to relieve congestion at army dumps, and so as to facilitate rapid distribution when emergencies arise.

(b) To regulate distribution from these corps and divisional dumps so that only the absolutely necessary amount of ammunition is scattered in battery positions, thus enabling the higher artillery commanders to check waste and distribute the ammunition to meet the requirements of combat.

(c) To select sites for dumps, on railway lines if possible, and properly located with respect to organizations to be served and roads available; then to construct at these sites the necessary platforms for projectiles, shelters for powder and fuzes, roads for incoming and outgoing traffic—all with a view to safety precautions and concealment from observation.

(d) To provide for each of these dumps adequate trained personnel, acquainted with kinds and types of ammunition, and to receive, sort, and issue the ammunition.

(e) To transport all ammunition from army dumps to corps and divisional dumps and battery positions, so as to make the best use of all available means of transportation, railway, trucks and caissons, saving double handling wherever possible, and insuring the ammunition reaching the batteries in the kinds needed and at the times wanted.

22. Our experience has shown that it is indispensable to fix the responsibility for the working of this whole complex process as closely as possible on one definite agency. Of course, one agency cannot perform the work independently of assistance and independently of coördination. Thus, railway transportation, dump selection and construction, and road traffic are necessarily matters involving special assistance and

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coördination; but these are merely incidents to the main executive problem of giving the necessary orders for regulating the flow of ammunition from army dumps to guns, and of controlling day and night the truck transportation required to move ammunition to the places where it is required.

23. The artillery is now charged with the foregoing responsibility. Recently it has been proposed that the Ordnance Department should man all dumps and ammunition trains and, acting under G-4, should take over the question of ammunition supply.

On the face of it this proposition looks promising. It fits into the existing diagrammatic scheme of supply, and should apparently relieve the artillery of an onerous burden, leaving it free to look only to the front and fight the guns. But closer examination brings up the question whether such a plan is the best for meeting the conditions of actual combat, and whether the responsibility for ammunition supply can properly be completely shifted to G-4 and the Ordnance Department.

If the Ordnance Department could have actually in being at the beginning of a war the trained personnel complete for manning dumps and ammunition trains, and if this personnel under its own officers could work in the field with troops and thus acquire practice and experience in field conditions, the proposition would undoubtedly have a great deal in its favor. But undoubtedly we will not be able to maintain such organizations in time of peace. All that we can hope for is a skeleton organization which can be expanded quickly on the outbreak of war. If this skeleton organization is to be valuable to work with troops it should be with the troops in time of peace so as to gain experience under field conditions; and if this condition is fulfilled it would be better to have them pertain to the troops which they will serve, on the general principle that loyalty should be toward the immediate commander and not toward some distant authority. It is obvious that the Ordnance personnel existing at the beginning of a war will all be required to carry on the work of construction and manufacture. We would seem more liable to be able to form our ammunition supply units quickly if we attached in peace time to our larger units of artillery a small skeleton personnel, charged with the study and practice of the problem of ammunition supply, and capable of quickly instructing the great numbers of recruits brought in on the outbreak of war to afford the necessary expansion.

But there is another and far larger question involved. Ammunition supply in the forward areas is not carried on as per a diagrammatic scheme. The requirements of ammunition must be foreseen, and the resources, both of ammunition and of transportation, must be adapted

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quickly to meet rapidly changing conditions. The chain of responsibility ought to be continuous. The men who serve the forward dumps and those who man corps and divisional ammunition truck trains and regimental combat trains should all be involved in the success or failure of the guns, and they should be responsible to the commanders of these guns. Ammunition is a vital concern to the artillery. Without it the guns are idle, and artillery commanders must inevitably carry a large part of the responsibility of seeing that the guns are kept active. They must give quick decisions during combat as to the distribution of available ammunition, and get prompt action thereon. To get the ammunition up is just as much the function of the artillery as it is to get the guns up. It is a function of command. To introduce the Ordnance Department into the scheme of ammunition supply at the front is merely to introduce an additional agency charged with a portion of the work to be done. Responsibility, instead of being single, would be divided between the artillery and the ordnance.

For the foregoing reasons it is not thought desirable to introduce the Ordnance Department as an active agent in the distribution of ammunition in the forward areas.

24. The proposition is also frequently made that G-4 in divisions or corps should, without any intermediary agency, take over ammunition supply and run it from his own office. A careful analysis of the considerations involved, backed up by any experience in the matter, shows that this would necessarily mean dividing responsibility for the continued activity of the guns between G-4 and the artillery commanders. But, in addition, it would be wrong in principle to burden G-4 with such a duty. He is a staff officer especially provided to harmonize the operation of all the different services engaged in supply. If he absorbs the functions of the heads of those services, he will be overloaded with work, will not have the leisure or the outlook qualifying him to perform the larger duties for which he is provided, and he will confuse the whole system of responsibility.

25. It is believed that responsibility for ammunition supply should remain with the artillery. But it is very important:

(a) To prepare at once a manual of ammunition supply showing the organization needed and the duties involved;

(b) To make ammunition supply one of the essential subjects of artillery training, to be taught at our schools and practiced on the training grounds and at maneuvers;

(c) To have a skeleton organization for ammunition supply for each artillery command from the battalion to the army, comprising a few permanent officers and non-commissioned officers specially instructed

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in the care, handling and movement of ammunition and the layout of dumps. If our military policy involves a reserve system, then reservists should be listed in sufficient numbers to make up the full quota of each ammunition supply unit.

At each artillery headquarters, from the battalion up to headquarters army artillery, there must be an ammunition officer, with the necessary clerks; for each battalion there must be a combat train; and for each division, corps, and army there must be dump and transportation personnel and the necessary ammunition trains.

26. *Armament.*—For *divisional artillery* a gun and howitzer are needed. The gun should fire a projectile of at least 15 pounds weight, should have an extreme range of at least 11,000 yards, the largest possible angle of traverse and of elevation consistent with strength and endurance of the mount, independent line of sight and panoramic sighting device. The 75 mm. has proved very serviceable, but the new British 18-pounder looks more useful in that it fires a heavier projectile to a longer range. Our ordnance engineers should give us a gun having at least the power and mobility of the 18-pounder, with, if possible, a wider angle of traverse on the carriage.

The howitzer should have the greatest power consistent with necessary mobility. Great rapidity of fire is not necessary—the task of the divisional howitzer being to destroy material objects which stop the infantry, such as houses and other masonry constructions, and to get at the personnel thus protected. The moral effect of a large shell bursting near infantry is far greater than that of a small shell. Taking both moral and material effect into consideration, it is probably true that, for the same tonnage of ammunition fired, the 155-mm. will produce as much, if not more, effect than a smaller calibre. The 155-mm. has shown itself in this war to have the necessary mobility, when horse-drawn, and now that it is motor-drawn it appears to have an ample margin of mobility. By retaining it for our divisional artillery, as well as corps artillery, we have an all-around gun that can be used interchangeably for both purposes. The division is in reality often required to do counter-battery work, because the corps cannot do it all, or because the division is acting more or less alone. For all these reasons it is considered that the 155-mm. should be retained as our divisional howitzer. It is the weapon that has stood the test in this war as a divisional howitzer, both for ourselves and for the French. It is true that the British and Germans have a lighter divisional howitzer; but they had these howitzers before the war began, and could not very well change them. It is extremely doubtful if the French will adopt a howitzer lighter than the 155 for their divisions.

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27. For *corps artillery*, howitzers are needed for counter-battery and for destruction of specially resistant material objects; while guns are needed for counter-battery, as well as for harassing the area immediately in rear of the enemy's front lines, for interfering with reinforcements or retirement, and disorganizing his system of command, communication and supply.

The 155-mm. howitzer is the weapon especially adapted to counterbattery work. Its present *extreme* range, using the strong powder charge, is about 12,000 yards. It would be desirable to have this as a *normal* range, since the experience of this war has shown that a great deal of counter-battery had to be done at ranges of 12,000 yards, and even beyond. Until the ballistics of the howitzer are noticeably improved, it will be necessary to use the strong powder charge (BG5) in larger proportions than heretofore permitted. The proportion of the strong powder to the weak should be 75 to 25.

The gun which has been most useful to our corps artillery, and which it has used with great effect in moving warfare for interdiction on the rear of the enemy's lines, is the 155 G.P.F., firing a projectile of about 100 pounds weight to an extreme range of about 17,500 yards. But the Germans, with their 150-mm. gun, get an extreme range of about 24,500 yards, and the British, with the horse-drawn 60-pounder, get a range of about 14,000 yards. The criticism to be made on the 155 G.P.F. is that it does not give us range proportionate to its weight.

We want a gun for corps artillery which will fire a projectile weighing at least 60 pounds to a range of 18,000 yards, and yet be considerably more mobile than the G.P.F. Its total weight should not be more than seven or eight tons, to permit prompt occupation of positions, and also to avoid being held up by the smaller bridges of a country. No gun is now available having the foregoing characteristics. Study and experimentation should be carried on to produce one. If it is true, as reported, that our 4.7 gun is capable of a range of 15,000 yards, with a 45-pound projectile, then this gun should be retained for the present; without it there is too big a gap between the mobility of the 75-mm. and that of the 155 G.P.F. Such a gun should assist materially in counter-battery, and carry on the work to range of which the 155-mm. howitzer is not now capable. The G.P.F. should be retained in the corps for counter-battery and interdiction, especially at the longer ranges.

Assuming, then, that the 4.7 gun, with a 45-pound projectile, is capable of a range of 15,000 yards, the brigade of organic corps artillery, recommended in paragraph 18, should include:

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A regiment of 155-mm. howitzers.

A regiment of 4.7-inch guns.

A regiment of 155-mm. G.P.F.

28. For *heavy and super-heavy artillery*, to be used by the Army, or assigned as needed to corps, there is required:

(a) A gun of about 6-inch calibre capable of a range of about 24,000 yards. This gun will be used for long-range interdictions and destructions, especially by the Army Artillery Commander;

(b) A heavy howitzer of about 9.6-inch calibre and a range of about 18,000 yards. This howitzer is needed to destroy material objects beyond the power of the 155 to destroy. It must have the mobility permitting it to follow the troops freely and to be pushed up fairly close behind the lines. It would be used primarily as a corps artillery howitzer. The 8-inch howitzers of older model, which were furnished our troops just before the armistice, were of little or no use, due to their very short range; they are hardly worth considering for the future. The latest models of 8-inch, getting a range of about 11,000 yards, and the 240-mm. howitzer may be used until a more efficient type has been devised;

(c) Super-heavy guns transported, as a rule, on railway mounts. The guns of this type will be suitable for use in the mobile defense of our coasts at home, as well as for important operations abroad. Guns of about 8-inch and 14-inch calibre and a howitzer of about 12-inch calibre are required, with extreme ranges of at least 20,000 yards in the case of the howitzer, of 30,000 yards for the 8-inch gun, and 40,000 yards for the 14-inch gun.

29. For *anti-aircraft artillery* two types are needed: a high-velocity gun of about 3-inch calibre, on a mobile mount for accompanying the troops under all conditions; and a high-velocity gun of about 4-inch calibre, on mobile or semi-permanent mount, for defense of important localities.

30. Sixty-inch searchlights carried on light trucks are necessary for use in connection with the anti-aircraft defense.

31. A mountain howitzer must be developed of about 3-inch calibre, and effective up to ranges of at least 6000 yards. A shield is not necessary for this howitzer. It must be very simple, and very strong, and capable of being put together readily.

32. A trench mortar of about 6-inch calibre and a range of about 2000 yards is deemed requisite. The Newton-Stokes is not sufficiently accurate. Experiments should be conducted with a view to producing a mortar, firing a projectile having a very large bursting charge, but yet a very mobile weapon suitable for transportation in trenches.

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33. The armament above recommended may be summarized as follows:

CALIBRE		WEIGHT OF PROJECTILE	RANGE	INITIAL VELOCITY
Gun	Howitzer	Pounds	Yards	f.s.
3-inch		15	11000	
	155 mm.	96	12000	
4.7-inch		45	15000	
155 mm G.P.F.		96	17500	
6-inch		100	24000	
	9.6-inch	400	18000	
8-inch		225	30000	
	12-inch	750	20000	
14-inch		1300	40000	
3-inch A.A.		15		2600
4-inch A.A.		30		2600
	3-inch			
	Pack Artillery	15	6000	
	6-inch Mortar	50	2000	

CONCLUSIONS

34. *Organization.*—No very radical changes in artillery organization are suggested by our experience in this war. The following general recommendations are made; for changes in detail, not inconsistent with these recommendations. (See the Proceedings of a Board of Artillery Officers Convened at G.H.Q., A.E.F., December 9, 1918, of which Brigadier General Andrew Hero, Jr., was President.)

35. *The Battery* of artillery should comprise, normally, 4 guns; but for anti-aircraft artillery and super-heavy artillery, a battery of 2 guns is to be recommended.

Eight caissons should be assigned batteries of 75 mm. The ammunition for all other types of artillery should be in trailers hauled by tractors, or else in trucks. Tractorized 75-mm. batteries should have trailers, in lieu of caissons, and the design and test of a suitable trailer for this type should be immediately undertaken.

36. *The Battalion* (preferably termed "The Group") should comprise 3 batteries in the case of 75-mm. regiment, 4 batteries in the case of anti-aircraft artillery, and 2 batteries in the case of all the heavier types of artillery. The two-battery battalion is to be preferred for the heavier types of artillery, because this organization lends itself best to association with the various infantry commands, and also to carrying out the variety of missions they are called upon to perform.

Each battalion should include an *ammunition battery*, in addition to the gun batteries, providing the "combat train" for the battalion.

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This will be made up of the individual combat trains heretofore pertaining to each battery, the change being based on the experience gained in this war. The ammunition carried with each battery, plus that in the battalion combat train, should amount to approximately the following:

	<i>Rounds per Gun</i>
75 mm.	300
155 mm.	150
4.7	100
155 G.P.F.	100
Heavier types	25 to 50
A.A.A.	50

The foregoing amounts constitute about a "day of fire."

37. *The regiment* should comprise 2 battalions in the case of 75's, and 3 battalions in the case of all other artillery.

The headquarters company now existing in each regiment should be broken up, and one section, suitably organized, assigned to regimental headquarters, and one to each battalion headquarters.

The signal details in batteries, battalions and at regimental headquarters should be largely increased to meet the requirements as actually developed during this war. (See Hero Report.)

38. *The brigade of divisional artillery* should comprise:

- 2 regiments of 75's or 3-inch.
- 1 regiment of 155 mm. howitzers.
- 1 ammunition train, with personnel for manning divisional dumps (artillery personnel).
- 1 mobile ordnance repair shop (attached ordnance troops).

(1) The trench mortar batteries should be eliminated from the division as well as from the corps. In the General Reserve of Artillery there should be trench mortar equipment comprising a mortar of about 6-inch calibre, and reserve units should be assigned for the use of these mortars where occasion demands. Instruction should take place at artillery schools in the use of such mortars.

(2) The divisional ammunition train is the link between the advanced divisional dumps in front and the corps or army dumps in rear. It must be prepared to transport both infantry and artillery ammunition. It should comprise 4 ammunition companies and 1 depot company, all commanded by a lieutenant-colonel. Each ammunition company should comprise 27 3-ton trucks for ammunition transport; the trucks necessary for transporting men's equipment and cooking equipment should be additional in each company. The depot company should furnish the personnel for taking care of divisional dumps, for sorting ammunition, and for unloading ammunition arriving from the rear and loading that going to the front. Its personnel must be fully instructed

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in the care of ammunition, and must be acquainted with all the different types of ammunition to be handled. (See Table of Organization 242, Series C, November 9, 1918).

39. The *brigade of corps artillery* should comprise, normally:

- 1 regiment 155 mm. howitzers.
- 1 regiment 4.7-in. guns.
- 1 regiment 155 G.P.F. guns.
- 1 regiment anti-aircraft artillery.
- 1 battalion anti-aircraft machine guns of 4 companies of 12 guns each.
- 1 ammunition train, with personnel for manning corps dumps (artillery personnel).
- 1 flash- and sound-ranging battalion, comprising 2 flash- and 2 sound-ranging companies (artillery personnel).
- 1 mobile ordnance repair shop (attached ordnance troops).

The corps ammunition train should comprise 4 truck companies, as described for the divisional ammunition train, and 3 depot companies, commanded by a lieutenant-colonel. Three depot companies are required, since at least one dump for corps artillery and two for divisional artillery will have to be manned.

40. *General Reserve of Artillery*.—The type army considered in this report comprises 3 corps of 12 divisions. The organic artillery recommended above for the divisions and corps of this type army may be compared with the total number of guns of all calibres used by three corps of the First American Army in one of its principal offensives, in order to get some idea of what our single type army will have to draw from a General Reserve in order to reinforce its divisions and corps and supply the super-heavy types for army artillery. The case of the Meuse-Argonne offensive of September 26th is taken because the available data are the most exact. Only the three corps serving west of the Meuse are considered, namely, the 1st, 3d and 5th.

<i>First American Army</i>	<i>Type Army</i>	<i>Difference</i>
All guns except anti-aircraft and trench mortars.	Organic artillery of division and corps as proposed.	
26th Sept. 1918 2194	1080	1114

Thus, assuming that the organic artillery of the three corps and twelve divisions of our type army are all in the line, 1114 guns will be needed from the General Reserve to give the type army the same number of guns employed by the three corps of the 1st Army.

On the general analogy of the ratio of calibres in the 1st Army these additional 1114 guns required by the type army may be enumerated as follows:

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		<i>Guns or Howitzers</i>
20 regiments 75 mm		480
10 regiments 155 mm howitzers		240
6 regiments 4.7-inch		144
6 regiments 155 G.P.F.		144
6 regiments 6-inch		24
2 regiments 9.6-inch howitzer		48
1 regiment 8-inch		12
2 battalions 12-inch howitzer		8
2 battalions 14-inch		8

1108

On the analogy of the above, the General Reserve of Artillery appropriate for field forces comprising two armies, or a total force of about 1,250,000 men, should be approximately as follows:

CALIBRES		REGIMENTS	GUNS OR HOWITZERS	REMARKS
Gun	Howitzer			
75		25	600	Part to be truck or trailer carried These two types to be combined if a single calibre can be provided capable of doing the work of corps artillery.
	155	15	360	
4.7		10	240	
155 G.P.F.		10	240	
6"		2	48	
	9.6	5	120	
8"		3	36	
	12"	3	36	
14"		2	24	
Pack Art.	3	4	96	
A.A.A. 3" & 4"		5	120	
A.A.M.G.		10 bus.	480	
Trench Art.	6"	12 btrys.	72	

RECOMMENDATIONS

41. The following special recommendations are made:

(a) That artillery be stationed in the same general locality with the groups of infantry and aeronautics, or cavalry and aeronautics, with which it is to fight, so that combined training may be often practised and the habit of coöperation acquired.

(b) That artillery have access to ample practice grounds and a liberal ammunition supply, and that, at different periods throughout the year, winter and summer, the artillery be required to carry out tactical exercises in which batteries, regiments and brigades take part, and in which fire will have to be brought to bear on designated targets under conditions as various and difficult as those ordinarily characterizing

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service conditions. Reconnaissance, observation, communication and registration to be especially practised and developed.

(c) That while moving warfare is made the basis of all training, the special requirements of artillery in stabilized warfare be studied, foreseen and prepared for.

(d) That a 75-mm. regiment and a 155-mm. regiment in each brigade of divisional artillery be motorized, and active experimentation carried on to perfect, not only the motors, but also the gun mounts and ammunition vehicles suitable for motorized artillery, as well as the details of artillery service (reconnaissance, for example), so far as these are affected by the substitution of the motor for the horse.

(e) That a Chief of Artillery and a Field Artillery Board of experiment be made a permanent part of our military system, charged with foreseeing artillery needs, and recommending the ways and means for meeting these needs. Anti-aircraft artillery and its special methods, motorization of artillery and the changes it will induce, guns with long range and the appropriate methods for adjusting their fire, coöperation with aeronautics, are a few of the matters demanding immediate attention, and the steady activity of a central artillery office is required to insure development being continuously pursued.

(f) That all the artillery of the Army should be mobile Field Artillery, organized, trained and habituated to work, in open warfare, with troops of the other arms, and living in close association with them.

(The end.)

Employment of Artillery in the Defensive

TRANSLATED FROM THE FRENCH BY CAPTAIN R. H. LEWIS, FIELD ARTILLERY,
U. S. ARMY.*

[There are but a very limited number of defensive major operations in which American troops participated during the World War. In consequence, study of such operations performed by our army is somewhat restricted. The following account is therefore of special interest. The 43d French Division formed part of the 4th French Army and played a similar rôle to many other French divisions in the great defensive action of July 15, 1918, an action which was planned, fought, and won in the most brilliant manner. The dispositions taken by the French artillery to withstand the shock of a big enemy "push" have a corresponding interest for all artillerymen.—EDITOR.]

It is proposed to examine the following points:

- (1) Organization of the defense in a stabilized sector.
- (2) Application to a concrete case, namely, the defensive battle of the 15th of July on the Champagne front.
- (3) Finally, certain considerations of the subject of open warfare.

This study will be confined to divisional artillery.

The principles which are laid down and the conclusions which are drawn from them have nothing of an absolute nature.

Each one, according to the teachings which his own experience may have suggested to him, may subscribe to these principles or contradict them as he may deem proper.

I. ORGANIZATION OF THE DEFENSE IN A NORMAL SECTOR

(a) *Plan of Defense.*—The plan of defense is the basis for the defense of the sector.

It should fix with precision the method of occupation of the ground and the method of defense of the different lines.

* Attempt has been made in making this translation to preserve the style and sequence of the author, while at the same time making it readable for those who have not had experience with French organization.—TRANSLATOR.

One may then prepare the successive methods or systems of artillery fire.

What is more evident, and what is more simple, and yet, however, how little and how poorly realized in general in the different sectors.

Who is the artilleryman who has not asked himself with anguish more than once, the following question: If the enemy breaks into our lines in what manner shall I support my Infantry during the course of the combat? Where, how, and at what moment shall I fire, etc.?

Let us admit the following: That even though the barrage plans and the counter preparation fire of the defense may have been minutely prepared, the preparation of fire to be laid down within our lines was absolutely rudimentary, if not non-existent.

One should, therefore, arrange the means at his disposition as though the enemy's attack were to be launched by surprise, for surprise is the initial element of success, and it is at least prudent to suppose that the enemy will try to obtain it.

The more reduced the means, the less they should be scattered or dispersed.

In place of supposing a continuous resistance, which is consequently uniformly fragile, and therefore inefficient, it is necessary to concentrate the means at one's disposal by limiting the action of the artillery and covering fire to the front of the centres of resistance or to well-defined zones.

In fact, in the development and building up of the plan of defense, it is essential to take into account with the greatest care the possibilities of the artillery.

(b) *Deployment.*—The dispositions of the plan of defense determine, as a natural consequence, the missions and the method of action of the artillery and in consequence its deployment.

It is unnecessary to insist on an echelonning in depth in such a manner as to permit of furnishing to the Infantry continuous support during the combat.

The fire of artillery should cover the enemy's first line of works and the ground beyond them to a depth of from 1500 to

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2000 metres, and it should also be capable of being placed upon the interior of our lines in such a manner as to cover the positions upon which the higher command has decided to resist, and should also be capable, if need be, of being placed on this latter position. It is often difficult to coördinate these missions, above all, if the first position has great depth.

From the relative weight given to these diverse missions, results the method of deployment.

(c) *Methods of Fire*.—The deployment being fixed, it is necessary to set up in detail the system of fire which includes principally:

Interdiction fire;

Counter preparation fire;

Barrage fire, and

Successive firings on the interior of the position.

(d) *Interdiction*.—From the point of view of interdiction one may perhaps be allowed the observation that it is worth more not to disperse one's efforts too much. Without doubt, one may cause certain losses, but this amounts really to harassing fire only, rather than true interdiction fire.

There are always some points vital to the enemy (at most, two or three) upon which the interdiction fire should assume a certain degree of strength and of permanence if one wishes to render it really efficient.

(e) *Counter Preparation*.—This is a question of what? Of seizing the enemy in his preparatory attack formations, whether sheltered or not, and of striking him where he may be, or at least where one believes him to be.

Therefore there is no absolute rule. It is necessary that one should be very much in touch with the enemy's methods of combat, with the ground, and with the trace and the condition of the works which play a capital rôle in this case. In fact, it is necessary to be always looking after information.

The objectives being once determined in depth, as well as in width, there remains to be fixed the conditions of time and of density under which they should be fired upon, in order to obtain

the efficiency which is recognized to be necessary upon each particular target.

For example, once one has determined the number of shots justifiable to be used on each particular target, should one act simultaneously upon all these objectives, dividing one's fire up between them?

This method would cause one to attack each of the objectives for a longer time, but with a less density during a certain fixed length of time, and therefore with less violence.

Is it necessary, on the contrary, to work with strong concentrations sometimes on one objective, sometimes on another, and therefore treat the different objectives in a briefer manner, but with more violence?

And then in what order is it necessary to attack them and which of them should be struck at the beginning or at the end of the counter preparation?

Whether one employs one or the other of these methods, is it advisable, first, to fire on each objective by dividing it up into sections and attacking one section at a time, or by attacking the whole objective at once? Second, to do all one's firing on an objective at one time or to repeat the fire from time to time and in this case, what should be the number of repetitions and what the intervals which separate them? Such are the questions to be solved according to the circumstances, the particular nature of the targets and the presumable duration of the counter preparation. It would appear that it would be more often advantageous to adopt the method of short and very strong concentrations and to renew them several times.

In fact, it is possible that the enemy may not have yet occupied a certain zone at the moment when it is first fired upon, and it is equally possible that he will attempt to infiltrate after the first firing into a zone which has already been fired upon, in order to avoid the effect of our fire.

If we add that it is also necessary to take great account of the task of resupply of ammunition, as the battle has only just commenced, one will understand what a study is involved in

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the preparation of this fire for the divisional artillery and how delicate it is.

The study of the barrage is no less so.

(f) *Barrage Fire*.—Barrages have generally been considered up to the present time as fire executed along a line, having for their object the prevention of the crossing of a certain determined line, for example, a line of obstacles, trenches, or wire entanglements.

This conception of the barrage has found its greatest development in a position warfare where trench raids are the currency of the sector (but the important thing is the battle).

Now the barrage wastes ammunition and it does not stop anybody because it cannot be kept up for a long time with the necessary intensity, and the enemy will quickly take advantage of any let-ups.

As in the counter-preparation, what is the great question? It is to strike there where the enemy is, with this difference, that in this case the assailant is in march and is therefore more vulnerable.

The barrage will then be, if you wish, in the first case, a curtain, giving above all a certain satisfaction to the Infantry, but also and principally a firing in depth, a series of bursts of fire as dense as possible covering the whole extent of the zone where the moving mass of the adversary is found—400, 500, 600 metres of depth, sometimes more, sometimes less, according to the depth which one supposes his formations to have.

It should be perfectly arranged as regards its mechanism and as regards its repetition. It does not uniformly sprinkle the ground. It should be distributed with good judgment, should fall on the probable paths of the enemy to the exclusion of the neighborhoods, the crossing of which is prevented by the fire of our own machine guns.

The Infantry should then come into this study and the action of its means of fire, which should be used to the maximum, should be coördinated with those of the artillery.

The combined effort of the two arms should be to dislocate,

to weaken, to neutralize, if possible, the assailant's formations.

The effect of the fire of our artillery should be to cause a void behind the first waves, which may have succeeded in pressing forward, and to prevent their reënforcement, their support and their supply, and to deliver them without defense to the effect of the Infantry fire; which arm has at its disposal, one must not forget, very redoubtable weapons.

A fire such as this is more than a barrage. It is also a zone fire, a neutralizing fire, in a word, fire for effect upon certain determined areas.

To tell the truth, a proper expression is lacking to characterize it. This method of barrage during the battle reaches its fullest effect during the period of the combat which takes place in the interior of the position. Above all, on open ground.

Is this contrary to the spirit or the letter of Instructions of December 20, 1917? Such is not thought to be the case.

"Barrage fire" (says Instruction No. 102b) "should include, on one hand, fire forming a curtain extending as nearly as possible to our lines, minimum density being 200 metres front per battery, and, on the other hand, superimposed fire to augment the density of this curtain and executed beyond it, extending even to the very trenches of the enemy."

(g) *Successive Fire Within the Interior of the Line.*—The dispositions for defense being decided upon, as well as the method of occupation by the Infantry, one establishes the system of successive firing within our own lines. This fire being as above, fire for effect upon certain determined zones according to the methods which have just been indicated for counter-preparation fire and for barrage fire.

We shall have occasion to return to this point in considering the defensive battle of the 15th of July. Let us say at once, however, that it will be necessary to fix with precision upon an understanding with the Infantry as to what moment the successive firing should be executed and what shall be the signal for their commencing. (As an example, a rocket of such-and-such

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a kind fired from such-and-such a place.) One will then determine their method of execution and their intensity.

These mechanisms are not to be improvised during the course of the battle. It is necessary that they should be worked out beforehand and that their execution may be realized automatically without orders from the higher command, and in the absence of all means of communication, because it is to be feared that the higher command will give no orders at the exact time necessary, and because often the greater part of the means of communication will have just failed.

This necessity of having the mechanism of fire all worked out may be applied also to the concentrations of all of the different calibres (the concentrations for counter-preparation or the concentrations during the barrage firing). These concentrations will never function well unless they are foreseen and prepared for in their smallest detail.

All that should be necessary is that a brief order "such-and-such a concentration" should be sent to the grouping or group commanders* in order to have the desired concentration realized immediately.

This is of particular interest for the howitzers which act in general along the whole front of the division.

IMPORTANCE OF THE QUESTION OF AMMUNITION SUPPLY AND OF THE CHOICE OF AMMUNITION

The preceding brings forth the importance of the question of ammunition supply. In accordance with the number of fire days which one has at one's disposal, it is necessary to allow for interdiction fire, counter-preparation fire, barrage fire, reserve

* The word group denotes a flexible and temporary combination of a certain number of batteries under the command of an officer, for the accomplishment of a certain mission.

The number of batteries, and the rank of the officer commanding the group, will vary with circumstances.

The French word "groupe" cannot always be translated by the English word battalion, but in the basic organization of the French artillery regiment the "groupe" corresponds to the American battalion.

A grouping (French groupement) is a combination of a number of groups.

During combat the functions of the "groupment" commander corresponds more nearly to those of the American regimental commander.—EDITOR.

the ammunition necessary to conduct the fight from start to finish, hold out an allowance of reserve ammunition and have ammunition already loaded upon transport and even to place it sometimes upon the positions to which one may have to retire.

The choice of ammunition is no less essential.

It is necessary to give to each battery the shells, charged and fused, which correspond very nearly, or as nearly as possible, to the probable missions which the battery will have to fulfill.

The preparation of each firing and each firing order should include a determination or an indication of the shell, and the fuse appropriate to the occasion, and the battery and group commanders should exercise a particular vigilance in this respect.

In accordance with the ammunition employed the efficiency of fire upon a target may be perhaps very great or negligible.

Let us mention only the importance of firing with time shell (shrapnel or high explosive) and of firing with the instantaneous fuse on personnel in the open. There will, therefore, be a great employment of this class of shell and fuse in interdiction fire and in the fire for effect upon the enemy's formations which are in movement or which simply are not sheltered.

The delay-action fuses also give good results in this case when one is sure of a ricochet, because then the shell bursts at a good height.

To fire upon personnel moving in communication trenches with an instantaneous fuse is nonsensical because the shell fragments pass above the communication trench. In this case it is necessary to call upon the time shrapnel if the fire can be conducted from an enfilading position. If not, take the time shell.

We only give this example to show the primary interest which is involved in the choice of ammunition. Finally, it will be necessary to include in the allowance of ammunition, double allowances of fuses, which will include a judicious percentage of different kinds of fuses.

It is only by this means that the battery commanders may be able to fire their projectiles with fuses which are appropriate

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to the different kinds of fire which they will have to execute. If they are not so equipped they will, at a given moment, be obliged to employ certain makeshifts which do not work and from which will result a deplorable waste of ammunition and an enormous falling off in the efficiency of their fire.

Still further interesting points in relation to position warfare:

(1) *Battery Emplacements*.—Everyone now agrees as to the necessity of maintaining the greater part of artillery in silence. The silence of a battery is its best method of camouflage.

Any battery which has been spotted or which is supposed to have been spotted should be moved.

The security of artillery and in consequence the possibility of its being able to fulfill the missions which are incumbent upon it reside in the fact that it is unknown.

As a corollary to this rule of preserving the battery silent and therefore unsuspected by the enemy, there is a necessity for carrying out to as great extent as possible the employment of roving pieces, roving sections, and roving batteries which look after the daily firing and which take part in the raids.

These mobile elements are placed in almost any emplacements among which may be those which are in very advanced positions and they may usefully occupy old emplacements to which they will give an air of activity. There is no better means of animating a false battery and of giving it the appearance of life.

One of the consequences of this method of action will be to conserve the strength of the artillerymen, and the rest which will be at their disposal will permit them to devote more time to their technical instruction.

On the other hand, the employment of roving batteries will have the effect of maintaining the manœuvring ability of the personnel, particularly of the officers. (As regards reconnaissance, camouflage, the improvement of and occupation of positions, preparation of fire, organization of observation posts, execution of daily missions, firing exercises, etc.)

Officers have found these manœuvres and exercises a very strong attraction.

(2) *Observation Posts*.—There is no need to insist on the capital importance of terrestrial observation. Any observation post which has been spotted should be abandoned the day of the battle. It really is no longer in existence and is only a danger for its occupants. It is necessary to organize with equal care the observation posts which are found in the interior of the position and the advanced observation posts which give a view in the vicinity of the front lines.

It is necessary to foresee the occupation in plenty of time, of one or the other; to foresee their simultaneous or successive utilization and their rational and methodical exploitation, and finally not to forget that an observation post is good for nothing if it is not connected with the groups by most excellent telephone lines.

(3) *Telephone, Wireless Telegraph*.—Attention should be devoted not only to the up-keep of the telephone line, but to the study and choice of its trace and to the proper organization of the installation.

It is necessary to bury the lines, at least in the neighborhood of the centrals and of the command posts, where the wires converge. This should be done well to the rear of the position on account of the great range of the long pieces of the enemy.

The wireless telegraph reënforces the telephone and supplements it when it is damaged.

It permits the sending of requests for information or of firing orders and of all other information. Its employment may be developed by the allowance of a sending set to the different groupings which will permit them to send orders to the groups and by the allowance of an amplifier which will permit of receiving messages from the divisions and from the Infantry.

(4) *Retirement and Reënforcement*.—On this subject the following reflections are submitted:

At first, it will not be known whether the defense will be reënforced or not, or to what extent it may be reënforced.

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It is believed that as a general principle the dispositions which are established, utilizing only the resources of the sector, should remain in force, only having greater power after the reenforcement takes place.

It will often be of great importance not to disorganize the existing organization and to cause the new elements coming into the sector to act in superposition with the ones already there.

Superposition has also the advantage that even if a group is missing the system of fire is not dislocated. Whatever may happen the dividing up of the different missions should be changed as little as possible at the last hour. If not, we risk a diminution of the usefulness of the different units if we do not risk their not being ready at the desired instant.

For the same reasons it is advisable, if possible, not to modify in carrying out the reënforcement, the general organization of the command, under whose orders the arriving elements will simply place themselves.

If the attack is not imminent we may certainly make all the modifications and dispositions that we judge opportune.

Concerning the reënforcing batteries, we should take into account in putting them into position, the advantage, if no other obstacle exists, in placing them as closely as possible to the existing centrals, in order to facilitate the establishment of communication. The same is the case on the retirement positions.

The facility of supply should be equally taken into account. Finally, for the reënforcing positions as well as for the retirement positions, the urgency in the choice of emplacements to be occupied will vary with the number of reënforcing units, with the situation, etc.

Always count on having certain truck transported battalions and reserve for them positions in the neighborhood of the good roads.

(5) *Position for the Grouping Commanders.*—It would appear that in a sector where one should be able to realize reliable telephone communication between the groupings and the groups, there is nothing to oppose the artillery grouping commanders

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being very near the Infantry grouping commanders.

While on this subject do not lose sight of the importance of lateral communication between the different groupings with a view toward the mutual support which they should lend each other spontaneously as much as possible.

II. DEFENSE OF A REINFORCED SECTOR

We now arrive at the examination of a sector organized in view of a battle which is considered as likely to come off very shortly and we shall take the Perthes sector occupied by the 43d Division from June till October last.*

There will be shown the application which has been made during the battle of the 15th of July of the general rules which we have just seen above.

(1) *Organization of the Sector.*—For some time past indications of an attack had been evident on the Champagne front. The second of July information made certain that the attack was to take place, at the latest, on the 9th. The sector was very well organized, and the zone of combat was made up of three positions. The first position, the intermediate position (P. I.), the second position. The first position itself was made up of a series of parallels, the first parallel, the support parallel, the parallel of redoubts; then a "Hinterland" separating the redoubt parallel and the intermediate position.

(2) *Method of Occupation.*—The general commanding the army decided to accept battle on the intermediate position which was to be defended at any price.

The sector was held by two regiments of Infantry and a group of battalions of Chasseurs a Pied; each one occupying a subsector, therefore all together three subsectors.

A plan of retirement was provided for as follows:

From rear to front: First, all the Infantry pulled back on the intermediate position with the exception of the detachments shown below; second, one company per subsector in the centres of resistance of the "Hinterland;" third, small fractions (in

* 1918.—ED.

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principle, one section for each subsector) in the centres of resistance of the parallel of redoubt; fourth, little observation groups detached from these fractions and in the support parallel.

The mission of these small groups was to send out patrols in front of the support parallels during the whole night, particularly to watch the wire entanglements and to gather up all indications of attack, but at the first danger these patrols should retire upon the support parallel.

The groups placed in front of the intermediate position were not allowed to retire. They were required to defend themselves to the end.¹

Their general rôle was (1) to give information about the enemy's advance in order to permit of opening the system of successive firing at an opportune moment; (2) to break up the assaulting waves, to cause them losses, to break up the harmonization of their progress with the movement of the rolling barrage, and finally to direct their progress into certain paths which came under well prepared fire.

(3) *Organization of Artillery*.—The Infantry of each subsector was supported by a group of the 12th Regiment of Field Artillery which organically belonged to the division and the P. C. of the group commander was connected with that of the subsector commander.

Each group commander was, in fact, the artillery commander of the subsector.

The three groups of the 12th Field Artillery Regiment were under the orders of the lieutenant colonel commanding the 12th who had his P. C. near to that of the colonel commanding the Infantry of the division (Translator's note: In a French division there is a divisional Infantry commander as well as a divisional Artillery commander), who commanded all the Infantry of the sector.

Finally, a group of 155-mm. howitzers under the orders of the divisional artillery acted along the whole front of the division (P. C. near that of the divisional artillery).

¹ An exception to this was that the elements from the support parallel could retire on the redoubt parallel after terminating their rôle.

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Here we have completely realized, and in all the echelons, the drawing together of the P. C.'s.

This was an advantage in every way because the telephone system was very well organized.

(4) *Reënforcing Operations*.—The reënforcement was carried out commencing the 4th of July by troops of the 46th Division which occupied the second position, the defense of which was their mission.

The reënforcing artillery consisting of two groups from the 227th Regiment (artillery belonging to the 2d Line Infantry Division), and, in addition, a truck transported group and a group of 155-mm. howitzers. Each of these three reënforcing groups of 75's was attached to a subsector and placed under the orders of the battalion commander of the 12th who commanded the artillery of the subsector. This measure was taken in each subsector without considering the relative rank of the interested battalion commanders; however, there resulted no difficulty of command. In fact, there is every advantage in allowing the command to rest with the officer who knows the sector and who originally belongs to the same large unit as the Infantry which is charged with assuring the defense of the position. However, before the arrival of the reënforcing groups the artillery commanders of the subsectors had already prepared for the new batteries, the reconnaissances of their emplacements, the organization of their observation posts and the folders with the firing data for the positions.

The new arrivals had only to put themselves immediately in touch with the artillery commanders of the subsectors who gave them all the necessary information.

The reënforcing artillery therefore entered easily from the outset into the prescribed dispositions. In a general manner it had missions of simply augmenting the fire of batteries which existed beforehand in the sector.

Under identical conditions the reënforcing group of 155-mm. howitzers was attached to the already existing group.

It is of interest to observe that the two groups of the 227th Regiment (division artillery of the 46th Division) had to be

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placed by order of the army in such a manner as to be able to act in the defense of the second position.

With this reservation one had the possibility of causing them to contribute to the defense of the first position and of the intermediate position. In fact, they could intervene from their emplacements within the interior of the first position in the "Hinterland," commencing at the parallel of redoubts.

(5) *Measures Taken so as Not to Disclose the Reënforcement.*—The order was given and it was rigorously respected that the artillery (as the Infantry) which made the reënforcement, should not disclose itself. Precautions were taken against aerial observation (marches and occupation of positions at night, camouflage, movement on the positions by day forbidden, and finally the batteries were kept absolutely silent up to the moment of attack).

In fact, the reënforcing artillery remained unsuspected by the enemy in its entirety.

The two groups of the 227th Regiment and a battery of 75's, that is to say, seven batteries of 75's, as well as the group of 155-mm. howitzers were installed in new emplacements in the open fields and did not receive a single projectile.

On the contrary the two other batteries of the truck transported group occupied partially constructed emplacements and they were taken under fire, although they did no firing before the attack. The conclusion is very clear. Reënforcing artillery should avoid occupying already constructed emplacements, and it is necessary to resist the attraction of works already constructed.

(6) *The Old Batteries Subjected to a Bombardment.*—As to the batteries of the 12th Regiment, they were subjected to severe handling. What had been the cause of this?

It is that, in the course of the progress of the development of the preparations of the enemy, that is to say, from the 3d or 4th of July on, night interdiction fire was intensified; destruction fire on the new and unprotected or slightly protected enemy batteries, the fire on his ammunition dumps, and trench raids, were taken up every day. All these missions rested solely upon

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the groups from the 12th Field Artillery Regiment. The intermediate position was at certain points 5 kilometres from the German line, and it was necessary to maintain in certain advanced emplacements certain batteries near the intermediate position in order to look out for the possibilities of long-range action.

These diverse reasons led to a keeping of a certain number of batteries in old emplacements which had been spotted by the enemy. These emplacements were very well constructed and one hoped that they would resist the enemy's fire. In order to diminish the risk run several batteries had been either divided up into sections or brought back further to the rear to new emplacements, but the intensive fire demanded of the artillery of the sector would not permit of leaving silent these batteries, and they were spotted as well as those left in the old emplacements.

Let us see, then, at once, what was the effect of the enemy's fire on the three groups of the 12th Regiment. The batteries were subjected to the German preparation fire.

Upon certain ones the fire of gas shells was not made with a sufficient density to oblige the personnel to keep on their masks permanently. In others, this precaution was necessary from start to finish. The inconvenience caused by the wearing of the mask was very great and the service of the guns extremely hard and was only assured by constituting reduced gun crews, the men being alternately serving the guns or resting in gasproof shelters where they could take off their masks and breathe freely.

During this time the losses in personnel and in material were about 9 guns in eight hours, or approximately one piece per hour. Although serious, these losses did not sensibly reduce the combatant value of the different units which punctually executed the missions laid down in the plan of employment.

The dugouts held down, in a very large degree, the efficiency of the enemy's fire which was almost entirely executed with instantaneous fuses.

A second cause of the relatively low efficiency of the enemy's

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fire was the exaggerated extent of the zone fired upon by him and the low density of fire which resulted from this.

What conclusions are to be drawn, however, from the preceding?

It is necessary to make such arrangements, at least for the greater majority of the batteries, that the old batteries shall not be any more disclosed than the reënforcing batteries.

It is believed that following this train of ideas it is necessary to accomplish the impossible in spite of very considerable difficulties, when this part of the artillery is obliged to be very active and when the time of waiting stretches out, as occurred during the month of July.

Systems of Firing—Interdiction.—The interdiction fire covered a zone situated at about 1200 metres from the German lines and which included a large number of batteries.

Counter-preparation and Barrage Fire Before the Opening of the Attack.—Counter-preparation No. 1, that is, where the Infantry elements placed before the support parallel had not yet retired, was made on the German first lines and in rear of them.

Counter-preparation No. 2, that is, where the advanced element have retired on the support parallel, the short limit of the preparation is then brought back within our lines to about 300 metres from the support parallel.

During this counter-preparation No. 2, fire is placed at the beginning on the objectives which are farthest away, particularly when the enemy fires on our most advanced parallels; this fire, on the contrary, is intensified on the nearest points of our support parallel, especially when the attack is about to commence (in particular, when the enemy has raised his fire for the purpose of permitting his Infantry to approach our wire entanglements and perhaps even to penetrate them).

Counter-preparation No. 1 is transformed automatically into counter-preparation No. 2 after ten minutes of firing. The opening of counter-preparation No. 1 serves as a means of notification for the Infantry elements which may not yet have

retired to the support parallel. (This provision being inserted in the orders for the advanced elements.)

Barrage No. 1 and barrage No. 2 correspond to this counter-preparation. The counter-preparation and barrage No. 1 make up disposition No. 1 and the counter-preparation and barrage No. 2 make up disposition No. 2.

Fire During the Course of Attack.—The manœuvre prescribed by the army had as an immediate result the leaving in front of the position of resistance of a field of fire for the artillery within which it had as its mission to destroy the dispositions of the enemy for assault, dispositions which had a certain depth.

The fire to be executed was then a fire for effect on certain determined zones starting out from the jumping-off line and coming closer and closer, but their fundamental characteristic is that they should continue during all the time which the enemy was moving within the field of fire defined above, without any limit other than the wear on the material.

There were, therefore, as regards depth, three firings on successive zones, each one of which made up a disposition. Disposition No. 3 between the support parallel and the redoubt parallel, disposition No. 4 between the redoubt parallel and the "Hinterland," and disposition No. 5 between the "Hinterland" and the intermediate position. There was provided a system of signals which had for its object the indicating during their progress, of the advance of the enemy's formations, and of permitting of determination of what should be the successive lines of departure for the firing on the different zones.

Opening of the Attack.—The opening of the attack is announced by a request for barrage made by the Infantry. In principal, this signal is made with rockets (the type of rocket with three stars) sent up by the observation groups in the support parallel and repeated by relay from the redoubt parallel and the "Hinterland" to the battalion P. C. on the intermediate position. One immediately applies disposition No. 3, which includes fire for effect on a certain zone, the short limits of which are about 300 metres beyond the line of redoubts.

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Fire for the Defense of the "Hinterland."—When the first position is carried, even though only partially, the artillery in the same manner takes up its dispositions for the defense of the "Hinterland" or disposition No. 4, which includes firing in front of each island of resistance and certain firings in the intervals between them.

The signal is given by flag rocket sent up from the P. C. of the company in the "Hinterland" and repeated to the battalion P. C. at the intermediate position.

Fire for the Defense of the Intermediate Position.—When the intermediate position is attacked the Infantry which occupies it calls for fire by means of a yellow smoke bomb. Rockets are sent up along the whole extent of the front which is attacked, the signal being repeated to the battalion commanders P. C.

The artillery then takes up disposition No. 5 which includes zone fire for effect, the short limit of which is about 200 metres in front of the intermediate position.

This fire is not placed on the islands of resistance in the "Hinterland," if they are not in the hands of the enemy or if there is not sufficient evidence to suppose that they have fallen.

General Remarks on the Execution of Fire.—This firing was carried out in principle in each subsector by successive concentrations on a series of trenches. These concentrations were classified according to their urgency, and they were repeated in accordance with the duration of each particular phase of the combat.²

The howitzers acted in a similar manner on the zones for which their action was justified, that is, the zones of dugouts, assembly zones, assembly trenches, etc.³

In general, the firing was brief and violent. This type of fire breaks up formations more surely than slow and uniform fire. It keeps the assailant continually under threat and it permits of increasing the duration of the intervals of rest during

² They were named in accordance with names taken from the ground or from the battle maps in order to make more easy their designation; for example, "Togoland barrage" or "Partridge barrage."

³ The heavy howitzer concentrations were named in the same way; for example, the "La Goutte concentrations" and the "La Pic concentrations."

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which one may take care of the material and allow the personnel to draw breath, a thing which is above all important for batteries which are under the enemy's fire. Effect against personnel in the open is always to be sought after the opening of the attack and to be executed with time bursts or with instantaneous fuses.

The firing for the defense of the intermediate position should be particularly violent and sustained.

Independently of the rockets sent up by the Infantry, the Infantry should, during each phase of combat, confirm its request for barrage, by telephone, visual signals, by ground telephone, or by wireless telegraphy.

Besides, if it is possible the airplanes should send up the prescribed rocket. Finally, the organization of the terrestrial observation and of the liaison detachments with the Infantry was carried out with care in such a manner as to be able to follow with all preparation possible the march of the enemy, particularly at the moment when he was on the point of crossing the line of the "Hinterland" and later the intermediate position.

A small amount of liaison personnel was even attached to the companies in the "Hinterland."

All the methods of liaison were made use of in order that the full exploitation of information should permit of the group and grouping commanders to modify their rigid mechanisms of fire.

The subsector artillery commanders and the divisional light artillery commander were required to report frequently the state of the situation to the divisional artillery commander. In order that the firing of the heavy howitzer and the long heavy artillery should be usefully applied to the enemy's troops which were signalled.

Execution of the German Attack.—After a period of complete inactivity on the part of the enemy, the preparation for the attack opened with violence on the 15th of July at 12.10 A.M.

A trench raid which was carried out on the 14th at 8 o'clock in a neighboring corps had given reliable information showing that the attack would take place on the morning of the 15th.

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From 11 o'clock on the French artillery carried out general interdiction fire.

At midnight counter-preparation fire No. 2. From one o'clock on the counter-preparation fire was progressively intensified in the zones which were nearest our lines without at any time abandoning the fire in depth.

About 4 o'clock the attack opened.

As was the case during the counter-preparation, all our fire was executed in accordance with the provisions of the plan of employment.

The attacking waves being once broken up the enemy was obliged to travel by means of communication trenches, and a grand attack which is reduced to this manner of progression is broken up.

About 6 o'clock our barrage was put down in front of the "Hinterland," and about 6.30 in front of the intermediate position.

Certain elements infiltrated at certain points of the intermediate position, notably into the village of Perthes, where they penetrated even among the batteries.

These elements isolated by a box barrage were reduced by our counter-attacks.

At noon the situation was reestablished throughout in the intermediate position and during the following days we occupied, by actions of detail, a part of the terrain which had been abandoned.

The Working of the Different Means of Liaison.—All the communications between the divisional artillery, the artillery and Infantry grouping commanders, and the group commanders, as well as with the observation posts, functioned without interruption, the lines being very well installed and for the most part buried.

From the beginning of the preparation the lines from the group P. C.'s to the advanced batteries were very rapidly cut, even those established in shallow trenches.⁴

⁴ From which arises the necessity of establishing the interior means of communication between groups with great care, if one wishes to give to the general system its full usefulness.

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Under these circumstances, the batteries could not act otherwise than they did. That was, to execute the prepared firings and to open them at the opportune moment by some simple mechanism, on seeing a rocket or on the reception of an order sent by a runner, for example, barrage number so-and-so.

The reënforcing batteries as well as all the howitzer batteries had their permanent telephone communication.

From 7 o'clock in the morning on, the telephone communications were established throughout which permitted of exactly regulating the action of the artillery in accordance with the situation at each moment.

It is in this manner that a great many concentration firings of the corps artillery, of the heavy howitzers, and even of the heavy guns were executed, either on the demand of the Infantry on certain points which were particularly menaced, or on certain objectives (tanks, batteries, columns of Infantry) indicated by terrestrial or aerial observatories; for example, at 8.30 A.M.—a box barrage at the north of Perthes; 9.00 A.M.—a concentration on the village of Perthes in preparation for our counter-attack.

In general the rockets were very well seen. The flag rockets sent up by the companies in the "Hinterland" were not very visible. The request for barrage made by these companies by ground telephone came immediately to the subsector artillery commanders who were located beside the subsector commanders.

Influence of the Systems of Fire Prepared in Advance, on the Outcome of the Attack.—The excellent organization of the Champagne front, well fortified and provided with numerous routes of communication and an excellent telephone system, considerably facilitated the defense.

One of the causes (the most important one, surely) of the success of this defense was the sudden manifestation of our reenforcing artillery, and the organization of the successive systems of fire in harmony with the Infantry dispositions.

These systems of fire were, thanks to the signals agreed on, to be opened, as one has seen, in accordance with the enemy's progress and on the interior of our lines.

The batteries were able to prepare in advance their fire on

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the objectives, which were assigned to them, in such a manner that by a simple word "disposition No. so-and-so," or "concentration No. so-and-so" the chief of piece could automatically execute the fire prepared in advance in all its details: range, method fire, etc.

In the same way there is an advantage in retaining the counter-preparation organization of heavy artillery, as much so in advance of the first position as in the interior of the French lines.

Concentrations for all the heavy batteries of the division having been prepared for each zone of assembly or each probable zone of travel or progress of the enemy, it was possible during the whole combat, as soon as information from a terrestrial or aerial observation post indicating an important objective was received to open instantly a heavy concentrated fire by a simple command, each battery executing a fire which had been prepared in advance in all its details and without which it would have been obliged to get up, in the middle of an action, laborious preparations for firing.

This organization of the counter-preparation appeared to be particularly flexible and to have permitted of the realization of a very great mobility for the heavy artillery.

The howitzer grouping which worked in the zone of the division and which was in close communication with the divisional artillery and the divisional howitzer grouping could, upon a direct request, take part in these concentrations.

Ammunition Supply and Efforts Demanded of the Material.—The supply of the pieces was, on the average, three fire days (about three and one-half for the groups of the 12th Regiment and about two and one-half days for the others).

The rates of fire laid down in the plan of employment and which were actually carried out in the firing executed during the enemy's preparation (which lasted four hours) led to an expenditure of one hundred rounds per piece and per hour for the 75's, and 45 to 50 rounds for the 155's, that is, a little bit more than a day of fire.

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The firing during the course of attack used up one and one-half to two days of fire.

For the nine field batteries belonging organically to the division which were by a great deal those which fired the most,⁵ the expenditure was in the neighborhood of 30,000 rounds for an average of 30 guns which they had at their disposal. That is, about one thousand rounds per piece in twelve hours (a little more than three fire days), from the 14th of July at 9 P.M. to the 15th of July at 9 A.M.

Generally speaking, the material stood up well. However, some pieces at the end of the day returned in battery a little too quickly, and therefore the above expenditures of ammunition should be considered as the maximum, which it would be dangerous to overstep.

If the German preparation had been sensibly prolonged, the situation in ammunition supply might have become critical, above all, if by a stronger interdiction on the roads and paths in the rear, the enemy had prevented its resupply.

In any case, the density of the bombardment in the zone of the advanced batteries, while the preparation was at its height, should have prevented all circulation of wagons in the vicinity of these batteries, and resupply was impossible until after 7 o'clock in the morning.

It is necessary, then, if possible, to augment the supply of the pieces; however, it would be prudent in circumstances similar to those of the 15th of July to be more economical in interdiction and in the counter-preparation before the opening of the attack (firing, the efficiency of which is sometimes a little uncertain) and to reserve the necessary ammunition to execute well sustained and efficient fire, commencing upon the opening of the attack, against the enemy on the move and in consequence very vulnerable.

Trench Artillery.—There was in the sector a battery of 58-millimetre trench artillery (12 pieces furnished each one with

⁵ In particular the two groups of the 227th Regiment did not fire during the preparation nor at the beginning of the enemies' movement, being out of range.

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one hundred rounds) which rendered excellent service in the defense of the intermediate position.

The majority of the pieces were placed in such a manner as to sweep a slope in front of the intermediate position in the region of Trou Bricot. This slope which masked the movement and the grouping of the assaulting elements could only be swept with difficulty even by the 155 howitzers. The fire of the trench artillery caused the enemy serious losses.

Anti-tank Guns.—There were three pieces in the groups in the "Hinterland" and five in the intermediate position.

The first rendered very little service and were captured without profit.

The others had numerous occasions to be employed (some very happy firing against tanks, but, above all, efficient firing against the enemy's infantry).

How Would the Defense and the Different Firing Systems Have Functioned if We Had Not Been Notified of the Imminence of the Attack?—One may object: "Everything went well because one was forewarned, which permitted the general in command of the army to prescribe a special retirement disposition for the Infantry."

But if one had not taken this retirement disposition how would the firing systems have functioned?

Just as well, because this case was foreseen in the plans of defense of the division and the employment of the artillery.

There would have been then in each subsector two battalions on the intermediate position, one battalion before the intermediate position. This latter subdivided in one company in the centres of resistance of the "Hinterland," two companies in the parallels of redoubts and the support parallel. Nobody in front of the support parallel. Each unit to resist on the spot and the firing could have been executed as in the case where the retirement was carried out. The only differences were as follows:

1. Disposition No. 3 would have been suppressed on account of the proximity of the support and redoubt parallels and one would have passed from disposition No. 1 to disposition No. 4.

2. It would have been necessary for the defense of the

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"Hinterland" to avoid firing on the organizations on the first position where little islands of French Infantry would have found it possible to maintain themselves. One could cover them with fire when one knew or when one was sufficiently informed that they had fallen.

Defense again here rests on the harmonizing of the artillery systems of fire with the disposition of fire and the mode of defense of our Infantry.

III. LESSONS PROPER TO MOVING WARFARE

The 43d Division took part in the retreat from Aisne from the 28th of May to the 5th of last June.*

In spite of the considerable extent of the front confided to that division and to the frequent absence of liaison with the corps on the right and on the left, the retreat was always well organized and the division fought foot by foot with all its forces—Infantry and Artillery.

(a) Choice of Battery Positions—Importance of Observation Posts.—That which it is necessary to hunt for above everything else in the choice of battery position is *proximity to an observation post*.

The resources of the batteries in telephone personnel and in telephone cable do not permit of constructing or keeping up long lines, and one should not hesitate to sacrifice the defilade of the batteries in order to get nearer to the P. C. Inasmuch as it is indispensable, in a war of position, to conceal the artillery, just so much in the period of movement one may show one's self very audacious; and if the situation stabilizes nothing prevents one, as a consequence, from increasing the security of the battery by getting farther away from the crest.

The value of the artillery is based upon the observation posts which it has at its disposal, and this consideration is capital in the determination by the higher command of the successive lines of resistance which it fixes for the Infantry. The idea would be that the artillery should see the neighborhood of the first French lines and, above all, the ground in front of it.

* 1918.

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Every time that this condition has been realized the enemy's attacks have not been able to break forth.* On the contrary, the German advance is almost always secured by the infiltration of elements which profit by cover and by zones hidden from view.

(b) *Necessity of Echelonning in Depth.*—Echelonning in depth is indispensable: in order to permit eventually of the retirement of the Infantry under the protection of batteries in rear and to assure the continuity of support of the Infantry in case of retirement.

This echelonning necessitated minute organization of the information service, in order that the battery in rear may utilize the observation posts of the advanced batteries. In addition, the rear batteries should be close to observation posts giving a good view of the ground in the interior of the French lines, where they will eventually have to act.

It is believed that the echelonning should be done within the group. The group commander is the only one in a position to know exactly the moment to pull out a battery, and it is necessary that he should, on this point, have a great deal of initiative. It is easy enough to pull out a single battery, but it is very difficult to execute the same manœuvre with an entire group. The movement by echelon of the group should be prepared in advance and the reconnaissance in plenty of time, of a succession of positions to be occupied, has a considerable importance. One should always be one position ahead of the game.

In order that reconnaissance may be made without risking false manœuvres, it is necessary that the group commander be informed in time by the higher command as to what neighborhood the reconnaissance should take place in, the direction of the retirement, and the successive lines to be occupied by the Infantry.

(c) *Employment of the Advanced Elements of the Artillery.*—It is of considerable advantage to place certain well supplied elements, batteries, sections or pieces far in advance in

* The value the French put on observation is to be noted. At times this value has appeared to be somewhat lost sight of.

the immediate neighborhood of good observation posts from which the fire may be easily directed on the numerous objectives which present themselves.

The employment of such advanced elements has permitted, on several occasions, in the course of the battle from the 26th of May till the 5th of June, of causing the enemy important losses and of throwing out of gear the menacing progress of the enemy (among others, the 31st of May, the fire of one piece of the second battery of the 12th Field Artillery Regiment permitted the 2nd group of the 12th to be pulled out at Grisolles, and the fire of the 5th battery of the 12th Field Artillery Regiment placed in the edge of the Bonnes broke up the attack of the enemy).

(d) The Artillery Should Scout Out and Organize the Close Defense of the Positions.—By reason of the mobility of the Infantry line, it is necessary that the batteries, particularly the advanced batteries, should assure their security by means of some Cavalry scouts, above all, on their flanks and in the covered regions where the enemy may infiltrate.

In the same way, it is necessary that the close defense of the battery positions should be organized by utilizing the machine guns with which the artillery is now supplied, particularly when a battery finds it impossible to withdraw its guns, it is necessary that the personnel of the batteries shall resist on the spot until the last moment, utilize the carbines and the machine guns, and transform the position into a centre of resistance on which the Infantry may support itself.

(e) The Manœuvring Difficulties of the Truck-Transported Seventy-five Groups.—The battalions of truck-transported 75's were bothered during their manœuvring by the subjection which the tractors imposed; breakdowns, difficulties in turning around, and blocking of roads, etc.

Besides, these groups did not have a single horseman at their disposal in establishing communications with the Infantry and in scouting.

These difficulties have often led the commanding officers of

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the 75 truck-transported groups to place their batteries at a great distance from the first line, and the efficiency of these batteries has been found on this account to be greatly diminished, above all, by the difficulty of communication and of observation which result from placing these batteries so far away.

For these reasons, perhaps it would be worth more in similar circumstances to those of the retreat from the Aisne to constitute mixed groups (75 horse-drawn and 75 truck) rather than to have homogeneous groups.

(f) *The Advantage of Attaching Groups of Heavy Howitzers to the Corps Groups.*—The third day of the attack, groups of howitzers were attached to the groups of corps artillery. Thanks to this method of procedure they were given information more rapidly about the situation, their security was better assured, and they were able to intervene more efficiently in the combat. This solution, moreover, looks after the possibility of concentration of fire by the support of one grouping by another, which may be effected by order of the divisional artillery.

(g) *Communication of the Long Heavy Artillery With the Divisional Artillery.*—It is indispensable that the long heavy artillery groups of the army corps should be in direct and close liaison with the divisional artillery. This was attained and permitted these groups to intervene very easily on several occasions.

(h) *Objectives and Execution of Fire.*—The large part of the objectives being in the open and dispersed, fire with shrapnel or with time shell should be employed to a maximum.

The objectives are: All the routes, all the concentration zones, such as woods, assembly places, and jumping-off trenches for the attack, all visible formations and especially the little machine-gun groups, etc.

Every time an objective is announced by a terrestrial observer or an aerial observer, destruction fire should be executed throughout the depth of this objective.

In particular, the attack of the enemy should be broken up by firing in depth on these objectives.

Night interdiction as well as day interdiction should have considerable importance.

(i) *The Position of the Grouping Commander.*—The bringing into the same neighborhood of the P. C.'s of Infantry and Artillery which was the general rule, rendered the communication more intimate, but it has often carried with it considerable difficulty of transmission of orders to the groups. If the Infantry commander is led to absent himself too far from the battery zones, it is better to agree for the moment to separate the two P. C.'s, but it is necessary then to reënforce by all the means of communication possible, the communication between the Infantry and the Artillery, that is, by a horseman, by telephone, etc.

In a general manner, however, liaison should be established, above all, by the assignment of well-defined instructions, leaving a wide scope to the initiative of those who are to execute them. It is necessary, also, that the chief of artillery should understand the situation well and also the situation of his neighbors and the mission of the Infantry which he supports.

(j) *Liaison.*—It has functioned very well, and thanks to it the combat of the division was enabled to be carried on from start to finish and the cohesion of its units maintained up to the end in spite of the most difficult situations. The telephone, too, rendered the greatest service.

After the telephone communication, in the order of usefulness, comes the wireless telegraph. The telephone with one or several axes of liaison functioned, one may say, all the time. Its installation and the maintaining of its working are a question of will.

It is necessary, on the other hand, that one should have material in sufficient quantity and the supply to the different echelons should be calculated in consequence, and the resupply in wire and instruments prepared carefully and abundantly.

The importance of this resupply is of the same character as the resupply of munitions.

A Successful Experiment in Submerging A Gasoline Motor

BY CAPTAIN LEVIN H. CAMPBELL, JR.

(Chief, Caterpillar Mount Section, Artillery Division, Ordnance Dept.)

ONE of the objections which is advanced by all informed officers in regard to the motorization of artillery, is the fact that it is not possible for a tractor or a self-propelled gun mount to ford streams which may be forded by horse-drawn vehicles. The effect of water entering the carburetor or short circuiting the ignition system is the factor which limits the capability of tractors or self-propelled gun mounts to ford streams. If, of course, the carburetor and the ignition system be raised, the depth of water through which the tractor may pass is increased by the amount these elements are elevated. For some time the design of a water-tight motor has been considered and, so far as is known, no serious obstacles have been met with.

In order to test the feasibility of running a motor under load submerged in water, the Artillery Division of the Ordnance Department initiated steps to have the motor in the self-propelled caterpillar mount, Mark VII, for the 75-mm. gun, Model 1916, waterproofed. It should, of course, be understood that the waterproofing of this motor is entirely an improvisation, as the motor used is the standard Cadillac eight-cylinder motor, such as is found in pleasure cars bearing that name.

The success of this experiment is largely due to the efforts of Captain L. A. Miller, of the Ordnance Department, and Mr. E. W. Barnhart, of the Holt Manufacturing Company, who are both stationed at the Aberdeen Proving Ground, Maryland.

No claim for originality, either in the conception of the idea of waterproofing the motor or in the mechanical execution of the problem is made; but, so far as is known to the writer,

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this is the first instance in the history of the gasoline motor of a motor running under load completely submerged. Especial note should be made of the fact that this tractor was run a distance of about three miles, so that the motor and exhaust manifolds were thoroughly heated. The tractor was then immediately run into water which was below the freezing temperature of 32° F. In fact, this water was so cold that the gasoline in the carburetor was frozen. In spite of the heated condition of the motor, the exhaust manifolds and other hot parts of the engine were not injured in any way.

It thus appears that the depth of water through which a tractor or self-propelled gun mount may pass is limited only by the height to which we bring the stand pipe for the air intake to the carburetor.

The Proof Officer's report follows:

ABERDEEN PROVING GROUND, MD.,

March 9, 1920.

THIRD PROGRESS REPORT IN CONNECTION WITH ORDNANCE PROGRAM NO. 4016—TEST OF S. P. CATERPILLAR MOUNT, MARK VII, FOR 75-MM. FIELD GUN, MODEL 1916, MOUNT NO. 2

ORDNANCE PROGRAM NO. 4016

Dates of Test: January 1, 1920—March 8, 1920.

Material Received: June 17, 1920.

1. *Authority for Test:* O. O. 451.221/438, O. O. 451.22/36.
2. *Object of Test:* To test the convenience and action of firing of the S. P. Caterpillar Mount, Mark VII, and also its ability to travel on and off the road, noting its speed and stability, particularly the obstacles and difficult places over which the tractor may safely pass.

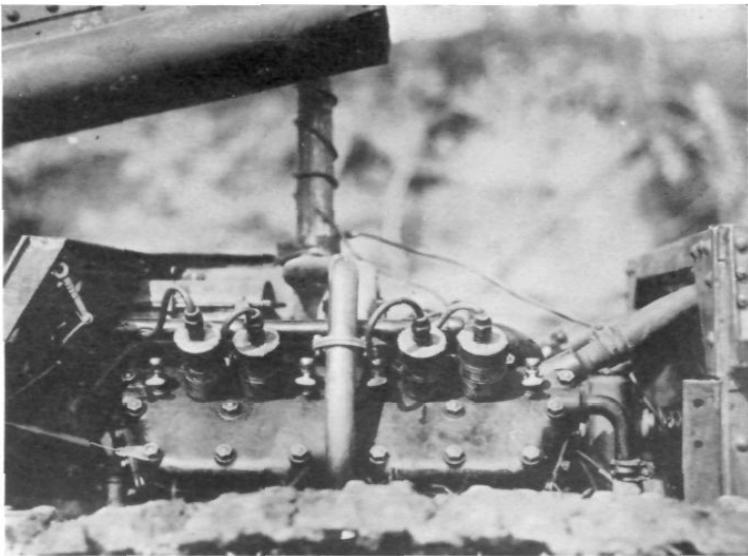
On or about December 1, 1919, instructions were received from the Ordnance Office to place mount No. 2 in running condition and to attempt to develop a waterproof motor, so that the mount might run when the engine was entirely submerged.

PLATE No. 1



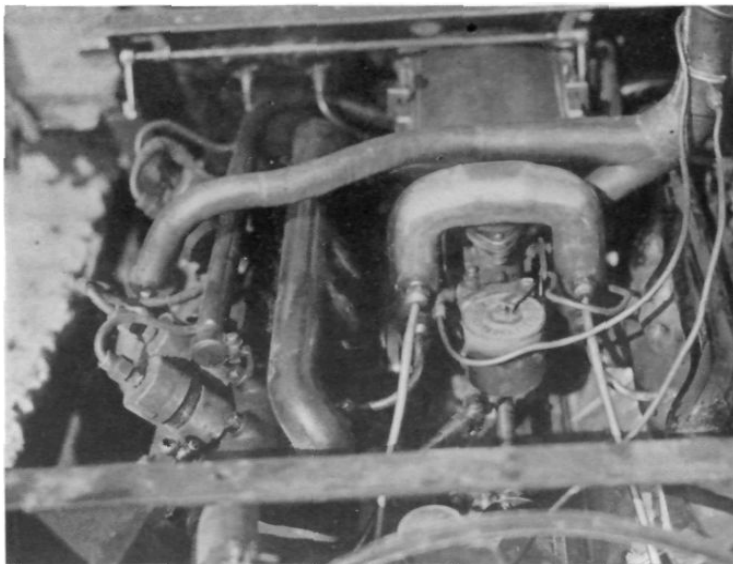
THIS PHOTOGRAPH IS A "CLOSE UP" OF THE LEFT SIDE OF THE MOTOR. THE FOLLOWING ARE SHOWN; THE WATERPROOF BOX FOR THE MAGNETO; THE WATERPROOF COVERING FOR THE SPARK PLUGS; THE WATERPROOF ELECTRIC CABLE; THE COPPER PIPES LEADING FROM THE CRANK CASE BREATHERS TO THE STAND PIPE; THE COPPER TUBE FOR THE CARBURETOR AUXILIARY AIR AND THE COPPER TUBE FOR THE INTAKE OF THE GASOLINE PRESSURE PUMP.

PLATE NO. 2



THIS PHOTOGRAPH IS A "CLOSE UP" OF THE RIGHT SIDE OF THE MOTOR. THE FOLLOWING ARE SHOWN; THE WATERPROOF BOX FOR THE MAGNETO; THE WATERPROOF COVERING FOR THE SPARK PLUG; THE WATERPROOF ELECTRIC CABLE; THE COPPER PIPES LEADING FROM THE CRANK CASE BREATHERS TO THE STAND PIPE; THE COPPER TUBE FOR THE CARBURETOR AUXILIARY AIR AND THE COPPER TUBE FOR THE INTAKE OF THE GASOLINE PRESSURE PUMP.

PLATE No. 3



THIS PHOTOGRAPH IS A "CLOSE UP" TAKEN FROM THE FRONT OF THE MOTOR. THE FOLLOWING ARE SHOWN: THE CARBURETOR; THE COPPER PIPE LEADING FROM THE AIR INTAKE OF THE CARBURETOR TO THE STAND PIPE; THE COPPER TUBE LEADING FROM THE AUXILLARY INTAKE OF THE CARBURETOR TO THE STAND PIPE; THE COPPER TUBE LEADING FROM THE STAND PIPE TO THE GASOLINE PRESSURE PUMP AND THE WATER-TIGHT BOX COVERING THE MAGNETO.

PLATE No. 4.



THIS PHOTOGRAPH TAKEN FROM THE SHORE, SHOWS THE MOUNT RUNNING WITH THE MOTOR COMPLETELY SUBMERGED. THE MOUNT HAS JUST STARTED TO BACK TOWARD THE SHORE, ICE CAN BE SEEN IN THE DISTANCE.

PLATE No. 5



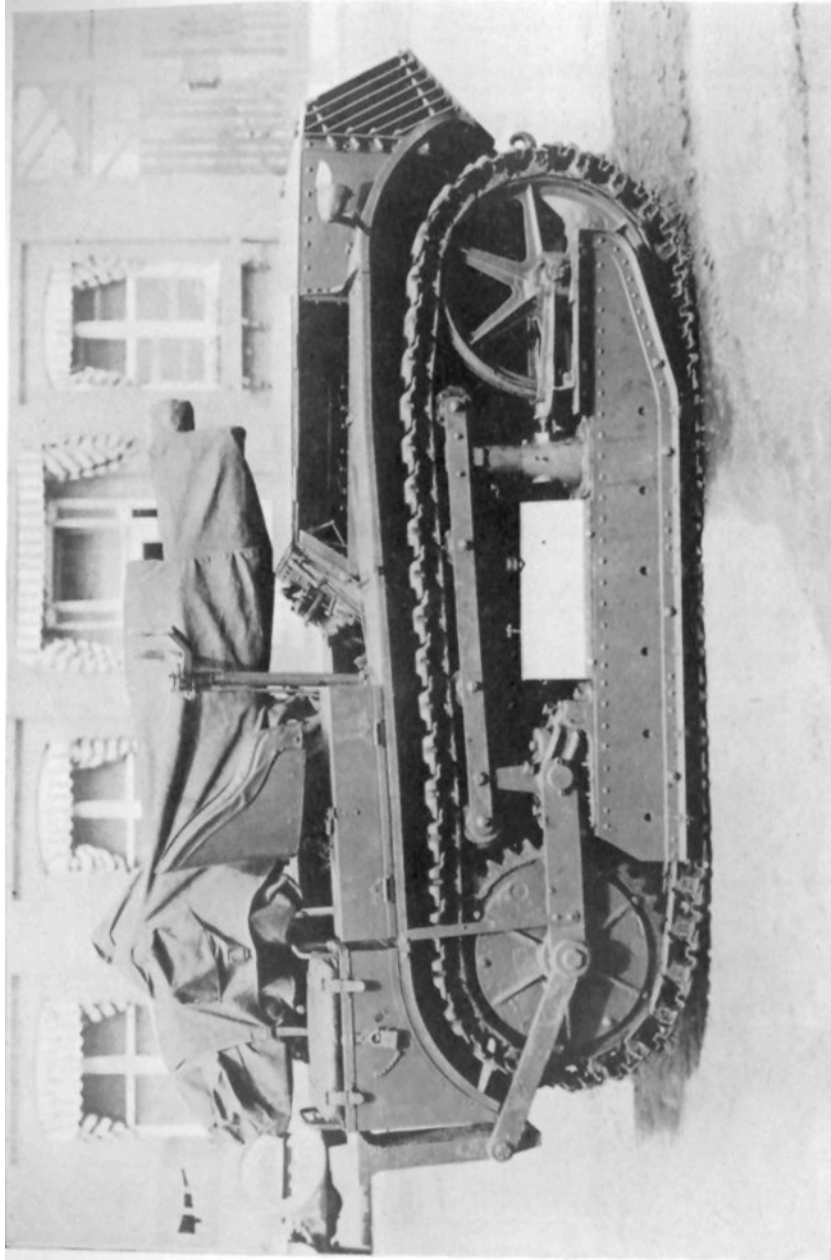
THIS PHOTOGRAPH TAKEN FROM A BOAT SHOWS THE MOTOR RUNNING WHEN ABOUT THREE-QUARTERS SUBMERGED.

PLATE No. 6



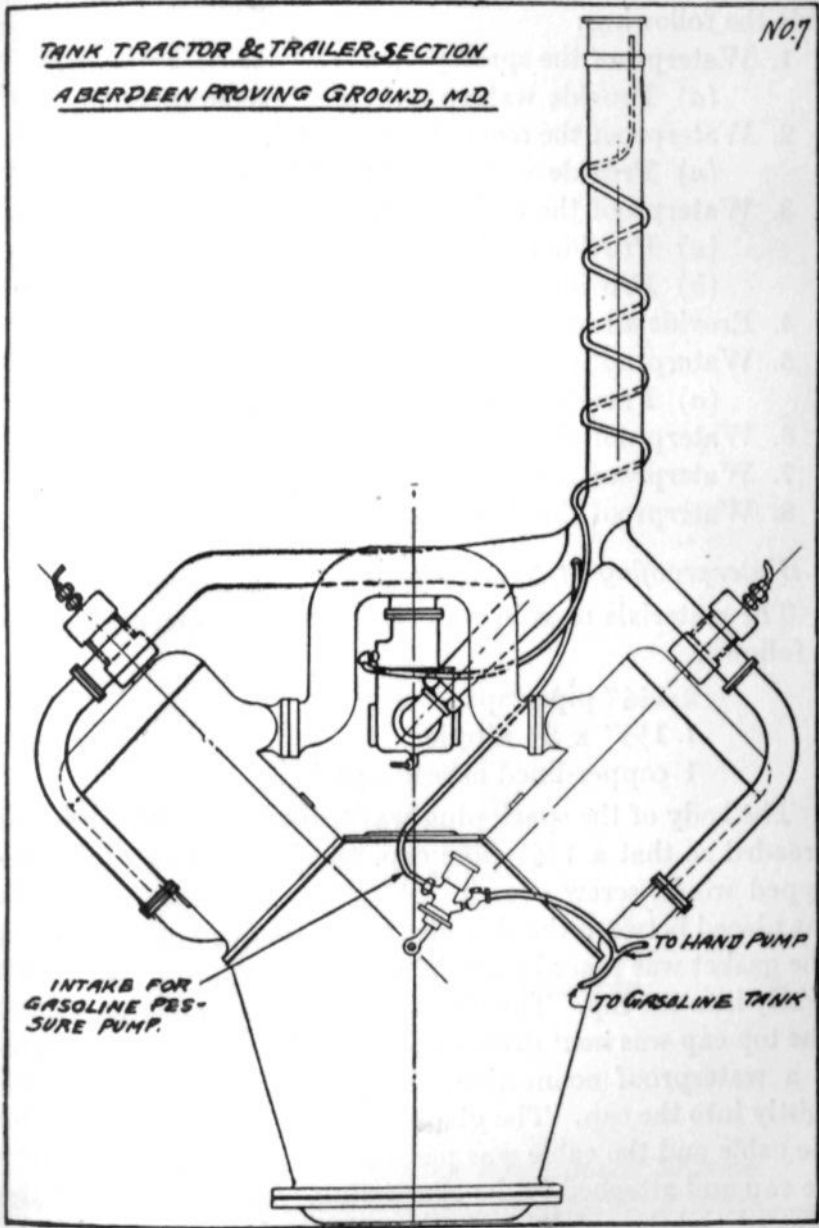
THIS PHOTOGRAPH IS A "CLOSE UP" TAKEN FROM A BOAT SHOWING THE MOUNT RUNNING WITH THE MOTOR COMPLETELY SUBMERGED.

PLATE No. 6½



S. P. CATERPILLAR MARK VII FOR 75-MM. GUN

SUBMERGING A GASOLINE MOTOR



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In order to waterproof the Cadillac motor it was necessary to do the following:

1. Waterproof the spark plugs.
 - (a) Provide waterproof electric cables.
2. Waterproof the magneto and distributor.
 - (a) Provide waterproof electric cables.
3. Waterproof the carburetor.
 - (a) Provide auxiliary air pipe for carburetor.
 - (b) Provide air pipe for intake carburetor.
4. Provide air intake for gasoline pressure pump.
5. Waterproof the crank case.
 - (a) Provide air pipe for crank case breathers.
6. Waterproof the exhaust.
7. Waterproof the valve hand hole plates.
8. Waterproof the clutch case.

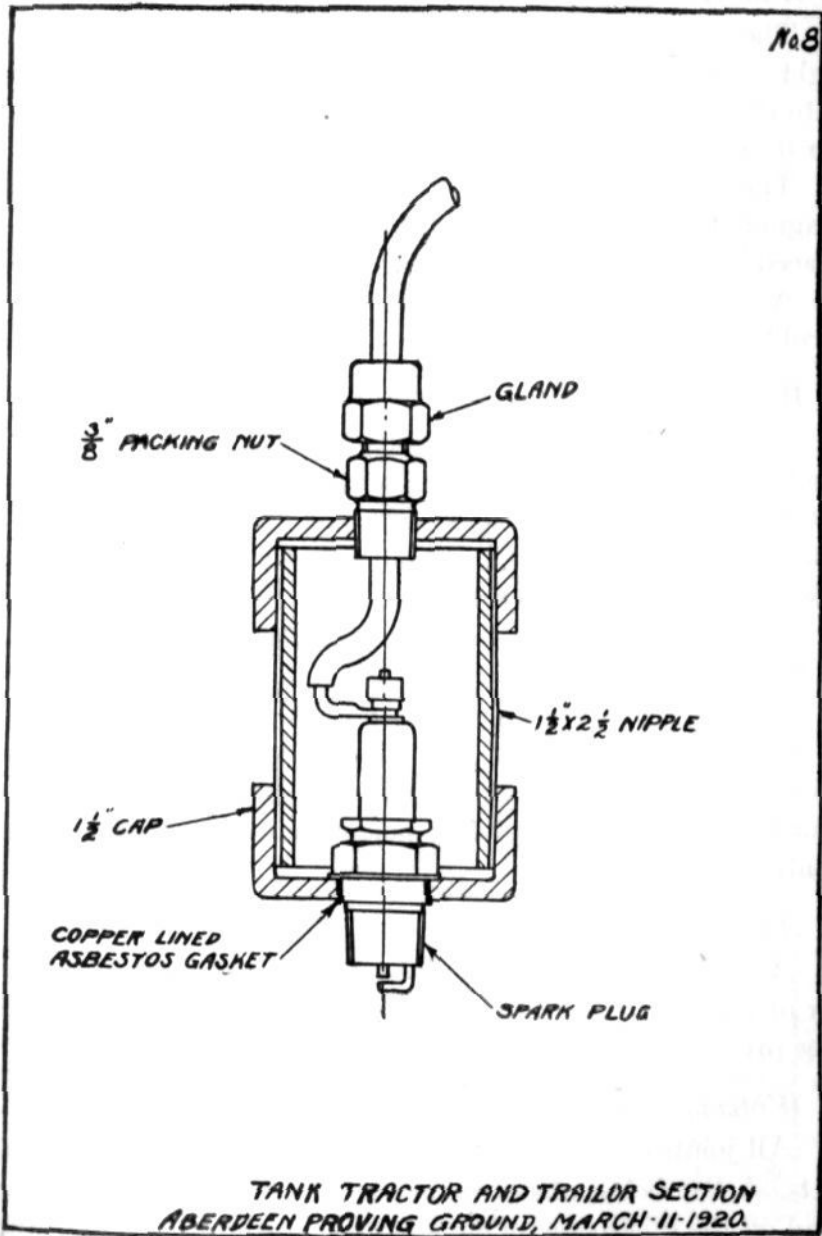
1. *Waterproofing of Spark Plugs:*

The materials used in waterproofing each spark plug were as follows:

- 2 1½" pipe caps
- 1 1½" × 2" nipple
- 1 copper-lined asbestos gasket

The body of the spark plug was turned down in a lathe and threaded so that a 1½" pipe cap, which had been drilled and tapped would screw over it. A copper-lined asbestos gasket was placed between the shoulder of the spark plug and the cap. The gasket was placed over the plug and the plug was screwed tightly into the cap. The nipple was next screwed into the cap. The top cap was next drilled and tapped for a ⅜" packing nut of a waterproof connection, the packing nut being screwed tightly into the cap. The gland was next slipped over the electric cable and the cable was passed through the packing nut of the cap and attached to the spark plug. The top cap was then screwed tightly onto the nipple. White lead was used on all threads. The gland was packed with lampwicking and white lead and screwed tightly into the packing nut.

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2. *Waterproofing of Magneto:*

The magneto was covered with a specially designed watertight copper box. A packing gland was provided for the magneto drive shaft and small brass packing glands were provided for the cables which lead to the distributor.

This water-tight copper box was attached to the aluminum magneto bracket by means of cap screws, a rubber gasket being placed between the bracket and the box.

A cover was made for the box which was clamped down on a rubber gasket by four wing nuts.

3. *Waterproofing of Carburetor:*

A French carburetor was used for this test instead of the Cadillac carburetor. A copper air pipe was run from the air intake of the carburetor to a large vertical copper stand pipe, which was designed to stand about 2 feet above the water level when the motor was submerged.

A small copper tube was run from the auxiliary air intake of the carburetor and attached to the stand pipe.

A cap and gasket were provided for the float plunger.

One of the bearings of the butterfly valve shaft was sealed with brass, while the other bearing was provided with a gasket and washer, the washer being held against the gasket by the control lever.

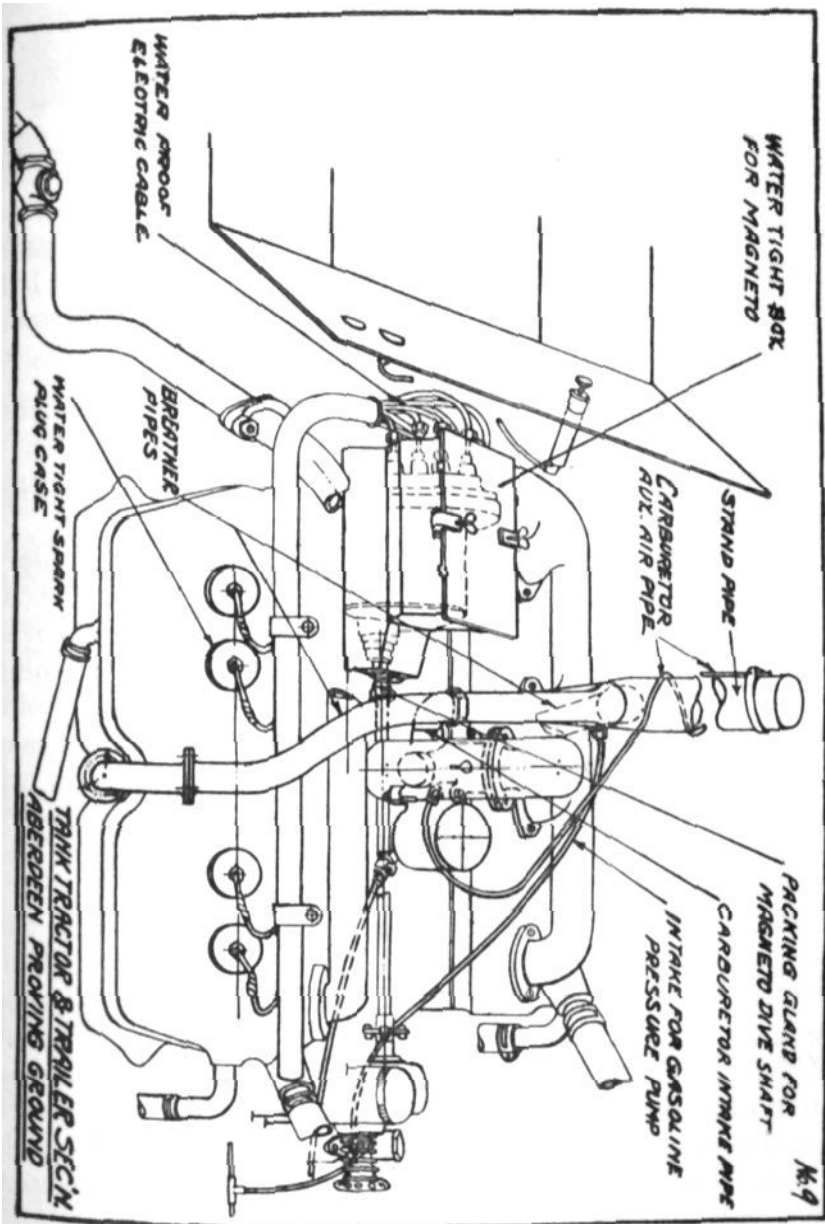
4. *Air Intake for Gasoline Pressure Pump:*

A small copper tube, similar to the one used for the auxiliary air of the carburetor, was run from the air intake of the gasoline pressure pump and was attached to the stand pipe.

5. *Waterproofing of Crank Case:*

All joints of the crank case were provided with rubber gaskets, shellac being placed on one side of the gasket and white lead on the other side. One and one-fourth inch copper pipes were run from the crank case breathers to the main stand pipe. All joints were provided with water-tight gaskets.

SUBMERGING A GASOLINE MOTOR



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6. *Waterproofing of Exhaust:*

Two 2" check valves were placed in the exhaust pipes about 4 feet from the motor, and between the motor and mufflers. (The mufflers were removed for this test.)

It was necessary to employ check valves in case that the motor would stop while submerged.

7. *Waterproofing of the Valve Hand Hole Plates:*

Rubber gaskets were placed between the valve hand hole plates on the motor and the motor casting.

8. *Waterproofing of Clutch Case:*

Rubber gaskets were placed on each end of the main clutch shaft. These gaskets were held in place on one end by a cotter key and washer and on the other by a washer and the operating lever.

All repairs on the tractor were completed about February 25, 1920. The waterproofing of the motor was completed about March 1, 1920. The detachable engine armor was removed and a piece of paulin substituted therefore. On the morning of March 2, 1920, the mount proceeded to Woodpecker Point under its own power, and descended to the edge of Chesapeake Bay. Here the paulin was removed and the water-tight cap was placed over the float plunger. The radiator fan was thrown out of gear and the mount was made ready to proceed into the water.

The mount left the shore and proceeded slowly into the water. The slope was gradual and the water rose slowly until the mount was about 100 yards from shore. Here the motor was completely submerged, the depth of the water being about 4½ feet. The mount was stopped in this position and the motor was allowed to idle for about five minutes. The gears were then reversed and the mount returned to the shore showing no ill effects. Here the motor was allowed to idle for about fifteen minutes when it was stopped.

After about three-quarters of an hour the motor was started and the mount made a second trip into the water.

SUBMERGING A GASOLINE MOTOR

The mount ran out about the same distance as before and the motor was again completely submerged. The mount was stopped and the motor was allowed to idle for a few moments. The gears were then reversed and the mount started for the shore. The mount started back rather suddenly and some water was splashed up by the foot board and entered the stand pipe. This caused the motor to stop.

A 10-ton Artillery Tractor was sent into the water a short distance and a line was thrown to the mount from the tractor. A cable was pulled out and attached to the mount. The other end was attached to the 10-ton tractor. The tractor then started to tow the mount ashore. The clutch of the mount was thrown in and after being towed backward about 10 feet the motor of the Mark VII started, while still about three-quarters submerged. The cable was removed and the Mark VII proceeded ashore under its own power. The motor was submerged about thirty minutes during this test. During this test the temperature of the water was about 32° F. Cakes of ice were floating in the water and solid ice was about 200 yards from shore.

Those present during this test were: Captain L. A. Miller, O.D.; Captain H. C. Mabbott, O.D.; Mr. Andren, Mr. Darby, and Mr. Barnhart, all of Aberdeen Proving Grounds.

On the morning of March 3, 1920, the Mark VII mount again proceeded to Woodpecker Point and again entered the bay as on the day before. The mount went out about the same distance from the shore, when the motor was completely submerged. The motor was allowed to idle for a few moments in this position, after which it backed ashore as before.

During this test the temperature of the water was about 32° F. and cakes of ice were floating in the water. Solid ice was about 200 yards from shore.

This test was witnessed by Lieut. Col. L. H. Campbell, O.D.; of the Ordnance Office, Washington, D. C.; Lieut. Col. C. H. Bandholtz, Captain L. A. Miller, and Mr. Barnhart, of Aberdeen Proving Ground.

In the afternoon this test was repeated. After the motor

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was submerged it was allowed to idle about twenty minutes. The condition in the water was the same as before, temperature of water about 32° F., and cakes of ice floating around. Solid ice was about 200 yards from shore. At the end of the twenty minutes the motor stopped. The mount was immediately towed ashore by a 10-ton Artillery Tractor. Upon inspection it was found that the carburetor had frozen, stopping the gasoline supply for the motor.

The carburetor was allowed to thaw out. This took about twenty minutes. After the carburetor had thawed out the motor readily started.

The mount entered the water again and proceeded to a point where the motor was completely submerged. The motor was allowed to idle for about ten minutes when the motor stopped. The mount was towed ashore by a 10-ton Artillery Tractor, and upon investigation it was found that the packing gland of the magneto drive shaft, in the copper box covering the magneto, had become loose, which allowed water to enter the magneto box, which "shorted" the magneto.

This concluded the test and the mount was returned to the shop for repair.

9. Conclusions of Proof Officer:

(a) That the Cadillac motor has been successfully waterproofed so that the mount may ford streams which completely submerge the motor.

L. A. MILLER,
Capt., Ord. Dept., U. S. A.,
Proof Officer.

Conclusions of the Proof Officer concurred in by the Commanding Officer.

H. W. Schull, Col., Ord. Dept., U. S. A., Commanding.

By: C. H. Bandholtz, Lieut. Col., Ord. Dept., U. S. A.

The Horse and the War

[EDITOR'S NOTE.—*Through the courtesy of Mr. Wayne Dinsmore, Secretary, Percheron Society of America, Union Stock Yards, Chicago, Ill., the JOURNAL is granted the privilege of reprinting extracts from "The Horse and the War," by Captain Sidney Galtrey, British Army, published at the offices of "Country Life," 20 Tavistock Street, Covent Garden, W. C. 2, and by George Newnes, Ltd., 8-11 Southampton Street, Strand, W.C. 2, London, England.*

The British are conceded to be past masters in the art of handling and training the horse, and the following extracts from what appears to us to be the best discussion of the subject yet published, will, we believe, be of interest to our readers.]

CHAPTER IV

THE FINISHED ARTICLE

IF more were required to justify the Allies' splendid war-horse, it is the firm conviction, which cannot be emphasized too insistently, that the light draught of American origin has come to stay in this country. Heaven forbid that the world shall ever again be racked by the agonies of such another war as this, or, indeed, of war at all, so that the question does not necessarily arise of establishing big breeding depots throughout the United Kingdom at which the type shall be bred and reared in readiness for another day. It is, nevertheless, safe at this stage to prophesy that the Percheron-bred light draught horse will surely be introduced to this country as a permanent institution. Actually I wrote this prior to the formation in this country of the British Percheron Horse Society. Already now there are in England pure-bred Percheron stallions and mares, which have been imported from France. They will take their place in history as the pioneers of the light draught breed in the United

Kingdom, just as will the best and most typical of the thousands of mares that will be brought back to us after surviving the rigors and perils of active service. Clearly such mares will be recovered and retained so that they may perpetuate their fine characteristics. For, apart from their value as war-horses, they must attract the employer of the general utility horse.

After all, they are a distinct type. Some may be better than others, and some may be heavier in physique than the vast majority, but these latter are as if they had all come out of the same mould. By comparison the British light draught is a nondescript, a misfit. He could be anything—a half-bred Shire or Clydesdale, a Welsh cob, a heavyish Hackney, a Cleveland bay, or a heavyweight "hunter" without true hunter lines and action. All these odds and ends of horse-flesh we have seen pass through remount depots *en route* to the theatres of war. They were classed as light draught because they were neither heavy draught nor riding horse. But the Yankee was essentially and absolutely a light draught horse, true to type, varying not at all in character and very little in the non-essential details. He is the real equine hero of the war, and by his triumphs, which must be as real in peace time as in war, he simply must take his place, and an important one, too, in the horse population of these islands.

Some further light may be shed on his personality if we resume our association with him at the point at which we left him in the last chapter. He had then stepped ashore—a stranger, indeed, and an obvious alien—from the steamer which had been his stable for about three weeks. We may remind you of his dishevelled state; and a critical onlooker, having no knowledge of his virtues, might have been excused for promptly arriving at wholly wrong conclusions. Let it not be forgotten that a horse thus "cribbed, cabined, confined" on shipboard must inevitably lose condition and show signs of physical wastage. Some, of course, will do so more than others. It is a question influenced as to degree by temperament, for the nervous animal must worry and fuss more than his phlegmatic and stoical companion.

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Then the feeding is not conducive to the retention of condition. Normal feeding on hard corn would quickly produce fever in the feet and intestinal complications in a horse which is denied all chance of exercise and which must stand in a very narrow stall in an unhealthy atmosphere for three weeks. Thus it is that the diet, chiefly of bran and hay, must be low to suit the unnatural conditions. The visitor is now the property of the British taxpayer, and progress is commenced the moment he enters one of the remount depots. He has to be made fit and trained for his new career. If he were not such a good and sensible horse the work of remount officers would be made ever so much more arduous than it is. It is their good fortune that the material is so pliable to the methods adopted. Think of the complications if the process of acclimatisation, where these horses are concerned, were long and tedious, or of the delay if their temperament were less placid and yielding than it is. We may think that conditioning and acclimatisation, as apart from training, are hurried; but we are at war, and what would be ideal in peace time is made impossible by the ruthless and inexorable exigencies of war. What a good thing, therefore, that he comes on as quickly as he does! Training the American light draught is the least difficult of all the details to be observed. Rare, indeed, is the animal that is a confirmed shirker and jibber in our artillery harness, and even he surrenders in time. Vice is found in very infrequent instances, but more often than not it is the product of cruelty and misunderstanding at some time rather than of nature itself.

See now that raw-boned, dishevelled horse that stepped ashore only a week before. He has had a few days' rest and a change of diet, his feeds containing something more palatable and satisfying than bran and hay. The clipping machine has caused him to discard the guise of rags and tatters; the tangled mane is off, and the outline of the cresty, strong neck stands out clear and distinct; the tail is no longer flowing and bedraggled, but has been neatly squared off to about the depth of the hocks; while the spreading hoofs have been shaped and now carry shoes.

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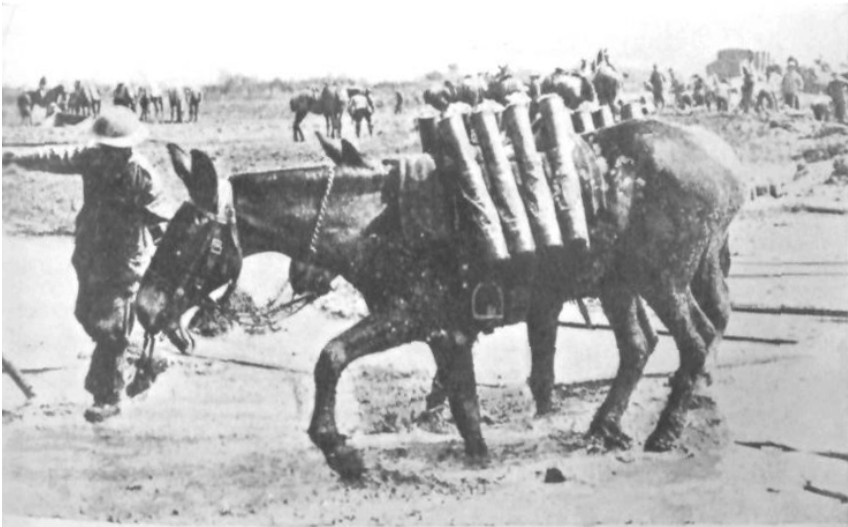
His eye is clear and healthy, and he is taking a quiet and intelligent interest in life, especially at feed times. For the "Yank" is a rare "doer." A month hence and the angularities are distinctly less acute. He has lost the "ribby" appearance, and is undoubtedly thriving on the none too lavish rations authorized by the Government. He is being regularly exercised now, and, if his progress has not been checked by those troubles that beset the horse when compelled to endure what are practically out-of-door stable conditions, he is certainly well on the road to France. He takes his place in the gun team with a duck-like partiality for water, and every day that passes he thickens and muscles-up in a way that gratifies the representatives of the Remount Service. This rapidity of acclimatisation and fluent adaptability to entirely new conditions as regards stabling, and his stout resistance to all ills of the flesh, excepting, perhaps, certain skin troubles more or less indigenous to the land of his origin, are features of his apprenticeship to the making of war. No doubt the ideal thing would be to give him plenty of time in which to acclimatise, for the reason that his improvement is probably more apparent than real; but in war-time ideals must be scrapped or adjusted and shaped by circumstances. That is why the Yankee light draught is passed out of his novitiate in this country, and is ready in an incredibly short time to resume his interrupted journey to France.

Here I am reminded again of the color question. He is, as already noted, chiefly grey, steel-grey or black, sometimes bay, and infrequently chestnut. Shattered is the notion that greys are not desirable for modern war because they are too conspicuous. This is the era of camouflage, with its devices and weird tricks to deceive. Color does not possess that importance which attached to it before the advent of the camouflage officer.

To see him as one of a team of gun horses is to enjoy a delightful spectacle. He is active, willing, under instant command, and he is imposing. Ask any officer of Field Artillery, and, where the lighter kind of horses with galloping conformation are concerned, any officer of Horse Artillery; they will, I



Pack horses carrying ammunition can go where wheeled traffic could not pass. A reminder of winter's mud in Flanders and in the Somme Valley.



The pack mule getting on with his job.

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am sure, give him an excellent "chit." Ask them which type of horse has best withstood the rigors and exhausting exposure of active service in Flanders, and they will unhesitatingly declare in favor of our friend from America. The heavy horse of this country has succumbed while the half-bred Percherons have still been resisting mud, wind, rain, gruelling hard work and pneumonia. And the extraordinary thing is that in the fifth year of war America can still supply them, and that the quality is as good as ever. Certainly it is just as well that this should be so, since it is quite certain that no European country could have maintained its armies for a three years' war except by purchase abroad. The mystery is how America came to have so many horses available, and how they were broken and utilized over there.

Apart from questions of conformation, weight and temperament, the real test of the war-horse must be one of endurance, of the capacity to resist exposure and hardship, to survive longest the trying conditions imposed by picketing on mud and in the open behind the fighting lines. It is the crucial test, and the horse which has answered it best is the American light draught. There is nothing in extenuation to be said for other draught horses after that. The "Yank" has beaten them all. It is reasonable to infer from this that while the transition of the stable-kept English horse to the mud and exposure of France is a doubtful one, the same thing, where the American is concerned, is made possible by reason of the conditions under which the latter has been bred and reared on the "runs" of the United States and Canada.

Every horse bought for the Army must of necessity be introduced straightaway to some degree of exposure as compared with pre-military career. That is due to the "exigencies of the Service"—a most convenient phrase to use in many more instances and senses than this one—and the simple necessity of having to legislate for thousands and tens of thousands. Thus the four largest Remount Depots in the United Kingdom are arranged on the principle of long rows of stalls of fifty or a hundred

apiece, open to the weather except for the not unimportant fact that they are roofed. The same principle obtains in the depots and veterinary hospitals in France, though much is done in the matter of extending the roofs well beyond the quarters of the horses, and in the erection of wind screens as some rough protection against the weather. It will be understood that in this way every opportunity is given to the latest-joined equine recruit to harden itself, and so prepare for probably more severe exposure in the actual theatres of war.

Remount officers must take this wartime feature of stabling into serious calculation in the feeding and training of all classes of horses. They have to be made fit, and the process cannot be made easy by abundance of food, a warm box knee-deep in straw and heavy rugs in winter time; such luxuries have no place in war. The semi-exposed lines, whether they be those of Remount Squadrons, Cavalry Squadrons or of Field Batteries, are the first home of the war-horse and mule whether they have just arrived from overseas or have been bought in the United Kingdom. Obviously a horse which feels the cold very much and has delicate respiratory organs is not going to do well. His acclimatisation is going to be slow and gradual, but even he will "come" in time. Apart altogether from military necessity, there may be much to recommend the principle. The sudden transition from stable to semi-open lines will frequently induce catarrh and coughs. They have to be carefully guarded against lest serious pulmonary troubles should supervene. It was such troubles that found out the weak spot in the heavy Shire and Clydesdale horses which were bought in large numbers during the first three years of the war. They simply could not battle against the conditions of army stabling. Once, however, the catarrh has disappeared the Remount rapidly becomes hard and fit, and when his time comes he is far better able to "keep agoing" under active service conditions than when he was apparently fit before the hardening process had been entered upon.

Mr. Wayne Dinsmore, the very able Secretary of the influential Percheron Horse Society of America, has given us a

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reason why the American light draught horses survive the weather test so well. They are more or less hardened by the nature of their life from birth, and the fact, of course, is not peculiar to one generation. Of our English horses the charger class with thoroughbred blood in them, either whole or in part, have done well, though the principle would not be the one ordinarily adopted when dealing with our hunters and high-class riding horses in peace time. They have required a good deal of nursing and watching, and wanted all, if not more than, the ration of hay and corn allowed them. The maximum amount of self-created bodily warmth is essential to make up for open stabling, which is often swept by chilling winds. A horse at liberty in a field can exercise himself in the hardest weather; far otherwise is it with him when tied up in the semi-open stall. Really it is wonderful how they have adapted themselves to the drastic change. No blankets to wear when they travel, no kneeboots and tail bandages as a protection against possible disfigurement, but instead they are sent to their destination on the first stage of their journey overseas eight or nine in a truck. Once that same truck carried cattle, sheep or pigs to a market town. Now it is the equipage *de luxe* of the charger or the mule.

Every horse should have his proper job in the Army. That there may be misfits is a matter for the buyer's conscience. Those at the head define the types required and issue instructions accordingly. If an animal is neither a heavy draught, a light draught, a charger, an officer's cob, a cavalry horse, an artillery riding-horse, nor a pack-horse, then there is only one class remaining for him. He is a nondescript. He may have his uses in civil life, but most certainly he should never have been bought at the public expense for some obscure military purpose. I suppose it is human nature for one commissioned critic to say contemptuously of the Remount buyer: "Whatever was he thinking about to buy a *thing* like that!" Yet, when you come to think of the hundreds of thousands bought here and abroad, the number of nondescripts or bad bargains has been extraordinarily few. And, of course, an animal may degenerate, and

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frequently does, after wear and tear. Take the case of the cavalry horse that develops faulty action. He becomes dangerous to ride by reason of his susceptibility to lameness. His limited physique does not fit him for transport, and he therefore loses his usefulness, because it is quite evident he would be too tall for pack purposes. One could pursue this line of thought indefinitely, but after all there is far more satisfaction in following the doings of the horse and mule while they are in training for active service and later when they actually embark upon it. The same serious attention must be paid to the riding horses as to the draught animals. The former have to be schooled just as the latter must learn their team work in the batteries, or the wagons of the Divisional Ammunition Column, or Army Service Corps Train Transport.

The day comes, and that soon enough, when the gun horse is ready for active service. Orders come for his transfer to France, and in pursuance of them he is assembled at the great depot which is contiguous to the port of embarkation. Actually, as well as in theory, he should now be fit for the real thing. He is the finished article, the well-fed, clean and healthy horse which has emerged from that steamer-soiled and ragged creature that was put ashore here two or three months before.

CHAPTER V

THE GALLANT MULE

MULES are a fascinating subject, whether dealt with on paper by the man with a pen or by the artist with a brush. Most men who wield neither a pen nor a brush would desire no other acquaintance, since they have no understanding of the fascination. Perhaps I should not say "most men." Most men are in the Army, and what gentleman in khaki has not some slight nodding acquaintance with his mule confrere in the Army? They are both battling in the same cause, both living on Army rations, and both, no doubt, longing for victory and the end of war. Many men, therefore, do not despise the mule—only

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the few who do not know him and do not want to know him. The difficulty, from a writer's point of view, is to know exactly how to treat him. Seriously or lightly? As a beast of burden and haulage which has assisted enormously the Allies' waging of war, and will continue to do so until the closing of the book? Or as an animal with more eccentricities of character and undeniable virtues than any other creature on Gods earth—as, in fact, just a mule? Where to begin and where to end? It seems to me that one is forced into a compromise, and that a middle course is the only one to take; for if you must dilate on his extraordinary utility you must of necessity take into the reckoning his oddities, and delineate those donkey characteristics that defy temper and patience, and more often than not transform your serious attitude to mirthful mocking and weird despair. How can you treat consistently a conglomerate mixture of stolidity, stubbornness, slyness, willingness, temper, sullenness, humor, contentment, waywardness and cunning, with no knowledge of which vice or virtue is going to assert itself next?

It is no use wondering how many tens of thousands of mules have been to Europe from North and South America, chiefly the North, since August of 1914, all conscripted in the Allies' cause. The figures must be an after-the-war revelation, but I know many of us would like to possess, say, war bonds for as many as we have seen and handled. And we are still alive to tell a tale of admiration! Perhaps if I say a quarter of a million I shall not be very wide of the mark. If the real horse of the war has been the light draught from America, the mule has been, and is, just as essential in his own peculiar way. Often and often he has done what the horse has failed to do. He has survived and outlasted him, and, maybe, has shown his perversity by apparent enjoyment of the awful din of battles, the deep mud and piercing cold of France or the heat and flies of the East. His temper and constitution have remained whole, while the specimens of his mother's branch of the species have cracked and fallen by the wayside. Given his liquid refreshment and his humbler rations, it takes a lot to put a mule out of action. He

has even kindled enthusiasm among ardent horse-lovers who were once prejudiced against him, and despised the donkey in his outline and demeanor. So in time they have come to say: "Give us mules for this job of war rather than horses." A strange and yet true conversion!

Again, as when writing of the American light draught horses, one marvels that America's supply should have been so abundant. They are coming still, travelling well over the much-troubled seas, and picking up rapidly on arrival in a way which says much for their sangfroid and entire indifference to new surroundings, strange white faces, and the conditions imposed in a country at war. They have been reluctant to step aboard ship on the other side, but, when once packed in steep holds, and breathing a gassy atmosphere, too pungent for all humans—except callous and leather-lunged muleteers—they soon become reconciled and contented to the point of being outraged and annoyed when asked to quit again. The acme of perversity, you see, but nevertheless quaintly characteristic.

They vary, of course, in this regard. Some are so mournful and devoid of expression, too unconscious of their own existence, that they climb the gangways to the main deck and descend the "brow" to the shore with all the solemn good sense of tractability in the world. They are the good mules that never want to slip into wrong-doing, that take a cuff or a blow as unresponsively as they do a mark of affection, that gaze vacantly on the shoeing-smith when he is tinkering with their donkey feet, and only show a spark of consciousness when they see food and are unable to reach it. The bad mule, not because he is really wicked, does not like to be hurried, worried or interfered with if at the psychological moment he happens to be feeling more like a donkey than a horse, or, maybe, is concentrating on the vices of both and the virtues of neither. He gets "worsen and worsen," and in the end will submit only to the *fortiter in re* rather than the *suaviter in modo* methods of those who from experience have not come to meet him unequipped with a long rope and a breeching with which to haul him among his tribe already on shore. At

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the moment he is hating everybody and everything. He is distinctly nasty. He will kick unkindly at his neighbor in that susceptible area between the fore and hind legs. He may even endeavor to eat the rope by which he is being led, and his new khaki-clad acquaintance has to admit that his heels have an uncommonly long reach. Nor are his forelegs to be ignored. A mule can box and strike with them most unpleasantly. But in ninety cases out of a hundred he is not always going to defy disciplinary methods, especially when quietness is judiciously mixed with firmness. Never crack whips or shout with a sensitive mule. He will only get worse. The foundation of all successful methods with these uncertain tempered creatures is quietness. The man who makes a noise does so because he is afraid of the mule, and really hates him at sight. The mule also hates him then and always.

If this were anything more than a chapter of impressions gained at first hand I might be expected to deal with the mule from a scientific point of view, dwelling on his hybrid origin and the ban placed on him by nature to produce his like as a distinct species. One might enter on a vast field of conjecture as to why there should be freakish colorings and markings and distinct suggestions of the wild ass and zebra. The prevailing color of the tens of thousands purchased on behalf of this country is brown, but you will also see a fair percentage of bays, chestnuts, greys and duns, and an occasional "smoky blue." Most of the duns and a few chestnuts have a strongly defined black line running the length of the neck and back right into the tail, with dark zebra-like bars about the shoulders, knees and hocks. Some have had white legs, but they have been very rare.

Then you will be told on some authority that successful mule breeding cannot be carried on about certain latitudes north of the Equator and below a certain line south of the Equator. It is why, the experts say, the United States does so much better than her neighbor, Canada. The point, however, is not one I am prepared to develop. But the suggestion, seriously put forward, that one nigger can get more work out of a team of mules

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than any white man may be true enough. The theory seems to fit in with the weird psychology of the animal. "A fellow-feeling makes one wondrous kind!" Clearly a mule takes a deal of understanding, and the inference is that a white man's brain is scarcely equal to the strain. For, after all, the best-meaning of our soldiers who have had to do with them are constantly being rudely checked just when they imagined they had arrived at a perfect understanding.

The artist has, for instance, noticed quite a common incident. There is the wrong and the right way of leading a mule to water or to any place where his presence may be required. The man who looks at the mule while he tugs at his head cannot appreciate the animal's unwillingness to move along with him. "Don't look at 'im," shouts the N.C.O., "e doesn't like yer face." And the recruit, feeling rather hurt, turns away to hide his blushes. The mule at once moves after him. The ridiculous creature will not be pulled at. He is a sure winner at that game, just the same as when he wants to go east and the man on the rope lead wants him to go west. Both go east until the man adopts new methods. It is wonderful how bull-headed an obstinate mule can be. I have seen him draw two or three men whither he willed, all of them hanging on to the rope lead and the head collar. The same mule works all right in harness and never does wrong, only he is conscious of his own strength at inconvenient times, and a horse is not; or, perhaps, the latter is too dignified to indulge in such unseemly capers.

I have known few mules that were not suspicious that someone was plotting to do something unpleasant to them. There is about them an ever-present sense of apprehension. Pass along a line of mules, either head in or tail on, and they regard you furtively and with a deep distrust. Obviously they do not like the look of you. The ears swing significantly, together or inconsequently, and each mule never takes his sullen eyes off you. Did a horse do the same you would say that he had been ill-treated at some time. Really, a mule talks to his neighbor with his ears. It is a kind of signalling; and if you learn to read the

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language of those long uprights, winking and nodding, you will really begin to know something worth knowing about mules. I have seen a line of mules in single file walking quietly towards the "brow," which is the gangway between the dock and the ship. The first one steps confidently on the "brow" and halfway he puts one ear backward and cocks the other one, at the same time pushing his toes into the flooring. He is not quite sure about what he is doing or being done by.

Of course, his remonstrance comes at an awkward time; but the trouble is that the mule behind has seen the one ear go back, and as he does the same thing to the fellow immediately in his wake, and so on right down the line, the whole lot are very soon in a state of quiet revolt. Do not shout and bully them or the ship may be delayed sailing. Devote all your attention to the leader, and when the donkey in him has given way to the more aristocratic side of his parentage the procession will be resumed. They will follow like good sheep that dislike being separated.

Sometimes one doubts very seriously, but on the whole I am inclined to believe that the "moke" has a distinct sense of humor. So many funny things have been said and written about him that the general public undoubtedly believes him to be a funny beast—that is, when he is not a savage one. Both ideas are exaggerated. The idea of humor probably arises out of inquisitiveness. When not working he must be finding something to do with legs and mouth. I am reminded of an incident in an advanced mule line near Ypres. A number of our friends were tethered in the open on a long rope, and a farrier was engaged in shoeing one. The mule thus being attended to stood quietly enough, and the stooping farrier was performing his task so conscientiously and well that he was naturally astonished when the next mule endeavored to take a mouthful from the seat of his breeches. Of course, he turned around sharply, as one would on being stung in a particularly susceptible part of the anatomy, and, while his back was turned once more, the mule he had been shoeing gave him a sly kick on that same unoffending

seat. Was that savagery? Of course not. Jack and Jenny were not vicious; they just wanted something to do.

If mules were really as wicked as popular belief suggests, think of the havoc they could work in our great Remount Depots, where the men are not physically fit for combatant units, but have been, say, piano-tuners, paper-hangers or fried-fish merchants before King and Country called—or fetched—them. You can have courage which is the product of ignorance of what you are taking on. In the same way you would have seen the bespectacled piano-tuner rushing in among the hungry animals at feeding times coming out unscathed and in no way conscious that he has escaped contact with heels that were being uplifted for fear that the feed might be taken away again the next instant to being given. Another man may have hesitated and shouted—fatal preliminaries—and from that moment he and the "donkeys" lose no love between them.

The grudge which thus has small beginnings does not give way to feelings of tender regard when, after patient grooming, he sees the perverse creature take the first opportunity of rolling in sand or mud, the sandier and muddier the better. How can they live amicably together after the man has been blamed for inefficient grooming? Actually the height of mule joy, next to satisfying a healthy appetite, is to roll. Why this should be so I do not pretend to know, except that the disconcerting habit doubtless comes of the donkey blood in his veins. Is it not among one's earliest memories of learning to ride? From a military point of view there is much to censure in the irregular proceeding; for they almost always do it before you have time to remove their packs and very often just as you have restored the packs to their backs. I have said that he gets into mischief for want of something to do. A long railway journey, for instance, bores him horribly. Hence you will find when the trucks arrive at their destination that each has made a slow meal off the other's rope halter and head rope. They have then made a start on the woodwork of the trucks. Now, it will be understood that he

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must have great merits in war as a set-off to these pernicious habits.

Most mules can buck, but few in my experience are really bad ones in the sense that they are vicious and therefore dangerous. Take the average one that bucks. Not only will he do it without previous warning, but often with his ears pricked. I am sure those pricked ears mean something. You would think it impossible for one to buck so thoroughly and skilfully as to get himself out of his saddle without breaking the girths. Yet it has been known. My illustrator has been good enough to show the simplest method of settling the buckler; for, unlike the bucking horse, which is practically incorrigible, the mule quickly gives in. The head collar of the offender is tied close to a quiet old mule of unimpeachable character, and he is then mounted. Short of lying down he is unable to dislodge the rider because he is unable to get his head down to buck.

How often have you seen illustrations in the papers during the war of mule races behind the lines of the various fronts. Almost invariably they have been treated in comic vein, but it is nevertheless true that the animals can jump cleverly and well over fences, and at a fast pace, too. As far as we have come to understand modern warfare, the mule has not come to be regarded as a cavalry remount, so that his jumping proclivities have not been developed in a serious way. But the fact remains that he might be thus schooled.

There is no need in concluding this chapter, to write of his admirable qualities, in the work of transporting food and munitions to the troops holding the trenches. I have before me as I write a letter from a transport officer in France, who remarks: "I cannot speak too highly of the mule as a most useful and valuable beast." It is the opinion of all who have to do with them in the many ways in which they are employed. The life of the mule at the front is longer than that of the average horse because he can better adapt himself to disagreeable things and tasks. He can endure more, exist on less and plainer food, and the machinery of his constitution does not run down so

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rapidly or so often. He just wants to be understood and treated accordingly. And, though the ideal type of draught mule—his body built on the lines of horse, square, with the legs coming out of each corner, wide in the chest and barrel, with short, powerful legs—is a splendid beast of burden in modern warfare, the other type shown by the artist has his many uses. The latter may be well bred on the dam's side because he is weedy, with a horse's fine coat and shorter ears; he is also light of bone, too long in the leg, flat-sided, and both forelegs seem to come out of the same hole as it were. Yet it is true of mules that they work in all shapes; for if it were not so there would be no place for the many that do not correspond with the artist's conception of the ideal type of draught mule. One of the many wonders of the war has certainly to do with the tens of thousands of mules transported from the Western to the Eastern Hemisphere, and now actively pursuing the big part assigned them in the Great Adventure.

MUSINGS OF A MULE

I am only a common or garden mule
Who was bred in the U.S.A.;
I was born in a barn on a Western farm,
Many thousands of miles away,
From where I am munching a Government lunch
At Great Britain's expense to-day.

With dozens of others I knew, and have seen,
In my Little Grey Home in the West,
Where the grazing was succulent, luscious and green,
And Life was a bit of a jest,
I have sniffed the salt breeze blowing over the seas
And I've landed in France with the rest.

The journey was horrid—a horrible dream
Was the loading—its shindy and row,
And the people expecting a moke to be keen,

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To swarm up a frightening "brow,"
And slither down ramps that were greasy and damp,
To a standing unfit for a cow.

They packed us like herrings 'way down in the hold,
With never a thought nor a care
For animals worthy more Government gold
Than all of the rest who were there;
And the best spot, of course, was reserved for the horse,
Who *had* to have plenty of air.

Well, we jibbed and we strafed and we kicked the Light
Draught,
And I planted my heels in the hide
Of a man on the ship who was flicking a whip,
And whose manners I could not abide;
But I've travelled so often since then in the trucks,
I have learnt how to swallow my pride,
And I go where I'm put without lifting a foot
For a rag song and dance on the side.

Many months at a time I was up on the Somme
In the rain and the mud and the mire:
We were "packing" the shells to the various hells
In the dips of the vast undulations and dells,
Where the field guns were belching their fire.

It was very poor sport when the forage ran short
First to eight and then six pounds a day,
But we managed to live on the blankets they brought—
Though blankets, I now think, and always have thought,
Are but poor substitution for hay.
I remember a week when we played hide-and-seek
With shrapnel the Boches sent over;

I remember the night when they pitied my plight,
And pipped me, and put me clean out of the fight
With a "blichty"—then I was in clover.

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For they dressed me and sent me quick out of the line
To a hospital down at the base,
Where the standings were good and the weather was fine,
And the rations were not a disgrace;
There, just within sound of the Heavies I found
La France can be quite a good place.

And now I've recovered—I'm weary and thin,
And I'm out of condition and stale;
My ribs and my hips are too big for my skin,
And I've left all the hair of my tail
On the middlemost bar of the paddock I'm in,
For they turned me out loose, as I'm frail.

Now the life in a paddock, according to men,
Is a sort of a beautiful song,
Where animals wander around and can squander
The time as they wander along,
With nothing to worry them, nothing to do,
Except for food intervals daily; but you
Can take it from me they are wrong,
For paddocks are places conducive to thoughts
That settle unbid on the brain,
And often I find them to follow a kind
Of a minor-key tune or refrain;
As I doze for an hour in the afternoon sun,
Or I stand with my rump to the rain,
I dream of the barn on my Illinois farm,
And I *long* to be back there again.
—L. L. L. L., Base Indian Remount Depot, B. E. F., France.

(To be continued.)

A Study in Battle Formation

BY CAPTAIN J. N. GREELY, F. A.

ARTILLERY

[EDITOR'S NOTE.—*The following article is extracted from "A Study in Battle Formation," now in the course of publication as a monograph prepared by the Historical Branch, War Plans Division, General Staff. It is believed that it may be of interest to readers of the FIELD ARTILLERY JOURNAL who are not reached by the monograph.*]

DEFINITION OF FORMATION AND PURPOSES OF ITS STUDY

THE definition of the word "formation" in a military sense is "the disposition of troops." It is in precisely this sense that it is used in this work. The study of battle formation, therefore, is the study of the disposition of troops in battle.

Innumerable volumes have been written on the employment of troops in battle. In all sound works the disposition is considered as a governing factor in the employment. When so much eminent authority on the subject exists, it would be superfluous to attempt any general discussion of the principles of the disposition of troops. This is especially true in that the war with Germany exhibited the same general features as have marked all others wars.

A brief exposition, however, of the battle formation actually used by American troops in the war with Germany may be of value. Aside from the remote possibility of American participation in another great war in the immediate future, there is a present necessity for reorganization of our continuing military forces. Troop formation is as inextricably bound up in organization as it is in employment of troops, and battle experience will undoubtedly have weight in the reorganization scheme. General principles of troop formation are sufficiently stated in reports of the high command in the war with Germany to enable authorities charged with reorganization to lay the grand lines of the scheme. Also many officers charged with the details of reorganization will have their personal knowledge of battle

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formations to work from. Individual officers, however, with few exceptions, cannot be fully informed of detailed battle formation in the American Expeditionary Forces as revealed by a study of the mass of original documents in existence. Few officers are properly placed, with sufficient time, to consult these documents, which as records of actual experience are the best authority on the subject. For the rest, Colonel Ardant du Picq, an authority on the psychology of war, in his "Etudes sur le Combat," says: "Nothing, especially in the trade of war, is forgotten sooner than experience. So many fine things can be done, beautiful manœuvres executed, ingenious combat methods invented in the musings of the office or on the manœuvre field!"

Pre-war minor tactics were laid down in the drill regulations of the various arms. The mechanics of minor tactics were naturally fitted to existing organizations, and consequently varied somewhat from the tactics employed in the war with Germany. The principles and essentials prescribed, however, proved sound.

The principal arms which assumed formations on the battlefield were: infantry, the machine-gun arm and artillery.

The governing purpose of pre-war artillery minor tactics in assisting the advance of the infantry was to secure unity of direction of artillery fire, which is characterized by the ease with which it can be shifted. This unity was favored by keeping units, especially the battalion, concentrated, and by employment in general of no smaller unit than the battalion. Pre-war combined or major tactics were based on the principles that infantry decided the issue of battle; that artillery, light and heavy, existed to assist the infantry by fire; that engineer or other special troops were to be used as infantry.

FORMATIONS IN THE FIRST DIVISION

The first occupation of a sector by American troops was the occupation of the Ansauville sector, north of Toul, by the First Division in January, 1918. This occupation was ordered by the French First Army, and naturally followed French customs.

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The divisional artillery was merely required to relieve the French artillery and occupy prepared or designated positions. This was a period rigidly restricted to defense, in contemplation of a German offensive. The occupation of divisional defensive sectors was exactly laid down in French regulations for French divisions, later published for American use. The first formations adopted, therefore, have no especial national significance, as they appear to have been dictated by the necessity of fitting the American divisional organization into the general French defensive scheme.

A characteristic formation in the First Division appeared during its tour in Picardy following the German offensive of March 21, 1918. In anticipation of a further German offensive on Amiens a counter-offensive was prepared, although it never became necessary to stage it.

The artillery formation ordered was divided into three groupements, and a reserve, each including both 75's and 155's. This showed a French tendency to constitute tactical units in place of using existing organizations; at the same time, it showed a tendency more apparent later, to assign artillery organizations to support infantry organizations within the division.

The first actual offensive operation of the First Division was against Cantigny. This was a local operation. The artillery, greatly reinforced, was employed as a unit, in accordance with the demands of such an operation. In this operation, with an advance limited to one or two thousand yards, it is evident that there was no occasion for the use of accompanying guns.

In the Aisne-Marne offensive of July 18th, south of Soissons, the infantry had the normal formation. The divisional artillery was reinforced by a regiment of French 75's and by other organizations of heavier artillery. One battalion of 75's was assigned to act with the infantry in each regimental zone. This was the characteristic assignment of subordinate light artillery organizations to act in direct liaison with subordinate infantry organizations. The necessity for having light artillery guns up behind the front-line infantry was recognized by prescribing

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that the 75's unable to cover the advance to the second objective, would move forward and take position to cover further advances.

The formation adopted by the First Division for the St. Mihiel operation was dictated by its mission, which was to cover the left flank of its own advance and the left flank of the whole southern attack.

The divisional artillery was reinforced by the Fifty-eighth Field Artillery Brigade, less one battalion of 155's, by one regiment of 75's from the Third Field Artillery Brigade, and by two batteries of eight-inch howitzers. The principal mission of the artillery was destruction fire and barrage. The 75's were required to deliver barrage to protect the infantry to the second objective. Certain units of 75's were required to move forward before the infantry reached the third objective, in order to support any further advance. The customary battalions or larger units were designated to act with subordinate commands in the various infantry zones. Notation of the designation of gun platoons to accompany the infantry appeared for the first time in the orders of this division, in the first purely American great attack in which it participated.

In its entry into the Meuse-Argonne operation the First Division used its normal infantry formation. The principal mission of the artillery for this advance was to furnish barrage. The customary forward movement by echelon was ordered, and the accompanying guns again appeared in the assignment to each first-line infantry battalion of two 75's.

Following the early German offensive of 1918, the Second Division was withdrawn from the defensive sector of the Verdun and placed in reserve in the vicinity of Gisors, northwest of Paris. It was there when the German offensive of May 27th developed an unexpected success, and the division had to be hurriedly moved to check the German advance; the disposition it assumed on its second entry into the line was dictated by necessity.

On June 2, 1918, the Twenty-third Infantry, one battalion

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of the Fifth Marine Regiment, the Fifth Machine-Gun Battalion, and one company of the Second Engineers filled a gap in the French line northwest of Château-Thierry. For the rest of June the division was engaged in bitter fighting in Belleau Wood, whose capture was not completed until June 25th. On June 23rd an infantry battalion commander stated: "Infantry alone cannot dislodge guns." This view was accepted by the command, and two days later the infantry lines were withdrawn, and an artillery concentration was placed on the northern part of the wood, which was then taken.

The first participation of the Second Division in a major offensive under American command was in the St. Mihiel operation. The infantry formation for this attack was brigaded in depth, regiments abreast in each brigade, with battalions in depth within the regiments. One battalion of artillery was assigned to assist the advance of the first-line infantry battalions as forward guns.

The Mount Blanc operation of the Second Division in early October showed another variation in infantry formation. The orders for the artillery in this operation required that it be brought forward in echelon. It is interesting to note that the division was at this time serving under French command, and that accompanying guns were not required in the division order.

Following the success of the attack of November 1st, the Second Division adopted an extraordinary night attack formation with the greatest success. An advance was made on the night of November 3rd-4th of six kilometres through the main enemy position. In this advance one battalion of the Ninth Infantry, accompanied by a battery of light artillery, was in the lead. The Second Field Artillery Brigade was required to place guns at the disposition of the front-line infantry commanders, following the success of this night's advance.

The initial success of the Second Division in the Meuse-Argonne operation was attributed to complete coördination of the two principal arms, the infantry and the artillery. The best results in the use of artillery throughout the advance was secured by placing responsibility for the support of the infantry

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in the hands of the artillery regimental and battalion commanders, in direct liaison with infantry commanders.

A report of value was rendered some time after the armistice by the commanding officer, Ninth Infantry, which set forth the opinions of various infantry company officers of this regiment, a part of the Second Division. The question treated of in this report which is of especial interest in the present study was that of the value of the accompanying guns.

Difference of opinion existed as to the value of the accompanying gun. One officer made a definite recommendation that one or two guns be put under the immediate command of the infantry battalion commander. This opinion, however, was not sustained by all of the other officers, one of whom noted invariably successful support of infantry advance by artillery fire when liaison could be maintained with artillery in the rear.

FORMATION IN TWENTY-SIXTH DIVISION

For the Aisne-Marne offensive from July 18, 1918, the Twenty-sixth Division was a part of the First Corps operating in the general vicinity of Château-Thierry. The use of accompanying batteries for the close support of the front-line infantry and to reduce machine-gun nests first appeared in this division in this offensive. It was noted, however, that the best use of such batteries was at 2000 yards at least in rear of the front line with very forward observers.

FORMATION IN FORTY-SECOND DIVISION

The report of the Commanding General, Forty-second Division, covering the division's participation in the Aisne-Marne offensive, from July 18, 1918, formulated some general principles as a result of experience gained in that operation. In the absence of tanks, it recommended the aggressive use of a portion of the divisional light artillery to assist advance of the infantry by destroying machine-gun nests by direct fire. For the St. Mihiel operation the Forty-second Division used a formation which it had developed from previous experiences. In addition to its component units, each infantry brigade had one

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battery of 75's attached as an accompanying artillery, from the taking of the first objective. One regiment of 75's was the nucleus of each of two groups of artillery which supported infantry brigades in their zone and on capture of the first day's objective passed to the control of infantry brigade commanders.

Orders for the first participation of the Forty-second Division in the Meuse-Argonne offensive insisted on the actual accompaniment of front-line battalions by two accompanying guns per battalion.

FORMATIONS IN THE TWENTY-SEVENTH AND THIRTIETH DIVISIONS

Several divisions had their first training with the British, but two only, the Twenty-seventh and the Thirtieth, had all their war service under British command. These divisions, under the Second Corps, participated in very heavy fighting, including the breaking of the Hindenburg Line, in September and October, 1918. It is interesting to note what difference, if any, existed between the formations adopted by the divisions which were more within the sphere of French influence.

In the attack of September 29, 1918, on the Hindenburg Line, the divisions of the Second Corps were supported by Australian artillery as their integral artillery did not serve with them. The mission of supporting artillery was barrage. Following the advance, supporting batteries were moved forward with daring and skill, while close liaison between infantry and artillery was maintained at all times. Tanks were effective in destroying many machine-gun nests and so far filled the rôle of accompanying artillery.

FORMATIONS IN OTHER DIVISIONS

Formations in other divisions as evidenced by division orders conformed essentially to the formations found in the six divisions already instanced. They naturally varied somewhat, according to conditions.

The Meuse-Argonne operation was the only major offensive in which the Eightieth Division participated as a unit. The

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normal infantry formation used by this division throughout the Meuse-Argonne operation was column of brigades. On September 26, 1918, the division attacked in its normal formation with the One Hundred and Sixtieth Infantry Brigade in front. This brigade had its regiments abreast, each regiment with battalions in depth. One battalion of 75's was assigned to the direct support of the One Hundred and Sixtieth Infantry Brigade, one battery from this battalion was assigned to each front-line infantry battalion; the third battery was placed under the direct orders of the infantry brigade commander and was to be moved up with the supporting infantry. The use planned for this artillery was fire and support of the infantry at from three hundred to fifteen hundred metres.

In the attack of October 4th, the Eightieth Division employed the same infantry formation. One battalion of 75's was assigned to its attacking infantry brigade as accompanying artillery. This battalion, however, was actually incorporated in the barrage and did not move forward on the first day. In the attack of November 1st, the Eightieth Division was supported by the One Hundred and Fifty-seventh Field Artillery Brigade of the Eighty-second Division. In this attack one regiment of 75's was utilized only six hundred yards from the front line.

A note published by this division during the latter part of the Meuse-Argonne operation prescribed the use of the accompanying guns, in accordance with instructions from higher authority.

The first experience of the Ninety-first Division was in the Meuse-Argonne offensive on September 26th. This division attacked with its infantry brigades abreast. There was a characteristic attachment of machine-gun companies to infantry battalions. One regiment of 75's was assigned to the support of each infantry brigade. Accompanying guns taken from the supporting artillery were reported to have been used successfully with assault battalions, as were the infantry 37's.

Following its participation in the Meuse-Argonne offensive, in the middle of October, the Ninety-first, together with the Thirty-seventh Division was attached to the Sixth French

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Army in Belgium. The Ninety-first Division was accompanied by the field artillery brigade of the Twenty-eighth Division. On October 31st this division attacked with its infantry brigade abreast. After the first objective had been taken by the infantry, one regiment of 75's passed to the command of each infantry brigade. One platoon of 75's was assigned for use as accompanying guns to each front-line infantry battalion.

GENERAL DISCUSSION

The instances quoted show the formations adopted by various divisions under various circumstances in an endeavor to utilize to the fullest the power of the various arms. This was naturally also the preoccupation of General Headquarters, A.E.F., which published from time to time during the participation of American forces in the war with Germany Notes on Recent Operations, in order to disseminate among the command knowledge gained from experience. Following the armistice various boards were convened by General Headquarters, A.E.F., to study and make available for future utilization late experiences. Finally a superior board was appointed to study the same questions in a more general manner, to pass on the reports of the boards on the various arms, and to render a final report on organization and tactics.* From a study of the documents just mentioned and especially from a study of the report of the Superior Board, general conclusions as to what formations gave the best results may be drawn.

The mission of tanks was found to be the destruction of strong points which impeded infantry advance and the employment of tanks was distinctly advantageous to morale. It was found that tank units should be organized in association with, and fight as a part of, infantry commands. It was believed that all tanks should be armed with a 75 mm. gun.

The principle of unity of direction of artillery fire as laid

* While the report of the "Superior Board" has never been approved by the Commanding General, A. E. F., it nevertheless contains much matter of interest to the field artilleryman, in that the conclusions reached are the result of studies made by officers of experience, whose opinions are entitled to consideration.—EDITOR.

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down in Field Artillery Drill and Service Regulations was found to be sound, and it was found that command of artillery units should normally remain in the hands of artillery officers. It appeared essential, however, that there should be the closest possible contact between infantry and the supporting artillery and that consequently within the division the subordinate artillery units should be regularly assigned to work with subordinate infantry units, one 75 mm. regiment to each infantry brigade.

Some inefficiency was found as a result of the employment in support of divisional infantry of French artillery or of American artillery not belonging to the division, with a consequent loss of intimate association and teamwork.

This lack of teamwork between infantry and artillery may have prompted the use of accompanying guns, which has been seen to have been consistently adhered to in operation under American command and which was directly ordered by such superior units as an army. The use of the accompanying gun conformed to German tactics in the German offensives of 1918. It may be noted that the Germans notoriously lacked tanks, of which no use was made in these offensives.

It has been seen that this device was not used by American divisions under French or British command, except in the case of a division serving under French control in the last days of the war after its habits had been formed under American command. The Field Artillery Board found that the use of accompanying guns has been a failure, and recommended the use of the tanks as accompanying artillery. The Superior Board found physical difficulties in getting up the accompanying gun. This recalls General Chaffee's statement: "Nothing whatever should be included in the infantry that cannot be moved by hand over any kind of ground, in any kind of weather and at any hour of the day or night." The Superior Board consequently considered the use of a tank mount for the accompanying gun. This board, however, insisted on the value of the psychological effect of intimate association between the infantry and artillery, as exemplified in the support of subordinate infantry commands by subordinate artillery commands.

The Artillery Horse

REPRINT FROM "THE FIELD," LONDON, ENGLAND, MARCH 6TH, 1920.

THERE are undoubtedly some who think that the days of horse-drawn artillery are numbered. It is not worth while to speculate on the accuracy, or the reverse, of this assumption. Facts alone should be considered, and they undoubtedly indicate that, while mechanical traction has certainly come to stay for heavy artillery (by which is meant 60-pounder and all, heavier guns, and howitzers of 6-inch and all larger calibres), the numbering of the days of the horse for the lighter field artillery weapons will prove a somewhat lengthy process. Until this, therefore, is complete it behoves all who are interested in the welfare of the Empire and the efficiency of the Royal Regiment to insure an ample supply of the best stamp of horse for the purpose being ever available.

Before it is possible to realize what constitutes the best type or types of horse for field artillery, a full understanding of the work for which they are required is essential. "Field" artillery in its broadest sense includes all guns and howitzers which are intended for warfare of fairly rapid movement in normal European country, and comprise the various pieces of ordnance with which our Royal Horse and Royal Field Artilleries are armed under the existing organization. The arm of the Royal Horse Artillery is the 13-pounder Q.F. gun, and those of the Royal Field Artillery the 18-pounder Q.F. gun and the 4.5-inch Q.F. howitzer. It should be remembered that at the present time there are two types of 18-pounder, the old pre-war model and what is known as the "new" gun. The hybrid created by fitting an air-recoil apparatus to the old gun is yet a third form, but for draft purposes it is almost identical with the new gun and so needs no further mention.

The gun or howitzer is hooked on to a gun limber, to which in turn are hooked the horses. There are a limited number of

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rounds in the gun limbers, but the bulk of the ammunition is carried in the ammunition wagons, of which there are two per gun or howitzer. In addition to ammunition both the gun limbers and the ammunition wagons are utilized for carrying a huge variety of stores, such as spare harness, buckets, entrenching tools, blankets, rifles, etc. In the Royal Horse Artillery all the gunners are mounted, but in the Royal Field they sit on the gun limbers and ammunition wagons—two on each gun limber and four on each wagon. It will accordingly be readily seen that the accumulation of weight behind the actual team of horses can be very considerable, and it may be as well to realize what these actual weights are. The figures are given below, and include all gunners, when their places are on the vehicles, and all stores:

	Weight behind team in lbs.
13-pounder Q.F. gun	3696
18-pounder Q.F. gun (old)	4816
18-pounder Q.F. gun (new)	5152
4.5-inch Q.F. howitzer	5040
13-pounder ammunition wagon	3696
18-pounder ammunition wagon	4816
4.5-inch howitzer ammunition wagon	5040

It is worth mentioning that the wheels of the new 18-pounder are considerably less in diameter than those of the old gun or wagons. The purpose for this reduction is to give steadier shooting and undoubtedly this end is attained, but all practicable minds will at once realize that another result achieved by the change will be heavier draft in proportion to weight. In deep mud or the heavy sands of the East this increase in draft weight will be at its greatest.

Having seen what the horses have to pull, let us now see how they pull. Each gun or wagon is drawn by a team of six horses. Drivers are mounted on the near or "riding horses," the off or "hand" horses merely carrying blankets, feeds, and waterproof sheets. A modification of the normal pole draft is used for harnessing the wheelers, while the swing and leaders

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are hooked on with leather-covered wire traces. Breast collar draft is always employed throughout, and the arrangement of the harness is so ingenious that if a horse is shot it drops straight out of its place, the rest of the team being able to carry on. It is hardly necessary to state that the loss of a wheeler would be most inconvenient and that of a swing the least so.

We now come to the great difference in principle between military and civilian draft. In the former the "line of draft" is upwards, while in the latter it is downwards. The "line of draft" or the "line of the traces" is considered one of the most important factors in military horsemanship, and in a well-organized team traces should follow a straight line commencing at the swingle-tree behind the wheeler and gradually rising to the breast collar of the leader. The full power of the whole team can only be obtained when this maxim is carried out. In civilian work full team draft is never employed except in the case of heavy drays or farm carts, and then the principles frequently do not appear to be understood. In a coach it is the wheelers which do all the serious work. The leaders are only called into full play when travelling uphill. The wheelers do all the work of holding back downhill and 80 per cent. of the pulling on the level. Teams of six horses are not used. In the army every one of the six horses should be doing an equal share of work on all occasions except when going downhill. The work is thus equally distributed. All guns, limbers, and wagons are fitted with very powerful brakes, which are applied by gunners dismounting for the purpose when any downward gradient is encountered. These brakes help the wheelers much, as, of course, the swing and leaders cannot hold back with traces. The only other occasion on which the wheelers do the work is backing a gun, limber, or wagon on to a position, and this backing should never be for more than a very few yards. The great principle of military draft is even distribution of work on all occasions.

If the "line of draft" is upwards it is obvious that the lowest horses must be in the wheel and the tallest in the lead,

with a mid-size in the centre. This is invariably arranged, and custom has also ordained that the off or "hand" horses should be from $\frac{1}{2}$ inch to 1 inch taller than the riding horses. At first sight this may seem absurd, but the extra height of the hand horse makes its control far easier for the driver than would be the case if he had to stoop over it. There are, however, many experienced gunner officers who prefer hand horses to be as near as possible the exact size of the riders, their reason being that interchangeability is of primary importance.

The driver has been frequently mentioned, so it is as well to remember that the artillery horse has to carry a man as well as pull a gun. The full weight of man, saddle, and accoutrements is 17 stone—no mean weight (238 pounds).

In addition to the draft horses there are a number of "outriders" with every battery used by such individuals as sergeants, corporals, farriers, signallers, etc., and in the Horse Artillery all gunners. The average weight carried by an outrider may be taken as 238 pounds, though doubtless this estimate is vastly inadequate in certain cases; but when it is exceeded, probably by some farrier or old-time quartermaster-sergeant, compensation is invariably set up by the rider's unwillingness to proceed at any but the steadiest of speeds.

We have now seen the task that is set the artillery horse and something of the manner in which it is expected to perform it. These are the essentials, and breeders can make their own deductions, but a few suggestions for indicating the ideal from the point of view of the Regimental Officer may not come amiss. First and foremost is the question of size. Short, "stocky" horses are unquestionably the best. An ideal Field Artillery team would consist of a riding wheeler of 15 hands, a riding swing of 15.1 $\frac{1}{2}$, and a riding lead of 15.3. The hand horses might be $\frac{1}{2}$ inch higher throughout. The pace of the Field Artillery is the trot, and so tall horses are not required, but the pace of the Horse Artillery is the canter. Accordingly, horses for the Right of the Line should be taller and generally built for more rapid movement. An average of 1 $\frac{1}{2}$ inch increase

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in height over the corresponding horse in the Field Artillery would be as near perfection as possible.

In build the Horse Artillery "hairy" should be somewhat lighter than his cousin of the Field, but in both branches sturdiness and weight are essential in all wheelers. It has already been shown that extra work is inevitably thrown on these animals, in spite of all efforts at equalization of draft, and selection must be made accordingly. Powerful quarters, large-boned gaskins, and broad chests are the first points for which a battery commander looks in selecting his wheelers. Bone is essential to all draft horses and is one of the greatest sources of strength, just as too sloping pasterns can be one of the greatest sources of weakness. This point is sometimes forgotten. Good shoulders—really good ones—are as great a joy as they are a rarity, but for draft they can be judged more leniently than for a rider. At the same time it must always be borne in mind that the back can never be too short, and that a roach back is invariably a strong one. An "expensive" horse to keep in condition is the gunner's worst enemy. None can be too well ribbed up.

In European climates the English horse is unrivalled, but in India and similar countries the Waler is probably best. Lighter than their English relations, they need more careful nursing and are more prone to knock up after continued long marches. As a compensation it was found before the war that, generally speaking, the Waler "hairies" showed more blood than those found in English-horsed batteries, and blood is essential for a really first-class artillery horse. Like other good qualities, however, it can be over-estimated in importance when making selections. But its palpable presence will ever be a joy, and in time of real stress will prove its true value.

In France a very large percentage of Walers that were brought from India in the autumn of 1914 died during the first winter, but those that recovered did well. The Canadians and Americans also stepped nobly into the breechings and traces, but they lacked bone and were delicate in constitution—not at

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all unlike Walers. The English horse stood alone,* and to give an idea of the capabilities of really first-class teams of the best of artillery horses, the following quotation from a letter written by a subaltern of Royal Horse will prove instructive. It is dated September 3, 1914. This particular section was one of the first of the British Army to be in action, and formed a part of the extreme rearguard during the whole of the retreat: "We've been trekking beyond all words. Day after day over thirty-five miles—lots of fighting and manœuvring—and one day over fifty miles in twenty-four hours. I have got my teams through till now without having a horse permanently out of work, less one detachment horse which I had to shoot for exhaustion and one team horse with bad sprained tendon."

Outriders should not be turned into a fetish. A few really fine such horses are the greatest asset to any battery, but none should be selected which could not be placed in draft should an occasion of dire necessity arise. All who love a good horse will regard the idea of putting a first-class hunter or pigsticker in draft with horror. This is a good sentiment provided the possibility of the coercion of circumstances is not forgotten. For this reason polo ponies are out of place in a battery. Many good leaders and swing make excellent rides, and hundreds, if not thousands, must have been ridden after hounds or pig in the years between the South African and Great Wars with unbounded delight and benefit, both to themselves and their riders. Wheelers are, as a rule, too heavy for such amusements, but they, too, have sent their representatives to these greatest of sports.

No mention has been made of the mule, but it must be remembered that he did nobly in France. Let us admire the results he achieved and even his character, but let our dealings with him stop short with this admiration when we are considering the future of the Royal Horse and Royal Field Artillery.

G. B.

* This statement may be questioned. We refer the reader to Part II of "The Horse and the War" in this issue.—EDITOR.

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Artillery in the Offensive

ETTORE ASCOLI, COLONEL OF ARTILLERY. REVISTA DI ARTIG. E

GENIO, JULY—AUG., 1919

14,000 WORDS; MAP*

Synopsis By Lt. Col. O. L. Spaulding, Jr., F. A.

THIS paper deals with the subject from the tactical side, neglecting artillery technic in so far as possible.

Assignment of Artillery.—An army for offensive operations is made up of a certain number of army corps, each complete in itself, and of artillery units of various kinds, particularly heavy guns and howitzers for destroying the enemy's defenses, and pack or mountain artillery to accompany the attack.

Part of the artillery is distributed among the corps according to the general plan and situation. Corps intended for a decisive attack require a strong force of heavy guns, and of long-range guns, so that successive units may advance under protection of the fire of those that remain in position.

This distribution of artillery is of prime importance; it should not be a compromise based upon the requisitions of the corps commanders, but should result from a genuine tactical decision. One may go so far as to say that from study of the distribution of the artillery of an army may be deduced the general conception of the whole maneuver.

Artillery not so distributed remains under the direct control of army headquarters. This consists chiefly of long-range heavy guns and howitzers, intended to deal with targets of exceptional importance, or affecting more than one corps. Other units, generally of heavy guns, are held in reserve, to be assigned to corps as required during the operation.

Army headquarters may also impose certain limitations upon

* From National Service with the International Military Digest.

the use of batteries assigned to corps, as, for example, directing that they be at the disposal of one corps for a specific phase of the operation, and pass to another for the next phase. The corps regulates assignments to divisions on the same principles. In special cases—as, for example, in mountainous country where a division has to be split into several separate columns of attack—each column may be given its own artillery under a temporary chief; the divisional chief may, as in the action of January 27-29, 1918, modify this assignment at will during the operation. Any such change of assignment should, if possible, be foreseen, arrangements for communications made, and the artillery commander given an idea of his probable targets.

Deployment of Artillery.—The deployment of the artillery is the natural consequence of its distribution, and should be considered at the same time. Each commander should be allowed as much freedom as possible in posting his batteries, but the general scheme must be given him. To secure enfilade fire, reach targets behind the enemy's lines, and to accompany the attack by fire, all the batteries must be gotten as far to the front as possible; so that an offensive deployment is characterized by concentration of guns to the front, in sharp contrast with the defensive deployment, which is in great depth. Hence the forward concentration should be made only at the last moment, and should be carefully concealed. Registration must be skilfully arranged, or dispensed with entirely for those batteries that do not require close adjustment.

In selecting gun positions, cover is to be sought, but guns which are to fire only during the main attack, when the volume of fire is great, may take position in the open without great risk. Depressions should be avoided, on account of danger from gas. Guns should be at wide intervals, well away from registration marks, main roads, depots, etc., and due use should be made of single guns, separated from their batteries, for adjustment, and to mislead the enemy.

After the position is selected, reconnaissance should be continued, communications established, etc., as far as time and

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facilities permit. In stabilized lines, elaborate works for concealment and shelter may be undertaken, but in the field such work must be omitted or greatly reduced. The occupation of position by large forces of artillery needs detailed planning and close supervision.

Tactical Organization.—The primary tactical unit, the battalion, should be homogeneous and permanent. Temporary groups of battalions are made up, according to mission, and reinforced as the critical stage arrives.

Thus, the divisional artillery should consist of the guns working in direct touch with the infantry, for destruction and accompaniment; if the batteries are very numerous it is advisable to organize two separate groups for the two purposes. The corps should have the counter-battery guns and howitzers, organized in one or more groups; all should be controlled by a single commander. The army should have its group or groups of high power long-range battalions, chiefly for distant interdiction.

These temporary groups are of great convenience and importance in the work of preparation. They should not be allowed to hamper the command in execution, but suitable modifications in organization and mission should be made whenever necessary.

Preparation of the Attack.—This is executed by all available batteries, and includes: (a) Action against material defenses or obstacles; this task is assigned to specific units of the divisional artillery. (b) Counter-battery; executed by groups organized for the purpose, and by batteries from the army artillery. (c) Action against hostile personnel, either in front lines or assembled in rear; this is assigned to divisional batteries, light or heavy, and to long-range batteries, according to the nature and range of the targets. (d) Interdiction fire, to interrupt the movement of troops and supplies; executed by either light or heavy batteries as above.

(a) This work is planned at division headquarters, after consultation with infantry brigade commanders. The plan includes designation of defenses to be attacked, assignment of batteries,

and all the details as to time, method of fire, and selection of projectiles. Observation of effect is best made from advanced observation stations, and from airplanes, rather than by patrols, since the latter method involves more and longer suspensions of fire. Destruction should be made as complete as possible, but the time element must be considered.

Detailed preliminary reconnaissance is desirable, but in operations involving manœuvre this is impossible. Reliance is then placed upon artillery officers' patrols pushed well ahead. It is desirable that commanders of battalions or heavy batteries themselves be well to the front and in personal charge of this work; and that authority be given them to place their guns in action without orders from higher authority, simply on approval of the immediate local commander.

(b) Counter-battery work involves, first, location of the hostile batteries, observation stations, ammunition depots, etc.; next, assignment of duties; and finally, installation of the batteries, establishment of communications, etc.

The artillery communication service should be as thoroughly organized and centralized as possible. Assignments are made under the direction of the army commander, who may, according to the nature of the ground and other circumstances, retain direct control of the work or apportion it to corps or even divisions. Details of the arrangements are on principle left to the subordinates.

Counter-battery includes fire for destruction and for neutralization. The former requires good aerial observation, and a great deal of time and ammunition. The permanent damage is small, and in our theatre of operations such fire is not in general justified.

For neutralization, one battery can generally deal with two hostile ones. In special cases, a battalion may concentrate upon one battery, but higher concentrations are seldom useful. The fire may be with ordinary or special projectiles, or with both; the target should be kept under fire to prevent re-entry into action, and ultimately the effect equals that of fire for destruction.

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Such fire should be by map, based upon registration, checked by the best possible ground and air observation. It continues throughout all phases of the action. In war of manœuvre, preparations must be made beforehand for advancing counter-batteries by echelon, remembering that guns should not be moved unless really necessary, and that a few with ample ammunition can do as much as many scantily supplied.

(c) and (d). In these cases the purpose is to injure personnel or impede movement. The fire must then be distributed in great depth to cover the entire zone of activity. The plan depends largely upon the configuration of the ground, supplemented by information as to the dispositions and customs of the enemy. This information, of course, must be fresh and accurate to be of any value. The targets are very varied, situated at all ranges, and guns of all kinds and calibres must be used; no one authority can handle all cases, and each artillery commander, from the army down, must handle certain parts of the work himself and apportion other parts to the lower units.

Accompaniment.—This includes all the fire which is intended for direct assistance of the advancing infantry. Analysis of a specific case—a raid executed by the 12th Division on December 22d, 1917—shows that the accompaniment included counterbattery, destruction and interdiction, as well as frontal and lateral barrages. The matter, then, is complicated—the movements of the infantry must not be hampered, unexpected targets have to be dealt with, and counter-attacks are always possible.

To avoid these difficulties the rolling barrage has become habitual. But this reverses the normal sequence, and makes the infantry advance depend upon a prearranged artillery timetable, rather than requiring the artillery to conform to the needs of the infantry. The system is so inelastic that it has been found necessary to provide for changes in the time-table, to be made on signal from the infantry during the attack, but even this is too rigid, not to mention the danger of errors. And at best the barrage can never completely accomplish its purpose, and be a satisfactory substitute for adjusted fire upon specific targets designated by the infantry.

In our mountainous frontier country, it is generally impossible to organize a large attack with a single coherent barrage. It is necessary to split the command into separate columns according to the ground, and let each one make its own attack independently, but according to a general plan. The barrage is therefore broken up into numerous small barrages, keeping generally abreast and connecting at specified times on certain lines, then starting afresh. This diminishes, but does not eliminate, the inconveniences of the system.

Advanced observation points should be sought, from which to watch the progress of the infantry; the artillery commander should be with the commander of the column, and the infantry should be practiced in the designation of targets. Finally, the infantry should be provided with its own light guns to deal with machine-gun nests; and there should be artillery, preferably mountain guns, assigned to the assault troops, with a group chief accompanying the advanced infantry commander.

The whole general plan of accompaniment is prepared by the divisional artillery commander; the artillery chief of each separate column handles the details for his own command.

Maintenance of Captured Positions.—The artillery assists in holding the captured positions by energetic counter-battery work; by fire upon zones where counter-attack troops are known or suspected to be assembled; by interdiction fire upon probable lines of counter-attack, and by transforming the accompanying fire into standing barrages. The plan is prepared by the corps chief of artillery, who assigns duties to the divisional artillery and supervises execution. If no further advance is intended, the fire is gradually suspended; but this does not mean rest for the batteries, which should continue in observation.

Exploitation of Success.—When the infantry resumes the advance, the artillery resumes its accompanying fire. The important thing now is to get the batteries forward. This should be provided for in the original artillery plan; but modifications should be freely made as conditions require, and the units should act with boldness and decision.

(*To be Continued.*)

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Artillery in the War of Movement

SPARTACO TARGO, COLONEL OF ARTILLERY. RIVISTA DI ARTIG-LIERIA

E GENIO, JUNE, 1919

3500 WORDS*

Synopsis By Lt. Col. O. L. Spaulding, Jr., F. A.

THE war of movement as understood before 1914 must be modified by the improved arms and means of transport. Certain elements of this modification are exemplified in the operations from July to November, 1918; but we must remember that while this period no longer had the essential characteristics of a war of positions, it was not yet purely a war of movement.

In working out the new tactical principles of the war of movement, two new factors must be specially considered: tanks and the participation of aircraft in ground fighting.

Infantry is of greater importance than ever; at the same time, to command it is a harder task, and requires quicker decision.

Communications have acquired greater importance.

The mass of artillery assigned to divisions is increasing, and with it the importance and difficulty of the work of its chief. In the same proportion, the importance of corps artillery diminishes and the heavier guns become of less general use. Methodical counter-battery work is not possible to the same degree as in fixed positions. Difficulties of observation tend to a greater use of neutralization fire upon a zone, subject always to considerations of ammunition supply. Air activities in the enemy's back areas may supplement or replace long-range artillery fire. Great attention must be paid to ammunition supply. Arrangements must be made for advancing the artillery so that the infantry may never be without its close support.

Combat sectors must not be rigid divisions, but troops must mutually support each other. Pauses will occur after each movement ahead and must be dealt with after the manner of position warfare, in so far as time permits. Special projectiles are often useful, but must be selected with judgment. Sedentary

* From National Service with the International Military Digest.

habits must be discarded and impedimenta reduced to the minimum. Traffic must be strictly regulated.

Communications.—Trench warfare accustoms the troops to ample and convenient communication systems. In the open, communication is even more important, and at the same time more difficult. The organization must be made simpler and more elastic.

Taking it as an undisputed principle that infantry and artillery must always be in communication, it follows that each artillery commander should always have his station near that of the infantry commander with whom he is working. Then each arm must make sure of its own internal communications. This indicates a communication detail as an organic part of every unit, fully equipped, and under the direct control of the unit commander.

Radio and ground telegraphy may relieve somewhat the strain upon the telephone systems. Battalion and battery commanders will as a rule be fairly near their batteries, so visual signalling and runners will also help out. Patrols, detachments, etc., must use every expedient that ingenuity can suggest to maintain constant communication.

Advance of the Artillery.—A part of the batteries should move forward promptly; the change of position should not be delayed simply because the guns can still reach the most distant targets from their initial positions. The limbers or tractors must be brought close to the guns. Every infantry unit should have the close support of artillery, of light and medium calibre. The long-range heavy artillery is best left to the army command. In mountainous country large forces of pack artillery are necessary, especially mountain howitzers of about 100 mm.; for the infantry is forced to manoeuvre off the roads, where ordinary batteries can not go.

Reconnaissance and Selection of Position.—Speed is essential—it is even said that a battalion or battery commander's reconnaissance must be made at a gallop. Elaborate preparation of the position is impossible. Cover should be sought, but

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it may be necessary to take position in the open. Batteries should be well separated in interval and distance, and wide intervals between guns may be used. Positions should have a wide field of fire, easy approach, easy exit to the front, facilities for ammunition supply, and good concealment. Flank protection should be provided for when necessary and great attention given to observation stations. Frequently fire can be observed only from the front lines; hence it should be remembered that any place offering a view is an observing station; the only equipment needed is a man, a field glass, a telephone, and nerve.

Scouts.—Artillery may have to come into action rapidly and unexpectedly, so that scouts and officers' patrols are necessary, working in close touch with the infantry patrols.

Conduct of Fire.—Simplicity and speed are the essentials. Ammunition is hard to get, and it should be used only on suitable targets. There can be no refinements of harassing and retaliation fire, etc., but only fire for effect upon targets of importance, intelligently selected. The ammunition service must be pushed with the greatest vigor; if a battery is out of ammunition it must not retire, but shelter its personnel and material and seek a new supply, meanwhile caring for the guns.

Selection of Position for Anti-Aircraft Batteries and Machine Guns

RAFFAELLO D'ANTONIO, LIEUTENANT COLONEL OF ARTILLERY.

RIVISTA DI ARTIG. E GENIO, JULY—AUGUST, 1919

4500 WORDS; DIAGRAMS*

Synopsis By Lt. Col. O. L. Spaulding, Jr., F. A.

THE principal points involved are: (a) Guns should be on the exposed side of the point they are to protect; (b) to avoid inconvenience from the sun, they should be on the south side; (c) they should be in a dominating position, or at least where nothing will interfere with direct pointing; (d) local conditions (woods, streams, etc.) must be considered; (e) the danger from shell fragments, from the same or other batteries, should be

* From National Service with the International Military Digest.

avoided as far as possible; (f) the battery should not attract attention to the place which it protects; (g) it should not be too near the enemy's probable targets. Every position will have its good and bad points, which must be balanced.

The first essential is that the batteries shall be so placed as to fire with maximum effect upon aircraft seeking to bomb the places they protect. Distance and altitude of the target are important in shrapnel fire, less so with time shell; of more consequence is to have the target under fire as long as possible, in particular at the time when it is maneuvering to drop bombs.

For safety, an airplane should of course fly high, but increase of altitude increases disproportionately the dispersion of the bombs. It is evident, then, that considering the size and form of each target, there is a certain altitude at which the probability of hitting falls below any selected figures, say 50 per cent. These limiting altitudes should be studied for each type of plane and bomb; but the theoretical results are useful only in a qualified sense, since they vary with the form of the target, direction of flight, time of day or night, condition of light, etc. In general, one may say that the probable altitudes in daylight will be: for single buildings, 1500-2000 m.; bridges, 2000-2700 m.; villages, 2700-3000 m.; cities, 3500-4000 m. These altitudes are of course diminished at night. Dirigibles will usually fly higher than airplanes.

For each battery a "crown" can be constructed, showing its possibilities of fire. Suppose a series of graphic trajectories, for a given gun, projectile and charge. Any given horizontal intersects these in two critical points, giving a maximum and a minimum range to reach a target at a given altitude. From these points we get the radii of two circles constituting the "crown."

Similarly a "crown" may be constructed for any target, showing the most important zones to be covered by fire. An aeroplane, to drop a bomb, has to fly for a certain period with uniform speed, direction and altitude. The distance from the target at which it will drop the bomb is a function of these

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variables. After dropping the bomb the plane does not, as a rule, fly over the target, but turns back to approach from another direction and try again. Two circles, then, may be drawn, showing the limiting distances within which an attacking airplane at any given altitude will probably manœuvre.

With these crowns, for each target and each proposed battery, we may tentatively select positions by assuming the target fixed and the batteries movable, and experimenting with different arrangements. Numerous distinct cases will arise, which will require different treatment, but this plan may be used as a basis. It applies to artillery, primarily, and requires certain modifications for machine guns.

It will be noted that as the size of the target increases the probable altitude of the plane, and consequently of the target crown increases, while the size of the battery crowns diminishes. Thus it is seen that the number and power of the guns required increases greatly.

If a large centre, rather than a single target, is to be considered, the problem is more complicated, but may be solved by the application of the same general principles.

Rules for the Installation of Anti-Aircraft Batteries and their Auxiliaries

ARCIERO CARLO BERNINI, CAPTAIN OF ARTILLERY. RIVISTA DI

ARTIG. E GENIO, JULY—AUG., 1919

3500 WORDS; PLATES AND DIAGRAMS*

Synopsis By Lt. Col. O. L. Spaulding, Jr., F. A.

Battery Positions.—The points to be protected must be studied, and arranged in their order of importance. From the range tables, the zones of effective fire against the highest targets should be determined, and the batteries so placed that at least the most important targets shall lie within these zones. Dominating sites are not essential; 150° clear space overhead gives a horizontal view of 10 km. for objects at 1500 m. altitude. It should not be assumed that planes will enter the zone of fire

* From National Service with the International Military Digest.

from the direction of the enemy's lines. On account of the sun, batteries should for preference be south of the points protected. The pieces should be in a line, nearly normal to the direction from the battery to the most important point covered, but not passing through any other such point—this on account of danger from premature bursts. Gun intervals should not be more than 10 m., for convenience in transmission of orders and supervision of the service of the pieces. Observers, etc., should be well out of the direction of fire; a movable platform may well be provided for them, to be run on rails to either flank of the battery, and two stations constructed for the battery commander, so as to place him in rear of the centre, whichever the direction of fire. Instruments should be oriented, and mil scales placed on gun platforms, to facilitate location of targets. All elements of the battery should be well concealed. Shelters for men and ammunition are unnecessary. At night diffused light should be used. If there are several batteries, the nature of their armament should be considered in assigning duties, and positions should be such that they will not interfere with each other.

Searchlights.—Only the most powerful (90 or 150 cm.) should be used. The positions depend upon the range of the lights, and upon the locations of the points to be defended, the guns, and the listening apparatus.

Their range at best is less than that of the guns, so they should be nearer to the points protected than the guns; but not so near that these points shall lie in the "dead zone," within which the maximum angular velocity of the beam can not keep pace with an aeroplane.

Dominating positions are not essential; 150° clear overhead is sufficient. Natural platforms are preferable to artificial, and dark or grassy ground better than light. A quiet place, near the listening apparatus, is evidently best. Hand control is surer and quicker than electrical. Each light should have at least two positions to prevent their use by the enemy as reference points.

Listening Apparatus.—These should be placed in polygon at about 15 km. from the points protected, communicating

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directly with headquarters. Others may be placed within the polygon, communicating with particular lights or batteries. Distance between stations depends upon their own range, but should not exceed about 8 km. Positions should be in quiet places; disturbing noises from special directions, *e.g.*, searchlight apparatus, may be guarded against by walls of sandbags. If a station has to be placed near a battery, notice should be sent it before each salvo, so that the listener may avoid shock to his ear. Since these stations function chiefly at night, positions should be judged by night; thus, certain daytime noises need not be considered. Grassy ground is best, so that the necessary movements of the crew of the station may not disturb the listener. A low site is best, cutting off local noises. The instruments should be oriented in conformity with those at the guns and searchlights.

EDITORIAL

THE JOURNAL is thoroughly appreciative of the excellent article on Infantry-Artillery, by Lieutenant-Colonel Paul B. Malone, which appeared in the January-February issue, as indicating the high spirit of comradeship and coöperation that has resulted from their close association on the battlefields of the World War, and the formation of a bond between the two arms that will insure even better teamwork in future war.

The primary mission of any auxiliary arm, and particularly of the Field Artillery, is clearly set forth in the report of Field Marshal Sir Douglas Haig on the Features of the War:

"Immense as the influence of mechanical devices may be (EDITOR'S NOTE—And the gun is a mechanical device), they cannot, by themselves, decide a campaign. Their true rôle is that of assisting the infantryman, which they have done in a most admirable manner. They cannot replace him. Only by the rifle and bayonet of the infantryman can the decisive victory be won."

To this doctrine the Field Artillery heartily subscribes.

But the question of "command" and "orders" in connection with the artillery support of minor units on the battlefield gives rise to grave doubts in the mind of the Field Artillery officer.

This question has arisen from time to time, and the answer is always the same. It was brought up after the World War, and acted upon by the service boards convened in France to consider the lessons to be derived from our experience.

We publish herewith quotations from the reports of the Field Artillery Board, A.E.F., and the Superior Board, A.E.F.,* which were adopted after exhaustive study and which embody the experience and opinions of officers of the highest rank of both arms, which seem to be entirely at variance with

* While these reports have never been approved, they nevertheless contain expressions of opinion of officers of experience.—ED.

EDITORIAL

the opinions expressed by Colonel Malone. We are assured that these findings of the boards are concurred in, not alone by the officers best qualified to speak for the Field Artillery, but by many infantry officers, whose command of brigades and divisions entitles their opinions to the highest consideration:

EXTRACT FROM REPORT OF FIELD ARTILLERY BOARD

"PLACING OF ARTILLERY UNDER COMMAND OF SUBORDINATE INFANTRY COMMANDERS

"Divisional artillery exists for the support of its infantry. If both artillery and infantry officers realize this fact, no question can arise as to the command of artillery passing to a subordinate infantry commander. The latter is occupied with his own difficulties in action and desires only that the artillery support him when and where needed. Arrangements for this support to be quickly and effectively delivered must be made by decentralization of command within the artillery brigade. The colonel, the major, or the captain, as the case may be, is closer in touch with the infantry, and realizes their needs more than the brigade commander can. To comply with the infantry's request for fire, quickly and effectively, must be a mission of first urgency. The first artilleryman who has the means at hand must furnish the desired support on his own initiative. Proper teamwork between artillery and infantry will ensure results, and there will be no desire on the part of the rational infantryman to command his supporting artillery. At the same time that freedom of action has been given subordinate *artillery* commanders for the close support of the infantry, the artillery brigade commander will still retain the command in such a way that he can, in an emergency, furnish such fire as the division commander himself may order."

EXTRACT FROM REPORT OF THE SUPERIOR BOARD

"LESSONS OF THE WAR

"This close association of infantry and artillery commands does not involve, however, *parcelling out the artillery among*

THE FIELD ARTILLERY JOURNAL

the minor infantry commands and making of the division a number of small separate combined commands. This would mean losing the ability to concentrate and to adapt the power of the artillery to meet the larger phases of the action. The commander must preserve the ability to use his artillery in this larger way, and to influence its action when he sees fit through the intermediary of his divisional artillery commander. *Hence the command of associated artillery does not pass to subordinate infantry commanders except in the case of special groups assigned to carry out certain definite missions.*"*

D. E. A.

* Our italics.—ED.

BOOK REVIEWS

THE TURN OF THE TIDE. By Jennings C. Wise. Formerly Lieutenant Colonel, Infantry, U. S. A., Historical Section, General Staff, G.H.Q., A.E.F. (Henry Holt & Company, New York.)

The author is well known to students of military history through his previous works, among which are: "Empire and Armament", "Gunnery", "The Long Arm of Lee", "The Call of the Republic", etc.

This book is an interesting and instructive study in narrative form of the American operations around Soissons. The author, as a member of the Historical Section of the General Staff, A.E.F., had access to the official records, and, using them to supplement his personal knowledge of the situation, has described in simple and interesting form the actions at Cantigny, Chateau Thierry, and Soissons. The book might have been improved for the student of military history by the use of better maps, but, as it is, it is worthy of study by all officers of the Service.

SIR DOUGLAS HAIG'S DESPATCHES (December, 1915—April, 1919). Edited by Lieutenant-Colonel J. H. Boraston, O. B. E. (Private Secretary to Earl Haig), with specially prepared maps, sketch, plans and portraits. 1919, London and Toronto. J. M. Dent & Sons, Ltd. New York: E. P. Dutton & Co. In one volume, with map portfolio.

These despatches give a very interesting and somewhat detailed account of the operations of the British Armies during the period December, 1915—April, 1919. As their author states in his preface, "Being intended primarily for the eyes of British subjects, and dealing with the operations of the British Armies, the despatches necessarily refer but briefly to the actions of our Allies." Nevertheless, they should prove of great interest to military students, and will be a valuable addition to an officer's library.

The book contains an Introduction by Marshal Foch which was written for the French Edition of the Despatches, and is reproduced in English with his permission and approval.

Marshal Foch has this to say in part of the Despatches:

"Written with the strictest regard for the truth, and scrupulously exact to the smallest details, these Reports are distinguished by their unquestionable loftiness and breadth of view. The information that

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they give, not only on the operations themselves, but also on the condition of the troops—on the changes made in their training and their formation during the course of the war—constitutes them historical documents of the highest order."

ARMY MENTAL TESTS. Compiled and edited by Clarence S. Yoakum and Robert M. Yerkes. Published with the authorization of the War Department. New York, Henry Holt & Company, 1920.

This book was prepared to meet the large number of requests received by the Office of the Surgeon-General of the Army and the National Research Council for information concerning the methods of psychological examining, and for the printed materials used in the United States Army.

The book has been prepared under the editorial direction of Majors Yoakum and Yerkes, who, in co-operation with other members of the Psychological Staff of the Surgeon-General's Office, selected the various materials and decided about the mode of presentation.

As an official report on the work and achievements of the Psychological Committee during the War, this book will be of decided value to psychologists, but it will be of particular interest to the executives of industrial concerns employing large numbers of employees.

The book gives an excellent explanation of the subject, and may be highly recommended to those who have need of the application of intelligence tests.

The United States Field Artillery Association

PROPOSED AMENDMENTS TO THE CONSTITUTION

WASHINGTON, D. C.,

December 31, 1919.

The Secretary, United States Field Artillery Association,
Washington, D. C.

SIR:

In conformity with Article IX of the Constitution of the United States Field Artillery Association, the undersigned, being active members of the Association, hereby propose certain changes in said Constitution for the following principal reasons:

(a) At the time of the adoption of the Constitution of the Association there were no officers of the Field Artillery Section of the Officers' Reserve Corps. There are now approximately eight thousand of these officers, all of whom were in the Field Artillery of the United States Army during the World War, and a considerable number of whom are subscribers to the FIELD ARTILLERY JOURNAL. It is believed that the service and interest of these officers merits the privilege of active membership in the United States Field Artillery Association, and representation upon the Executive Council of the Association.

(b) It is believed that the natural interest in Field Artillery matters of those persons who served in the Field Artillery of any of the United States forces during the World War should entitle them to the privilege of associate membership in the United States Field Artillery Association.

The proposed amendments to said Constitution are clearly set forth as follows:

1. It is proposed to amend Section 2, of Article III, by

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inserting the words "and commissioned officers on the active list of the Field Artillery Section of the Officers' Reserve Corps" between the words "District of Columbia" and "provided" in line six of said Section, so that said Section shall read, when amended, as follows:

Sec. 2.—The following shall be eligible to active membership:

Commissioned officers on the active lists of the field artillery of the regular army and of the organized militia of the several states, territories and District of Columbia and commissioned officers on the active list of the Field Artillery Section of the Officers' Reserve Corps; provided, that officers of the regular army when separated from the field artillery, by promotion or detail in staff departments, shall not thereby lose their status as active members.

2. It is proposed to amend Section 3, Article III, by adding thereto the following sub-paragraph:

"(g) All persons who, in any war, served in any capacity in the Field Artillery of any of the forces of the United States Federal Government," so that said Section shall read, when amended, as follows:

Sec. 3.—The following shall be eligible to associate membership:

(a) Commissioned officers on the retired lists of the regular army and of the organized militia of the several states, territories and District of Columbia.

(b) Those who, as commissioned officers, either regular, militia, or volunteer have served with batteries or larger units of field artillery in time of war.

(c) Commissioned officers of the regular army and of the organized militia of the several states, territories and District of Columbia, not now belonging to the field artillery,

U. S. FIELD ARTILLERY ASSOCIATION

who have served at least one year as commissioned officers in field artillery.

(d) General officers of the regular army, except as provided in Section 2 of this Article, and of the organized militia of the several states, territories and District of Columbia.

(e) All commissioned officers and former officers of the United States Army, Navy and Marine Corps, and of the organized militia in good standing, not included in the classification hereinabove set forth.

(f) Those in civil life, whose applications are approved by the Executive Council hereinafter provided for.

(g) All persons who, in any war, served in any capacity in the Field Artillery of any of the forces of the United States Federal Government.

3. It is proposed to amend Section 1 of Article VI by striking out the word "five" in line two of said Section and substituting therefor the word "nine"; by striking out the word "three" in line two of said Section and substituting therefor the word "five"; by inserting a comma after the word "army" in line three of said Section; by striking out the word "and" in line four of said Section; and by inserting the words "and two officers of the Field Artillery Section of the Officers' Reserve Corps" between the words "militia" and "to" in line four of said Section, so that said Section shall read, when amended, as follows:

Sec. 1.—The Executive Council shall be composed of nine active members, five of whom shall be officers of the regular army, two officers of the organized militia, and two officers of the Field Artillery Section of the Officers' Reserve Corps, to be elected biennially for a term of two years by a majority vote, in person or by written proxy of the active members. The Council shall hold its meetings at the headquarters of the Association, which shall be in the city of Washington.

THE FIELD ARTILLERY JOURNAL

4. It is proposed to amend Section 3 of Article VI by striking out the word "Three" in line three of said section and substituting therefor the word "Five," so that said Section shall read, when amended, as follows:

Sec. 3.—The Executive Council shall meet from time to time, at the call of its senior member present in Washington. Five members shall constitute a quorum for the transaction of business.

Respectfully submitted,

E. P. KING, JR., Col., F.A.	C. P. GEORGE, Col., General Staff.
JOHN B. ANDERSON, Lt. Col., F.A.	J. F. BARNES, Major, G.S.
W. C. POTTER, Col., F.A.	CLIFT ANDRUS, Lt.-Col., F.A.
R. E. LEE, Col., F.A.	M. CHURCHILL, Brig.-Gen., G.S.
G. R. ALLIN, MAJOR, F.A.	D. F. CRAIG, Major, F.A.
T. W. WRENN, Major, F.A.	MANUS MCCLOSKEY, Col., F.A.
WILLIAM E. BURR, Lt. Col., F.A.	WM. BRYDEN, Major, G.S.C.
T. D. SLOAN, Col., F.A.	MAXWELL MURRAY, Col., F.A.
W.W. HESS, JR., Major, F.A.	WM. J. SNOW, Maj.-General.
C. S. BLAKELY, Major, F.A.	OLIVER L. SPAULDING, JR., Lt.-Col., F.A.
E. T. SMITH, Col., F.A.	J. N. GREELY, Col., F.A.
F. W. HONEYCUTT, Col., F.A.	H. W. BUTNER, Lt.-Col., F.A.
H. D. HIGLEY, Lt.-Col., F.A.	

WASHINGTON, D. C.
December 31, 1919.

The Secretary, United States Field Artillery Association,
Washington, D. C.

SIR:

In conformity with Article IX of the Constitution of the United States Field Artillery Association, the undersigned, being active members of the Association, hereby propose certain

U. S. FIELD ARTILLERY ASSOCIATION

changes in said Constitution for the following principal reasons:

It is believed that no good reason exists for the requirement of the Constitution that the Secretary-Editor and the Treasurer of the Association shall be active members of the Association. Since the policy and records of the Association and the editorial policy of the FIELD ARTILLERY JOURNAL are under the close supervision of the Executive Council, the members of which are required by the Constitution to be active members of the Association, and since the Executive Council selects the Secretary-Editor and the Treasurer, it is desirable that the Constitution be amended so as to permit those offices to be held by retired officers. It is necessary that the Secretary-Editor and the Treasurer should be stationed in or reside in Washington. As officers on the active list are constantly changing station, the number of troublesome changes in the officers of the Association will probably be diminished by making retired officers eligible to hold these offices.

The proposed amendments to said Constitution are clearly set forth as follows:

1. It is proposed to amend paragraph number three, of Section 2, of Article VI, by inserting the words "or associate" between the words "active" and "members" in line two of said paragraph, so that said paragraph, when amended, shall read as follows:

3. A Secretary-Editor, to be selected from its own members, or other active or associate members of the Association, and who shall be an officer of the Regular Army.

2. It is proposed to amend paragraph number four, of Section 2, of Article VI, by inserting the words "or associate" between the words "active" and "members" in line two of said paragraph, so that said paragraph, when amended, shall read as follows:

THE FIELD ARTILLERY JOURNAL

4. A Treasurer, to be selected from among the active or associate members, and who shall be an officer stationed or residing in Washington, D. C.

Respectfully submitted,

(Signed)

JOHN B. ANDERSON, Lt.-Col., F.A.	F. W. HONEYCUTT, Col., G.S. MAXWELL MURRAY, Col., F.A.
WILLIAM E. BURR, Lt.-Col.,	WM. J. SNOW, Maj.-General.
R. E. LEE, Col., F.A.	OLIVER L. SPAULDING, JR., Lt.- Col., F.A.
E. P. KING, JR., Col., F.A.	J. N. GREELY, Colonel, F.A.
T. D. SLOAN, Col., F.A.	W. S. BROWNING, Col., G.S.
W. C. POTTER, Col., F.A.	H. W. BUTNER, Lt.-Col.
T. W. WRENN, Major, F.A.	ALFRED A. STARBIRD, Lt.-Col., F.A.
CLIFT ANDRUS, Lt-Col., F.A.	DWIGHT E. AULTMAN, Col., F.A.
D. F. CRAIG, Major, F.A.	M. E. LOCKE, Major, F.A.
MANUS MCCLOSKEY, Col., F.A.	C. D. HERRON, Lt.-Col., F.A.
M. CHURCHILL, Brig.Gen., G.S.	A. S. FLEMING, Col., F.A.
WM. BRYDEN, Major, G.S.C.	A. J. BOWLEY, Col., F.A.

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