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BATTERY F, 5TH F. A., CAMP BRAGG, N. C., FIRING PERCUSSION SHRAPNEL FROM 155-MM. GUN (G. P. F. Photograph Gives Good View of Split Trail in Firing Position.

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ARTILLERY AMMUNITION SUPPLY

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Part I.—General discussion of certain lessons on Artillery Ammunition Supply gained from the World War.

Part II.—The functioning of the system of Artillery Ammunition Supply in conformity to the Tables of Organization, Series 1920-1921.

PART I

GENERAL DISCUSSION

1. To one who has casually considered the subject of ammunition supply, the bewildering variety of terms which are assigned to an ammunition "dump" is an outstanding obstacle to any further pursuit of the study. Why should a dump not be called a dump whether it belong to Army, Corps, Brigade, Regiment or Battalion? This is simple terminology, requiring no mental effort and is quite devoid of all mystery. Consider on the other hand the alternative epithets that are used, such as stockage, depot, advanced depot, rendezvous point, refilling point, ammunition distributing point, and ammunition distributing station. These terms were all in use overseas, which necessitated, in the opening paragraph of each ammunition supply order, a definition of the terminology that was to be employed therein.

In time of war the great majority of functionaries are laymen, a fact well worthy of consideration. The simpler a thing can be made the better will everyone perform. With this in mind, and with a declared policy of simplicity, the term "dump" will be adventured in the following pages to the exclusion of all other more sonorous phrases.

2. The "day of fire" is an arbitrary unit of measure of ammunition, based empirically on the experience of the Armies in the World War, and it is taken as follows:

Weapon	Day of Fire (Rounds per piece)
75-mm. gun	300
105-mm. howitzer	150
155-mm. howitzer	150
155-mm. gun	100
9.2-inch howitzer	80
240-mm. howitzer	60

3. "Day of fire" is a phrase that easily rolls off the tongue, but when it is translated into millions of rounds of ammunition and thousands of tons of train and truck shipment, it has infinite possibilities for causing worry. It very soon becomes the bugbear of generals as well as of lieutenants, who live in mortal terror lest the amount of ammunition, rigidly prescribed by higher authority, not get to the proper units when H hour arrives.

In the preparations for the St. Mihiel offensive, a great quantity of ammunition was ordered into the battery positions. There was required for this operation five days of fire in the Army area, of which *three* were ordered to be at the battery positions before the battle commenced. This order resulted in a hectic scramble all the way forward from the Army railheads, and ended in the ruining of many a good disposition and the wrecking of many a staunch truck.

When the offensive was launched and the batteries moved forward in pursuit, piles of ammunition, which later on it took weeks to salvage, were scattered over the whole front in abandoned battery positions. Had we not been "feeling ourselves out," so to speak, in this attack, part of the ammunition might have been concentrated—to better advantage for future use—in brigade or regimental dumps that were easily accessible to trucks, instead of being scattered about over so many positions that were hard to locate and difficult for trucks to get to.

At St. Mihiel, the *total* amount of ammunition fired by the 75s throughout the entire five days' attack was only 1.63 days of fire. Of this amount, 1.3 days of fire were expended on the *first day*.

For the Meuse-Argonne Operations, the initial attack required the greatest quantity of ammunition that it was possible to get up. It was decided to stock the Army area with five days of fire, as had been at St. Mihiel, and, similarly, three days were ordered into the battery positions.

On the first day, September 26th, the 75s expended only 1.02 days of fire.

For the 155 Howitzer, Schneider, the figures are somewhat reduced. Reports of the firing of September 12th show 1.02 days of fire expended, and reports of September 26th, .75.

For the 155 G.P.F., September 12th records show .61 and September 26th, 1.5 days of fire expended.

The conclusion to be drawn is not to overburden the batteries before an attack with a huge excess of ammunition. Getting such a big quantity so far forward adds much to the congestion of roads, interferes with other supply movements, delays organizations getting into position and augments the inevitable confusion at the front. It also helps to pile up truck casualties. Standing orders required that all movements of vehicles within 30 kilometres of the front lines should be done at night, with no lights of any kind showing on the trucks, not even tail lights in most cases. This resulted in numerous collisions and in trucks overturning in ditches. Truck casualties during the night in bad weather, ran well above twenty-five per cent. Motorcycles hardly stood a 50-50 chance. It was tragic, the number of vehicles that were put out of action for long periods due to night running without lights.

Experiments certainly ought to be made in peace time between airplanes and vehicles to find out the right kind of light, with the proper sort of shade, which could be burned at night by a truck or wagon on a main highway without danger of its being spotted by an enemy plane. Even the dullest kind of red or blue lamp to mark each end of the vehicle would be better than no light at all. It is believed, however, that a dim white head light, properly hooded with a long funnel-like arrangement, and the ordinary red tail light could be used with perfect safety.

4. Success in ammunition service depends a great deal on the smooth operation of the truck system to and from Brigade, Corps and Army dumps. It is often possible to arrange a schedule of truck train arrivals in order to prevent the inordinate confusion and road jams so often to be found at these dumps. This is very important as all those who had anything to do with ammunition supply at the front will freely admit.

5. Success in ammunition service also depends upon the judicious selection of ammunition dumps. They may be located from the map, but the locations must be checked by personal reconnaissance of the terrain by the Munitions Officer and the Ammunition Train Commander of the unit concerned. Skillful reconnaissance on their part will avert much trouble later on.

The fewer the dumps chosen the better they can be administered. For offensive actions they should be placed as far forward as possible. They must be accessible and at the same time must be concealed to the greatest possible extent from hostile observation. It was simply due to the fact that the enemy artillery was giving almost undivided attention to targets that were of greater tactical importance than ammunition dumps, and due to the noticeable diminishing of hostile activity in the air, that very few American dumps in rear of regimental areas were damaged to any appreciable

extent by bombing or by shell fire, though many of these dumps were out in open ground.

6. In the final analysis the fact remains that success in ammunition service is measured by the arrival or non-arrival of ammunition at the front. This is axiomatic: it is the only test that counts with the troops in the line: it is the true test as to whether or not the supply system is going right. Nevertheless, the more the difficulties are appreciated and studied by all concerned the better they can be avoided. *Understanding, coöperation* and *fair play*, all the way down from the Army Headquarters to the battery, will help immeasurably to solve what is perhaps the most difficult of all supply problems, *viz.*, that of ammunition.

7. There are certain rules regarding the establishment of dumps, which, if time and facilities permit, must be followed. In the larger units such as Corps and Army, ammunition for Heavy and Medium Field Artillery should form a dump separate from that for Light Field Artillery inasmuch as the problems of supply for these two general classes of artillery are quite different. This principle of the segregation of dumps, though generally not feasible in lower units, should be observed wherever possible.

If time permits, traverses must be made between piles of ammunition. The maximum amount of high explosive (75-mm. ammunition excepted) that should be placed in one pile is 7½ tons. This refers to the weight of the high explosive *filling*, and not to the weight of the shell. Piles should be separated from one another by at least 15 yards. This maximum of 7½ tons should not be taken advantage of except in cases of necessity. The 75-mm. shells should be sorted in not more than one half lot—approximately 6000 rounds to a lot—per pile, which should be traversed and separated from the next pile by at least twenty yards.

It is an invariable rule that powder and fuzes must be protected from the elements to the limit of the time and the facilities available.

8. During an engagement there are three vitally important jobs in the Divisional Artillery Brigade. These are: (1) liaison, (2) munitions and (3) command of the ammunition train. (The telephone and radio services may and do break down, but the liaison service—by courier as a last resort—and the ammunition service MUST NOT FAIL.) The efficient functioning of the brigade is immeasurably helped if highly capable officers hold these three positions. Therefore, it is essential that men of resourcefulness, unlimited energy, courage, common sense, and quick thinking be chosen to fill these positions. They must know artillery well, must appreciate its needs, and above all must be imbued with the idea that success or failure actually depends on how well they do their work.

9. The ammunition service in France, difficult at best, was simplified to a certain degree because of the splendid roads, speaking generally of course. Even when the No Man's Land of several years' fighting was crossed in the beginning of the Meuse-Argonne operations, the frightfully torn up stretches of road were quickly made usable. Good roads notwithstanding, the ammunition service would have been hard put to it without the 60-centimetre railroad. This little giant can cut straight across country, can be pushed forward rapidly and can feed places that only tractors with caterpillar treads, or pack animals, would otherwise reach. Trucks cannot go off good roads in bad weather: this has been conclusively proven in peace as well as in war. This means that the tractor, the tractor trailer, and the 60 centimetre must be called upon for crosscountry work of any *great* distance. There is no question but what the horse will be required to bear a large part of the burden of *shorter* hauls. In many sections of our country, pack horses or pack mules will have to be used to solve the problem of ammunition transportation.

In the General Headquarters Reserve, the pack trains over and above those assigned to Pack Artillery should be prepared and trained to carry ammunition when the necessity arises, which it often will in this country due to the vast areas of abominable roads. These trains could be rushed to the front with little delay. They would be of especial value in the proposition of stocking a combat area with ammunition prior to a big attack when most of the wheeled transportation was mired down, or when roads were so badly jammed that detours in roadside ditches furnished the only solution to getting supplies forward. These trains do not need to carry any weighty surplus equipment. The regular quartermaster pack saddle can be used and over this a canvas sack is slung. This sack, similar to the one issued to the British service, is stitched in four compartments on each side, thus holding eight rounds of ammunition. It is snapped under the mule's belly. Best of all it can easily be thrown across a McClellan saddle as a result of which *draft* horses can be converted into *pack* horses FOR SHORT HAULS if roads become so thoroughly blocked that no wheeled transportation can move. The 10th Field Artillery tried them out to their own satisfaction at the crossing of the Meuse, each battalion being equipped with about 50 such sacks.

Before quitting this question of ammunition transportation, "taps" should be sounded over the 155-howitzer caisson. This unwieldy vehicle does not and never will solve the transportation problem and worst of all it is a serious handicap to an organization. Its uselessness is frankly admitted. One escort wagon will carry 25 rounds of 155-howitzer ammunition, this being a normal load

for *four* mules or horses. One caisson and limber (155 howitzer), which is a most efficient horse killing combination, requires *eight* horses to move nearly the same amount of ammunition—28 rounds. Eight horses doing under enormous strain what four horses can do comparatively easy!

In a motorized organization the 155 caisson is just as unwelcome, for the truck or tractor trailer so far outclasses it that there is no comparison. The day when all 155 caissons are "scrapped" will be a day of great rejoicing throughout the Field Artillery.

10. Previous mention has been made about limiting as far as possible the number of dumps. Overseas the Artillery Brigade generally functioned with one, or at most two. The Corps sometimes established separate Corps dumps to feed each of its several divisons, but often a Corps functioned with only one for its whole area. The number established depends largely on road facilities, the degree of efficiency in handling road circulation, the condition of the roads and the length of hauls.

Army Headquarters, with its ammunition supply reaching out to the Army Artillery, the General Headquarters Reserve (which may have been sent into the area), the anti-aircraft batteries, the artillery of three or more Corps, etc., with the numerous types of ammunition dependent thereon, will necessarily have to establish many more dumps than the lower units. For the St. Mihiel Operations, G-4 of the 1st Army used fourteen and for the Meuse-Argonne, eighteen.

The personnel to man the Army dumps is supplied by the Chief Ordnance Officer of the Army. The personnel for the Corps, Brigade, Regimental and Battalion dumps comes from the Ammunition or Combat Trains. Five hundred Ordnance troops and thirty-six hundred labor troops were required for the handling, upkeep and construction work for Army dumps, and this personnel was in no way too large.

The Army Artillery may establish dumps wholly independent of those in operation by the Army Headquarters (G-4). During the first part of the Meuse-Argonne Operations, the Army Artillery Headquarters took over from G-4 at the Army Railheads all of the G.P.F. ammunition which was destined for the Army Artillery, and trucked it forward to the Army Artillery dumps. This system did not work well, however, and Army Artillery Headquarters changed it and drew directly from Army dumps in the same manner as did the Corps.

11. In rapid movement forward it is vitally necessary to shove dumps ahead with commensurate rapidity. In France, trucks sometimes had to go back 30 kilometres for ammunition. The seriousness of this was realized and all construction work on dumps—except road work that was absolutely necessary—was abandoned.

In semi-stabilized warfare, platforms for the ammunition, and "elephant iron" shelters for the powder and fuzes can be thrown up, but in rapid advances it is of vital importance to get the ammunition forward in some shape or other first of all, even if it has to be thrown off at the roadside. Dump conditions can be improved later on if time permits.

Due to the almost continuous hauling in and out of Army and Corps dumps, they must have better loading facilities than those of regimental or brigade, and the roads within the dump itself have got to be in fair condition. During the St. Mihiel Operations, from August 27th to September 16th, 5400 tons of ammunition went forward from the fourteen Army dumps. This would require 2700 two-ton trucks going in and out of the Army dumps in 21 days. As a matter of fact, the 60-centimetre railway did considerable hauling forward. Without its help, it would have been a physical impossibility to have sent forward the entire amount ordered to be at the battery positions on the day of the attack.

12. Stocking a sector with ammunition in preparation for a big drive is a tremendous task, and difficulties of all kinds mount up at a bewildering rate.

When an operation is planned, Army Artillery Headquarters, with approval of G-3, Army, determines the number of cannon to be sent into the area, and the "days of fire" necessary to feed these cannon. For the St. Mihiel and the Meuse-Argonne Operations, the First Army had twenty-five different types of cannon in its area, totaling nearly 2600 individual pieces. September 8th was one of the tentative dates for the attack, which allowed only eleven days preparation for getting the ammunition from the French S.O.S. to the battery positions. A total of 56,000 tons of artillery and 6000 tons of infantry ammunition was handled during these eleven days. Measured in trains (a French train, normal gauge, was made up of 36 cars, each 10 tons), this meant 173 trains of ammunition. The *maximum* receptive capacity of the Army Railheads in trains per day was 25, or a total of 275 trains in eleven days. It seems, however, as though this latter figure were an exaggeration, for the 173 trains arriving during the fortnight certainly kept the details at the Railheads busy night and day.

There were *12,000 tons of 75 ammunition alone*, and as three fifths of this, or 7200 tons, had to go to the battery positions, the road congestion the nearer one got to the front lines may well be imagined.

13. A few of the most patent troubles in ammunition supply may be summarized as follows:

(a) Untrained or insufficiently trained personnel at the dumps, which often resulted in the sending out of wrong powder or fuzes

with the projectiles, or sometimes in the sending out of projectiles without any powder at all.

(b) Convoys went astray and never got to their destination, though they were in most cases supposed to be met by guides at certain designated points, who had orders to conduct them to their point of unloading.

(c) Almost hopeless jams occurred at times in ammunition dumps due to more than one ammunition or combat train arriving at the same time.

(d) Trucks went off the road because of the difficult and hazardous night driving with no kind of light on the truck whatsoever.

(e) Roads were jammed by stalled trucks, during which French drivers philosophically ate bread and American drivers cursed profoundly.

14. Much dissatisfaction was occasioned among the combat artillery units because they could not always get the powder, fuzes or projectiles they wanted. Anathemas were hurled at the Supply System all the way up, and it was accused of every kind of base charge. It is a truism that the fighting man should have what he needs in order to make for his success in combat if it is humanly possible to give it to him, but economic factors enter into his supply and he must be made to understand that such is the case. He may call for nothing but H.E. Normal Shell, but if the arsenals of the country are turning out a proportion of one-sixth shrapnel, one-sixth reduced charge, and two-thirds H.E. shell, as happened in France, he must expect to receive somewhat the same proportion at the front. It is an economic condition which cannot be helped. The same holds true regarding fuzes and powders. In peace times, Regular Officers, as well as officers of the National Guard and of the Reserve, must be instructed in these matters, and the manufacturing programs, which should be drawn up long before there is even a thought of war, must provide for satisfying the war time demands of the field soldier as far as possible.

15. Dissatisfaction at the front was also occasioned by the insistence of higher headquarters for reports of ammunition expenditures. If these reports are made on as simple a form as is given in Appendix II at the end of this paper, which is the form actually used by many of the units at the front, there can be no sane reason for objecting to them. A report on a form such as this takes only a few moments to make out. Every Battery Commander, if he is running his battery efficiently, has got to know the status of the ammunition in his unit each day, and it is not a hardship to send back a résumé of his knowledge to the Battalion Commander. Certainly there are exceptions to this: there will be times when a battery is fighting for its very existence, and, in such cases, the

Battery Commander cannot be bothered with reports of any kind UNTIL THE CRISIS IS OVER.

In operations, the Battery Commander will probably charge one of the battery officers with getting up ammunition, if such officer is available. This man has got to be a "hustler" or he is of no use whatsoever. He should be able to render a reliable report on the status of ammunition within the battery whenever called upon for such a report from the Battery Commander.

Replacements all the way back to the S.O.S. depend on reports of expenditures. These reports have a big tactical, technical, and economical value. If fairly accurate, they demonstrate as nothing else does, the performance of gun matériel: they are absolutely essential in determining present and future manufacturing programs: they form an invaluable basis for calculations of amounts of fire for future operations, and they show what tonnage will be necessary to handle ammunition supply in a more or less similar situation. Without ammunition reports the ammunition supply system would break down: it would not be a "system": it would be chaos.

Battery Commanders must realize this, and they must bend every effort to get in these daily reports. It sometimes takes time and trouble to send them back. Battery telephone lines are often out, but it does not take so very long for a runner, mounted or dismounted, to get to the Battalion Headquarters. From the latter headquarters to Regiment, to Brigade, to Corps, to Army, presents no insurmountable obstacles. In the majority of cases, reports can be sent back within the time limit allowed to each unit, if the "spirit is willing."

16. Many erroneous ideas were broadcast as to ammunition expenditure. No good reason could be seen by many officers for exercising economy in expenditure. No attempt was made in many cases to care for ammunition, to preserve powder, to put the unused powder bags back in their containers, nor was an attempt made even to close up the containers in order to protect the contents from the elements. In big operations of long duration, economy in ammunition expenditure becomes a considerable factor, not only from the transportation point of view, but also from the supply and manufacturing viewpoint.

Marshal Petain felt so keenly on this subject that he issued a confidential and secret letter to Army and Group Commanders dated October 8, 1918, from which the following poorly translated excerpts are taken:

"Since the battle of 1918 has begun, the attention of the Command, in all echelons has been repeatedly called to the necessity of

closely watching the ammunition expenditures in order to hold out.

* * *

"The hostile artillery, *being considerably reduced by losses* and on the other hand showing generally but little activity, it is inadmissible that the ammunition expenditure be constantly maintained as for an incessant artillery battle, very often out of proportion with acquired results.

* * *

"It is absolutely necessary that all Commanders take particular care to supervise and regulate ammunition expenditure—this suggestion being especially important in *zones of battle*.

"The attention of all concerned is called once more to the following general regulations, which, for the most part, have already been issued.

"1. Aim only at definite targets and to obtain a certain result. When the result has been obtained, cease firing.

"2. As a rule, use short and violent burst, rather than a slow and continuous fire.

"3. Avoid, except in emergencies, any fire that cannot be *observed and controlled*. This requires a careful organization of the ground ranging service.

"4. When preparing requisitions for ammunition supply, with a certain phase of operation in view, the *number of guns actually put in action* must be taken as a basis, and not the theoretical number of guns. Consequently, all artillery units in reserve and all missing guns must be deducted.

* * *

"6. Take energetic measures against any well proven lavish expenditure. Do not tolerate that orders be issued prescribing reckless firing (firing without observation ranging—daily firing, regardless of a situation, of a certain number of rounds fixed in advance, etc.), and do not hesitate to use disciplinary measures if necessary.

* * *

"IN THE PRESENT CIRCUMSTANCES, MORE THAN EVER BEFORE, WHEN VICTORY IS COMING OUR WAY, IT IS A SERIOUS OFFENSE, ENTAILING MILITARY DISGRACE FOR THE GUILTY ONE, TO PUT VICTORY IN JEOPARDY THROUGH CARELESS OR INCAPABLE MANAGEMENT OF AMMUNITION."

16. If artillery ammunition supply presented as few difficulties as infantry ammunition supply all would be easy. Infantry ammunition is conveniently handled and can be quickly rushed to any spot in event of emergency. Expenditures of infantry ammunition overseas were always much less than was anticipated. In the division, the infantry handles its own supply through the transportation of the Division Train, Quartermaster Corps.

In the Corps, Infantry Ammunition can easily be taken care of in the office of the Corps Munitions Officer, and it is believed that this is the place to handle it. The Corps Munitions Officer, who is on the staff of the Major General at Corps Artillery Headquarters, needs a commissioned assistant (he is not allowed one under the latest Tables of Organization) and this officer can be directly charged with Infantry Ammunition Supply. There should be two Munitions Officers at the Corps in order that there may be one of them on hand at all times to answer emergency calls that come in by telephone, radio, or courier. One of the Corps Munitions Officers should be "outside" all of the time. He should supervise the functioning of the Corps dumps, make advanced reconnaissances, help to solve any practical difficulties of supply that may be troubling those up forward and get in personal touch with the Munitions Officers of the units working under the Corps. A Munitions Officer's job is not a desk job: to do his work right he must get forward and see whether the ammunition he issued on paper is really moving up, and if not why not. Sitting in an office, figuring away on paper, gets him nowhere. However, during the absence of one of the Munitions Officers, the other must be on hand at Corps Headquarters competent to act in emergency.

There is apparently no reason why in the Corps the Munitions Office should not be charged with the supply of ammunition for the Infantry as well as for the Artillery. It is a business-like proposition, and simplifies matters, rather than to have the infantry end of it handled in the office of the Corps G-4, and the artillery end handled at Corps Artillery Headquarters.

PART II

THE FUNCTIONING OF THE SYSTEM OF ARTILLERY AMMUNITION SUPPLY IN CONFORMITY TO THE TABLES OF ORGANIZATION, SERIES 1920-1921

1. This discussion of the actual functioning of the system of ammunition supply for the light, medium and heavy artillery will begin forward at the battery and work back to the highest headquarters in the combat zone—the Army.

The Divisional 75 regiments, HORSED, and the Corps, 155 Gun and Howitzer Regiments, MOTORIZED, will be considered.

The system of ammunition supply in rear of the Corps will be sketched very briefly.

It is to be noted that ammunition supply for the artillery within the divison is now wholly divorced from that of the infantry.

2. In this chapter, six general questions will be discussed with respect to each separate unit from the lowest to the highest, *viz.:*

(a) Who is in general charge of the ammunition supply within the unit, and to whom is he directly responsible?

(b) What transportation, *i.e.*, kind and number of vehicles, is normally at the disposal of the unit munitions officer for moving ammunition belonging to the unit when it moves?

(c) What is the NORMAL ammunition carrying capacity within the unit, *i.e.*, total number of rounds carried, also expressed as the number of rounds per gun, or as "days of fire"?

(d) What personnel is assigned to handle the ammunition supply service within the unit?

(e) What is the system of resupply employed in each command?

(f) By what means is ammunition moved up from the rear to the combat area of the unit under discussion?

3. *The Battery 75-mm. Horsed* (*Table 38 W*).

(a) A suitable officer or noncommissioned officer is in general charge of the replacement, care and storage of the ammunition at the battery position. He is directly responsible to the Battery Commander.

(b) Transportation: Six caissons, six caisson limbers, and four gun limbers comprise the battery transportation normally under the orders of the Battery Commander.

(c) The carrying capacity of this transportation is as follows:

6 caissons, each carrying 70 rounds	420 rounds
6 caisson limbers, each carrying 36 rounds	216 rounds
4 gun limbers, each carrying 18 rounds	72 rounds
Total	708 rounds

This is 177 rounds per gun, or .59 day of fire.

(d) Personnel: Six cannoneers from the 5th section are regularly assigned. These may be augmented by calling upon four of the nine cannoneers in each gun section. In emergency, therefore, there is a total of twenty-two ammunition servers in the light battery.

(e) Resupply: The Battery Commander must submit his 24 hour expenditure report to the Battalion Munitions Officer (Battalion Supply Officer) *not later* than 9:00 A.M. daily. This report is made by telephone if possible and is later verified by written report. (See Appendix II for form of this report.)

Replacements are forwarded by the Battalion Commander through the Battalion Munitions Officers to cover these expenditures. (NOTE: Extra ammunition will be ordered forward to the battery position by higher authority if it is necessary to accumulate a stock for contemplated operations. This surplus stock will not be touched by the Battery Commander until the specified time.)

A great deal depends upon the promptitude with which the

Battery Commander submits his 24-hour expenditure report, because the Munitions Officer in each higher command must consolidate the reports of the units below him, and these reports, finally consolidated in the various Corps, must reach the Army G-4 not later than 5:00 P.M. daily.

(f) Ammunition is moved forward to the battery position from the rear in one or more of the following ways:

1. The six battery caissons, with their limbers, make trips between the battery position and the battalion, or regimental, dump. This is generally an inadvisable method, and is exceptional unless the battalion dump is very close to the battery position.

2. The Battalion Combat Train (Table 39 W) brings ammunition forward from the Battalion, Regimental or Brigade dump and leaves it at the battery position. This is the usual method.

3. The ammunition train, artillery brigade (Table 56 W) brings ammunition directly forward from the Brigade or the Corps dump to the battery position. This method is employed whenever possible.

4. *The Battalion 75-mm. Horsed* (*Table 37 W*).

(a) The Battalion Supply Officer, who commands the battalion section of the Service Battery, is also the Battalion Munitions Officer.

He is directly responsible to the Battalion Commander.

(b) The normal battalion transportation for ammunition is the battalion combat train (Table 39 W). The combat train is commanded by its own train commander, who is a captain under the Tables of Organization. He receives his orders through the Battalion Munitions Officer insofar as the movement of ammunition is concerned.

Eighteen caissons and eighteen caisson limbers comprise the ammunition carrying transportation in the battalion combat train.

(c) The carrying capacity of this transportation is as follows:

18 caissons, each carrying 70 rounds	1260 rounds
18 caisson limbers, each carrying 36 rounds.....	648 rounds
Total	1908 rounds

This is 159 rounds per gun, or .53 day of fire. Therefore, WITHIN THE BATTALION, there is normallly for each gun 336 rounds, or 1.12 days of fire.

(d) Personnel: Each combat train has forty-five ammunition servers (Table 39 W), who ordinarily accompany caissons (2½ men per caisson) except when certain men are detailed to man Battalion or Regimental dumps.

(e) Resupply: The Battalion Munitions Officer consolidates the battery expenditures as given by each Battery Commander in his

9:00 o'clock report. The Battalion Munitions Officer submits his consolidated report by telephone, if possible, to the Regimental Munitions Officer not later than 11:00 A.M. and follows it with a written report through the courier service.

Replacements are forwarded by the Regimental Commander through the Regimental Munitions Officer to cover these expenditures. (Extra ammunition will be ordered forward to the battalion by higher authority if it is necessary to accumulate a stock for contemplated operations.)

(f) Ammunition is moved forward to the battalion area from the rear in one or more of the following ways:

1. The Battalion Combat Train brings ammunition forward to the battery positions from the Regimental dump. In this case no Battalion dump is established.

2. The Battalion Combat Train brings ammunition forward to the Battalion dump from the Divisional Artillery Brigade dump, in which case no Regimental dump is established.

3. The ammunition train of the Divisional Artillery Brigade brings ammunition directly forward from the Corps and turns it over to the Battalion Combat Train, or unloads it at the Battalion dump.

5. *The Regiment 75-mm. Horsed* (*Table 34 W*).

(a) There is an officer, a lieutenant, on the Regimental Staff who is the Regimental Munitions Officer. He is assisted by a Munitions Clerk, a private, specialist 4th class.

The Regimental Munitions Officer is directly responsible to the Regimental Commander.

(b) Transportation normally at the disposal of the Regimental Munitions Officer: NONE. (NOTE: Each battalion has its own combat train which in *any* movement pulls out with its caissons filled with ammunition taken from the Regimental or Battalion dump. Prior to any movement *forward*, the Battery Commander must see that his abandoned ammunition is piled at the roadside. This spot must be accessible if possible to vehicles. The Battery Commander must send data giving the location of this point to the Battalion and Regimental Munitions Officers and to the Combat Train Commander. This abandoned Battery dump may form the nucleus of a battalion, regimental or even a brigade dump in the movement forward. In any event, though it is many times impossible for a battery, battalion or regimental commander to move his surplus ammunition forward, it is possible and essential that the Battery Commander form a dump and send back its location. This immeasurably expedites the salvaging of abandoned ammunition by higher headquarters and enables these headquarters to actually push this ammunition forward to the new positions.)

(c) The carrying capacity within the regiment is of course the carrying capacity of the separate battalions.

(d) Personnel: None ordinarily at the disposal of the Regimental Munitions Officer. If a regimental dump is established, some of the 45 ammunition servers in each of the two Battalion Combat Trains must be used to man this point, or else personnel may be allotted by Artillery Brigade Headquarters from the ammunition train.

(e) Resupply: The Regimental Munitions Officer consolidates the 11:00 A.M. expenditure reports of the Battalion Munitions Officers. The former telephones this consolidated report not later than 1:00 P.M. to the Brigade Munitions Officer, and replacements are based on these expenditures. A written report must be submitted to the Brigade Munitions Officer the same day through the message centre. (As noted under "the battery" and "the battalion," extra ammunition over and above the expenditure replacements will be ordered forward to the regimental area by higher authority if it is necessary to accumulate a stock for contemplated operations.)

(f) Ammunition is moved forward to the regimental area from the rear in one or more of the following ways:

1. The ammunition train, Divisional Artillery Brigade (Table 56 W) brings ammunition directly forward from the Corps to the Regimental dump. In this case, no Brigade dump is established.

2. The Corps train (Table 191W) moves ammunition directly forward from Corps or Army to the Regiment. In this case no Brigade dump is established. This method is exceptional where the forward end of the haul is the Regimental dump of a *Divisional* Artillery Brigade Regiment, but not so exceptional where the forward end is the Regimental dump of a *Corps* Artillery Brigade Regiment. (See par. 6, f, 2.)

6. *The Divisional Artillery Brigade 75-mm. Horsed, Two Regiments* (*Table 31 W*).

(a) There is a lieutenant on the Divisional Artillery Brigade Staff who is the Munitions and Supply Officer. He is assisted by a Munitions Clerk, who is a sergeant.

The Brigade Munitions Officer is directly responsible to the Divisional Artillery Brigade Commander.

(b) The normal brigade transportation for ammunition is the ammunition train, artillery brigade, Table 56 W, which consists of train headquarters, one transportation company, and one ammunition company. The latter administers the personnel for manning the train and the dumps.

For carrying ammunition there are:

26 cargo trucks in the transport company, Table 57 W.

25 escort wagons in the transport company, Table 57 W.

This is approximately one truck and one escort wagon for every two guns.

(c) The carrying capacity of this transportation is as follows:

26 cargo trucks, each carrying 200 rounds of 75..... 5200 rounds
25 escort wagons, each carrying 100 rounds of 75 . 2500 rounds

Total ..... 7700 rounds[1]

There is, therefore, 154 rounds per gun in the Ammunition Train, Artillery Brigade. Since there are 336 rounds per gun normally carried within each regiment of 75s, there are carried WITHIN THE DIVISIONAL ARTILLERY BRIGADE 490 rounds per gun, or 1.63 days of fire. Considering trucks that will be out of commission and other troubles that will arise during operations, this amount will probably be reduced to 1.5 days of fire, which is the amount recommended by the Special Committee on Army Reorganization for the Divisional Artillery Brigade.

(d) Personnel: Fifty ammunition servers in the ammunition company of the Ammunition Train, Artillery Brigade. These accompany the trucks and escort wagons, and are also used to man the Brigade dump if such is established.

(e) Resupply: The Brigade Munitions Officer consolidates the 1:00 P.M. telephone reports from the Regimental Munitions Officers and communicates the consolidated report to the Corps Munitions Officer not later than 3:00 P.M. This telephone report is later confirmed by written report, its time of arrival at the Corps being subject to schedule of the message centre couriers.

Replacements are forwarded from Corps Headquarters to cover the expenditures. Extra ammunition will be forwarded to the brigade area if necessary for future operations.

(f) Ammunition is moved forward to the Divisional Artillery Brigade area in one or more of the following ways:

1. The ammunition train, Artillery Brigade, Table 56 W, brings ammunition forward from the Corps or Army to the Brigade, Regimental or Battalion dump. This is a usual method.

2. The Corps train brings ammunition from the Corps or Army to the Brigade or Regimental dump. This method is exceptional, however, as the Corps generally has all of its available transportation occupied in moving ammunition from the Army to the Corps dumps and will very seldom be able to haul FORWARD of the Corps.

7. *The Army Corps—Corps Artillery Headquarters* (*Table 119 W*).

[1] Probably one cargo truck and one escort wagon will be needed to carry pistol, as well as machine gun and auto rifle ammunition for the artillery units of the brigade, thereby reducing the artillery ammunition carried by 300 rounds, leaving the total as 7400 rounds.

(a) The Supply (Munitions) Officer, a lieutenant colonel or major under the Tables of Organization, is on the staff of the major general at Corps Artillery Headquarters and is directly responsible to him. (NOTE: There is a Corps Artillery Headquarters, Table 119 W, and also a Headquarters, Corps Artillery Brigade, Table 132 W. The brigadier general, under the organization of the Corps Artillery Brigade, commands the three regiments of 155 Howitzers and the one regiment of 155 guns. The Corps Artillery Brigade is a unit of the Corps organization, just as the Divisional Artillery Brigade is a unit of the Division organization. There is a Corps Munitions Officer as well as a Corps Artillery Brigade Munitions Officer.)

(b) Transportation normally at the disposal of the Corps Munitions Officer: None.

(c) Carrying capacity of the Corps transportation, the Corps train, is one-half day of fire for ALL of the guns which are part of the type Corps, including of course the guns of the divisional artillery brigade. (NOTE: See discussion under "Corps Train," sub-paragraph "f".)

Within the Divisional Artillery Brigade there is carried a total of 1.63 days of fire, therefore, WITHIN A TYPE CORPS there is carried a little over two days of fire for these guns. This figure holds equally true for the 96 guns of the Corps Artillery Brigade. This may be shown as follows:

Each battery (Table 138 W) of 155 howitzers has 12 caisson bodies,[2] carrying a total of 168 rounds, or 42 rounds per howitzer.

Each Battalion Combat Train (Table 139 W) of 155 howitzers has a total of 24 available trucks, carrying 960 rounds in all, or 120 rounds per howitzer.

The ammunition train, Corps Artillery Brigade (Table 156 W) has 144 trucks available for carrying ammunition, which allows 5760 rounds, or 60 rounds per gun and howitzer to be carried.

The sum of the above figures gives 222 rounds per howitzer, or one and a half days of fire.

The days of fire for the 155-gun regiment may be figured in the same way, substituting two trucks for the 12 caisson bodies of the howitzer battery.

(d) Personnel: None.

If Corps dumps are established, the Corps Munitions Officer will

[2] These 155 caissons are archaic. Not only are they obnoxious from the standpoint of draft (see Part I, par. 9), but they are also fundamentally wrong because they necessitate the powder charge being removed from the containers in order to load it into the caissons. This was especially bad overseas where the charges, when removed from the metal containers, had no pasteboard tubing to protect them as do the charges now issued to the service in this country. Consequently moisture worked its ravages. Another disadvantage lay in the greater difficulty in identifying powder lots after the charges were once distributed around in the caissons.

have to *borrow* personnel from the ammunition companies of the ammunition train, Corps Artillery Brigade, in order to man them. Each ammunition company has 120 ammunition servers. There are three companies, or 360 men, in the corps artillery bridage for manhandling the ammunition. This averages two and a half men for each ammunition-carrying truck (see par. 4, d). This personnel may be called upon to man *Corps* as well as *Corps Artillery Brigade* dumps. In a type Corps, three Corps dumps, one to feed each division area might well be established. Considering the reinforcing artillery that will be assigned to the Corps, these points will handle a large and varied assortment of ammunition. Sixty men at least will be required to man each corps dump—night and day shifts. A minimum of forty men will be required for the corps artillery brigade dump. Hence, in big operations, 220 of the 360 men will be needed at the various dumps, leaving 140 men with the trucks, or about one ammunition server per truck.

(e) Resupply: The Corps Munitions Officer receives consolidated telephone reports of 24-hour expenditures not only from the Divisional Artillery Brigade Munitions Officers, but also from the Corps Artillery Brigade Munitions Officer. These reports must be submitted to the Corps Munitions Officer not later than 3:00 P.M. They are confirmed by written reports to be submitted on the same day. The Corps Munitions Officer consolidates the telephone reports and gets them to the Army Munitions Officer not later than 5:00 P.M., confirming them by a written report which must reach the Army Munitions Officer before midnight of the same day. Replacements are sent forward to cover expenditures, and extra ammunition may be sent up if required for contemplated operations.

(f) Ammunition is moved forward into the Corps area in one or more of the following ways:

1. Army transportation moves ammunition forward from the Army to the Corps dumps, which is a usual method.

2. The Corps train moves ammunition up from the Army to the Corps, Divisional Artillery Brigade, or the Corps Artillery Brigade dumps.

3. The ammunition train, Corps Artillery Brigade, moves ammunition forward from the Army or Corps dumps to the Regimental dumps of the Corps Artillery Brigade.

Notes on the "Corps Train, Quartermaster Corps, Transportation Service" (*Table 191 W*).

The Corps train consists *in part* of 25 motor transport companies, each of 27 trucks, one and a half or three tons[3] (Table 95 W) and three wagon companies, each of 92 escort wagons (Table 198 W). The organization equipment of each company is hauled by two trucks or two escort wagons, so that only 25 trucks and 90 wagons can be considered available for cargo.

The cargo-carrying transportation of the Corps is then:

25 × 25 = 625 trucks

3 × 90 = 270 escort wagons.

Only part of this transportation is used for ammunition hauling. The Corps train carries one-half day of fire for ALL of the guns which are normally in the Corps organization. One-half day of fire for these guns is as follows:

For the 75-mm guns .....48 × 150 = 7200 rds.= 36 trucks[3]

For the 155-mm. guns .....24 × 50 = 1200 rds. = 30 trucks

For the 155-mm. how.....72 × 75 = 5400 rds. = 135 trucks

The sum of the above figures gives 201 trucks, or eight motor transport companies. In other words, about one-third of the Corps train is used to carry artillery ammunition.

It is to be presumed that in operations, the Corps train would drop its one-half day of fire in one or more of the Corps dumps and the trucks would then be free for hauling. If these 25-truck companies remain "pooled" under the Corps Transportation Officer, then he will from day to day assign a varying number of truck companies to the ammunition service. This number depends upon the tactical situation. The Corps Munitions Officer must ascertain each evening from the Corps Transportation Officer the number of trucks allotted to the ammunition service for the following twenty-four hours, and the Corps Munitions Officer can then make his dispositions accordingly for the movement of ammunition. Army transportation must supplement Corps transportation whenever possible. Army trucks may in extreme cases haul from Army dumps to the Divisional Artillery Brigade dump. It is a usual procedure for Army transportation to haul from Army to Corps. The limit of this is: (1) The reserve of trucks which the Army Headquarters has available and (2) the conditions of the roads and the nature of the road circulation.

8. *The Army—G-4—Munitions Section.*

(a) The Army Munitions Officer differs from the Corps, Regiment and Brigade Munitions Officer in that he functions as a general staff officer under G-4 of the Army, and he is directly responsible to the chief of the G-4 section. The Army G-4 is in intimate liaison with the office of the Chief of Artillery of the Army, and keeps the latter informed by daily reports of the ammunition situation within the Army.

(b) Transportation normally at the disposal of the Army Munitions Officer, none. (See sub-paragraph f.)

(c) There is no normal carrying capacity for ammunition laid down for the Army.

(d) Personnel: The Chief of Ordnance of the Army, who

[3] These trucks considered as averaging two tons. A two-ton truck carries 200 rounds of 75.

functions under the Army G-4 section (coördination-of-supplies section) maintains the upkeep of personnel for manning the Army dumps. An officer in the office of the Army Chief of Ordnance has direct charge of the administration, assignment and functioning of the personnel at the various Army dumps. There is an ordnance officer in immediate command at each of these points.

(e) Resupply: The Army G-4 is given a credit at certain of the ammunition depots in the S.O.S. and may draw upon these depots until the credit is exhausted. G-4 renders daily reports of expenditures and replacements, the latter from existing credits, to G-4, General Headquarters. When the credits in an S.O.S. depot are low the Army G-4 requests a renewal of said credits.

Ammunition is a Class IV supply, being thus defined:

"Class 4.—Ammunition, construction material, all articles of an exceptional nature not included in authorized allowances and all articles the distribution of which must depend upon operations, lists of which will be published from time to time."

* * *

In order to expedite the supply of these articles to the troops, certain amounts in the depots, called credits, may be placed at the disposition of Army Headquarters. Upon these credits Army Headquarters may draw without reference to General Headquarters sending their requisition direct to the proper depot. Army Headquarters should inform General Headquarters (G-4) of such drafts upon the credits, in order that they may know at all times the status of the credits. Action upon requisitions for articles on which no credit has been established, and upon renewals of amounts withdrawn from existing credits, is determined by General Headquarters (G-4) in consultation with proper supply officer. When decision is reached the necessary information is sent to the proper depot, with directions to forward the supplies or to renew the credits as the case may be. Information upon all such points is also sent to the Regulating Officer and to Army Headquarters. Army Headquarters will also be informed if the credit is not to be renewed immediately."

The Army Munitions Officer must keep in touch with the Munitions Officer of the several Corps, with the Munitions Officer of the Army Artillery, the latter being on the staff of the Chief of Artillery of the Army, and with the Ordnance Officers at each Army dump. These officers render telephone reports to the Army G-4 not later than 5:00 P.M. daily, and written reports follow in every case.

(f) The necessary ammunition is ordered from the rear by Army G-4, received at the Army railheads, unloaded, and sent by truck or narrow gauge either to the Army dumps, or directly to the dumps of the many other units in the Army area such as Army Artillery, Corps, or Corps Artillery Brigade dumps.

The amount of ammunition that can be forced into an area in a given time depends largely upon three factors, and they are:

(1) The capacity of a railhead, measured in the unloading and storage facilities of the railhead and in the number of trains per day which it can accommodate, depending upon sidings, switching facilities, etc.

(2) Condition and nature of the roads in the area, including width of road, character of roadbed, state of upkeep, etc.

(3) Number of motor vehicles, including trailers available for cargo.

Without any question there is a limit to the extent to which an area can be gorged. If railroads are not carefully administered they become almost hopelessly blocked, and so do roads, too, for that matter. Road jams do more than anything else to thwart the system of supply.

In big operations, it is very difficult to get a sufficient number of motor vehicles to do the work required. The Army Munitions Officer (G-4) applies to the transportation section (G-4), at a specified hour daily, to allot certain tonnage for the movement forward of ammunition for the next 24 hours. The transportation section allots what it can, but it also has numerous other demands that must be met, it cannot as a rule give all of the tonnage asked for, and so the ammunition service may have to function with only a part of the required truck tonnage.

9. *Ammunition-carrying Vehicles of Division, Corps and Army*.

The ammunition-carrying trains of the Division, Corps and Army are as follows:

In the Division: One ammunition train, Artillery Brigade, which transports ammunition for the Divisional Artillery Brigade, and contains personnel for manning the dumps.

One division train, Quartermaster Corps (Table 91 W), a few vehicles of which transport the small arms ammunition for the infantry of the division. No artillery ammunition is carried and no personnel included for manning dumps.

In the Corps: One ammunition train, Artillery Brigade Corps Artillery, which transports ammunition for the Corps Artillery Brigade, and has personnel for manning the dumps.

One corps train, Quartermaster Corps, part of which carries one-half day of fire for ALL the guns within the Corps (normal organization) and a few vehicles of which transport a reserve of small arms ammunition for all of the infantry within the Corps. There is no personnel for manning the dumps.

In the Army: One ammunition train, Army, motorized (Table 256 W), which transports ammunition for the Army Artillery. There is no personnel for manning the dumps as they are manned by ordnance personnel.

One army train, Quartermaster Corps (Table 291 W), for which no ammunition quota is specified.

10. *General Principles.*

(a) "It is a basic principle in ammunition supply that all ammunition vehicles maintain in the vicinity of their bivouacs or at some other convenient place their normal loads of ammunition for an emergency. In supplying ammunition effort is made to keep these loads intact by drawing from the rear and distributing without touching the reserve."

(b) The normal load of the brigade ammunition train, whether corps or division, is termed the brigade reserve.

(c) When a division moves, all ammunition vehicles should be filled with their normal allowance of ammunition.

(d) When a division moves from the line to reserve or rest area, it may not be possible or practicable to complete the normal loads at the front. Effort must be made as soon as the division has reached the new area to complete its full ammunition allowance.

(e) In rest or training areas, the supply of ammunition is normally a matter of formal requisition: at the front the supply is effected either by action of higher authority upon reports of expenditures or by informal telephone or other similar requests.

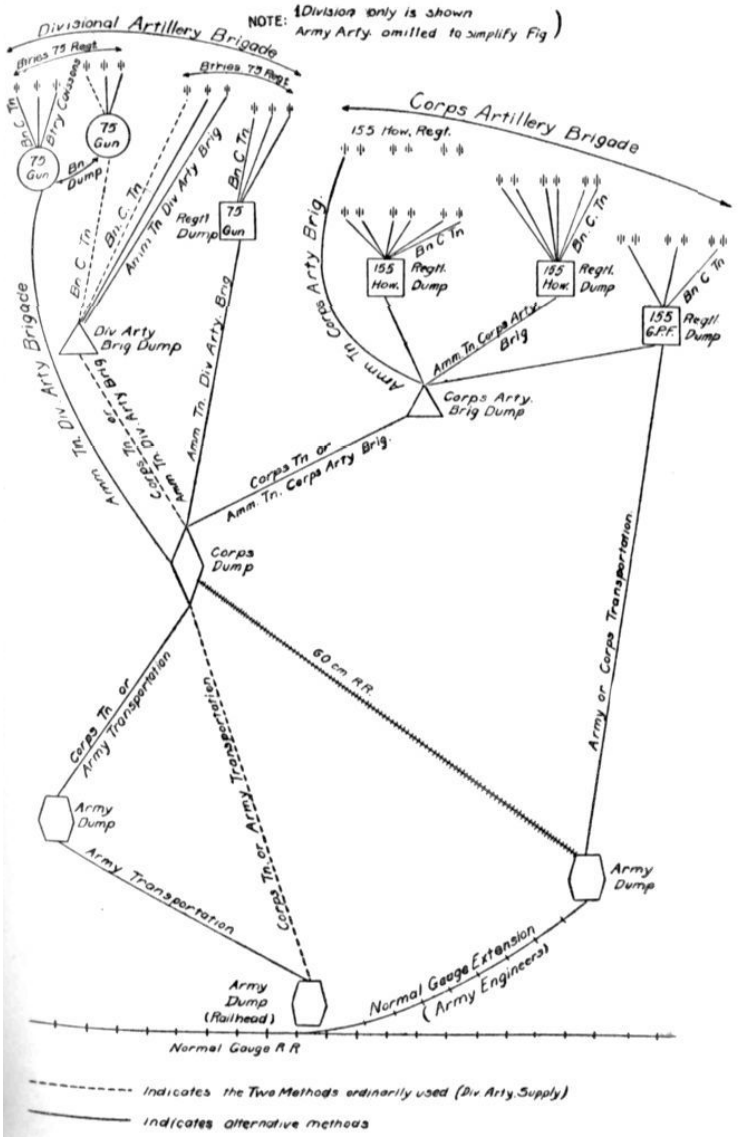
(f) "It may be stated as a basic principle in the supply and distribution of ammunition that preservation and conservation of ammunition demands that stock be kept concentrated in one place and under the control of one person as much as may be practicable."

(g) Officers, noncommissioned officers and privates who are connected with the ammunition supply service should be given special instruction in kinds of projectiles, powders, primers, fuzes, and the percentages which are issued for all calibres. They should receive instruction in the maintenance of ammunition dumps, in the conditions which must be fulfilled in their selection and in the care of ammunition in the field under combat conditions. Before being "graduated" they should, if possible, be attached to units at the front as assistants, there to learn the practical work at first hand.

11. In closing this discussion, one feature of the scheme of ammunition supply as laid down by the Tables of Organization is protested. It is implied in these tables that ammunition is a part of the routine supply system and officers charged with ammunition responsibility are first listed as *suppy* officers and then as *munitions* officers. It is believed this is too big an apportionment of duties. On officer should be detailed to handle ammunition and nothing else. He will have his hands full with this problem alone and he should not be bothered with other supply troubles. Munitions Officers were busy all of the time during operations handling nothing but ammunition, and a day of twenty-four hours was not long enough for most of them. In time of peace the supply officer can handle ammunition

as well as other supplies. In time of war it is believed that this is impossible. *The ammunition problem is big enough and vital enough to warrant the undivided attention of one man, and in some cases of two or more men.*

APPENDIX I
AMMUNITION SUPPLY SYSTEM — ARTILLERY.



APPENDIX II

TYPE FORM OF AMMUNITION REPORT

Report of Battery ....., F.A., Cal. ..... mm.
From: ..... A.M. (P.M.) ....., 1922, to ..... A.M. (P.M.), ... 1922.

Actual number of guns which are on the line.	.....	
Amount on hand as per previous report.	H.E.	
	H.E. red.	
	H.E., Mk. IV	
	Shrapnel	
	Special	
Fired.	H.E.	
	H.E. red.	
	H.E., Mk. IV	
	Shrapnel	
	Special	
Received.	H.E.	
	H.E. red.	
	H.E., Mk. IV	
	Shrapnel	
	Special	
On hand, including load of six caissons, six caisson limbers, and four gun limbers.	H.E.	
	H.E. red.	
	H.E., Mk. IV	
	Shrapnel	
	Special	

Signature: .....
.....

THE DEVELOPMENT OF THE GERMAN PLAN OF CAMPAIGN*

AUGUST-SEPTEMBER, 1914
(With Map)

BY CAPTAIN G. C. WYNNE†
KING'S OWN YORKSHIRE LIGHT INFANTRY

I

THE mass of German and French war literature published during the past two years[1] has revealed many of the mysteries connected with the operations of August and September, 1914. It was perhaps only natural that the full limelight of military opinion should at first be directed on the battle of the Marne, but the operations on the French eastern front have thereby been placed in a deeper shadow than they deserve. Of the two, the sequence of events that led up to the offensive of the Allied left wing north-east of Paris is, it is true, the more dramtic; it was here that the spark of French genius caught up in the midst of the frontier disasters, suddenly became living flame and materialized into victory. Nevertheless for the Germans, it was along the line of the French eastern fortresses that the scene of the principal act of their great tragedy was laid, and the heights that border the Upper Meuse and the Upper Moselle may justly claim to mark the grave of Germany's hopes for a rapid decision in the West. It was the stubborn defence of those great bastions of eastern France, Verdun, Nancy and the Vosges, against the attacks of a German numerical superiority that enabled the battle of the Marne to run its course and decide the opening campaign of the war.

The German Plan in Lorraine.—To appreciate the development of the operations in Lorraine, it will be necessary to refer for a moment to the German plan of campaign. The plan as handed over by Count Schlieffen on his retirement in 1906 was altered in an important particular by his successor. Schlieffen maintained that if his conception of the advance of a strong right wing through Belgium on Paris was firmly persisted in, the French, whatever action they might take after mobilization, would turn and go in the direction of their greatest menace—in this case, Paris. It was here

* An article on the German Campaign in the West, August, 1914, appeared in *The Army Quarterly*, vol. ii, No. 1.

† Reprint from *The Army Quarterly*, London, England, July, 1921.

[1] Special references for this article are: "Der Marnefeldzug," Kuhl; "Graf Schlieffen und der Weltkrieg," Foerster; "Bis zum Marne," Tappen; "Der Wendepunkt des Weltkrieges," Muller-Loebnitz; "Quatre années de Commandement," Dubail; "La bataille de la frontiére: Briey," Engerand.

that he intended to fight the decisive battle and his disposition of force made full preparation for winning it. He concentrated his attention on one consecutive operation which was to compel the enemy to his will and ensure the undisputed possession of the initiative through the campaign. In 1913, a few days before his death, he was still of the same opinion: "The war must come," he wrote, "but keep the right wing strong." Nevertheless it was on this very point that Moltke, his successor, differed.

From a personal knowledge of the trend of opinion in military circles in France and from other sources, Moltke was convinced that the French would deliver their main offensive in Lorraine as soon as their mobilization was completed. He considered that the aim of the German enveloping movement through Belgium was to draw the enemy away from their fortress-positions, so that, if the French came into the open themselves by taking the offensive into Lorraine, the German objective would be automatically attained. As soon, therefore, as the offensive of the mass of the French forces between Metz and the Vosges was confirmed he intended to march with all available strength to the scene of the decisive battle there.

Instead of forcing his will on the enemy, Moltke was thus prepared to allow the initial operations of the French to settle where the decisive battle was to be fought. It might take place on his left wing in Lorraine, or on his right wing about Paris, or on both: and therein lay the seeds of that vicious indetermination which was to beset him in the full throes of the operations in August, 1914.

Formation of the Sixth and Seventh Armies.—This alteration in the conception of the operations resulted in a modification of the plan of concentration. Schlieffen had left only a thin frontier protection of nine divisions (4½ corps) between Metz and Switzerland in order to have the greatest possible strength for his right wing, the hammer-head of his mass of attack with which all the enemy's positions were to be turned and the battles won. Moltke, however, with his vision of a decisive battle in Lorraine gradually strengthened the forces south of Metz, and by 1914 two Armies, the Sixth and Seventh, a total of sixteen active and reserve divisions, that is to say about a quarter of the entire German strength, had been allotted to the Lorraine and Alsace fronts. Of the nine new divisons formed between 1905 and 1914 he allotted eight to these two Armies, only one being given to the right wing. As an additional precaution, the six Ersatz divisions intended to invest Paris, were on mobilization sent to the Lorraine front.

The Operations of the Sixth and Seventh Armies: 9th-17th

August.—In 1914 the German plan of campaign retained the idea of the wheel of an offensive mass of twenty-six active and reserve Corps, First to Fifth Armies, through Belgium and Northern France pivoting on the fortified zone Metz-Thionville.

The Sixth and Seventh Armies were to protect the left flank of this mass of attack and be prepared to coöperate with the Fifth Army against a French offensive between Metz and the Rhine. Their initial operations to this end were, however, marked by indecision. A succession of orders and counter-orders prevented any useful result, and their strength during the first three weeks of the war was to a great extent wasted. This was not the fault of the Armies themselves, but rather that of the indefinite instructions of Supreme Headquarters.

On the 9th of August the Sixth and Seventh Armies were placed under the common command of Crown Prince Rupprecht of Bavaria, commanding the Sixth Army. His immediate object was twofold: first, to protect the left flank of the mass of attack (the First to Fifth Armies), from a French enveloping offensive between Metz and the Rhine; and secondly, to hold the French forces assembling in front of him and prevent their being transported to the French left wing. He decided to fulfil his double rôle by taking the offensive towards the line of the Moselle, below Frouard, and the line of the Meurthe, but waited at first on a front south-east of Metz—Delmé-Chateau Salins-Blamont-Cirey for the arrival of the Seventh Army which was to be moved north from its concentration area Strassbourg—Freiburg to a position of assembly about Saverne and Molsheim. The advance of the French VII. Corps on the 7th-9th of August into Upper Alsace had, however, delayed this movement, as the XIV. and XV. Corps of the Seventh Army had to be sent south to Neuf Brisach and Colmar respectively to meet it. Assembling behind the Forêt de la Hardt, they delivered a violent counter-offensive on the 9th towards Cernay and Mulhouse,[2] and drove the French back across the frontier to Belfort. Consequently the greater part of the Seventh Army did not regain touch with the Sixth, west of Strassbourg, till the 14th.

Moltke Prepares for a Decisive Battle South of Metz.—By this time, however, it was realized at Supreme Headquarters that the French were concentrating in great strength on a front Raon L'Etape—Pont à Mousson. It seemed that Moltke's anticipations were about to be realized and that the principal French offensive was indeed to be delivered in Lorraine. The decisive battle appeared imminent, but since the German offensive mass (First to Fifth Armies) could not begin its advance till the 18th, an attack by the Sixth and Seventh Armies against greatly superior numbers would

[2] For further details see "Neun Monate an der Westfront," Volderauer.

be premature. The Bavarian Crown Prince was therefore informed by Supreme Command on the 13th of August that his plan to advance the Sixth and Seventh Armies across the Meurthe was not in keeping with the intentions of the Supreme Command; he was also told that the French were massing in superior numbers in front of him and that he was to yield to their pressure.

While the Sixth Army moved back towards the Sarre, Moltke was preparing for the great decisive battle in Lorraine. The Foundation of his plan was the position about Metz and on the Nied. In the years 1893-1911 some twenty millions sterling had been spent in constructing the Metz fortifications, an immense fortified zone with twenty-three forts on a perimeter of sixty miles. In addition to this, special defense works had been organized along the Upper Nied between Metz and the Sarre. Shortly after mobilization the Nied position was garrisoned by seven Landwehr brigades and eight 10 cm. heavy batteries. Moltke hoped that the withdrawal of the Sixth Army would attract the French towards this position where they would be checked, and then, as soon as their deployment for the assault was completed, he would make a concentric offensive against them from the north, east and south-east. For this purpose, he arranged for the wheel inwards of all available troops to the scene of the decision. The Fourth Army was ordered to hold itself in readiness to move southward, the Fifth Army was to take the offensive through and east of Metz, and the Ersatz divisions were brought up behind the Sixth Army. The stage was thus prepared for the concentric attack of the Fourth, Fifth, Sixth and Seventh Armies against what the German Commander believed was the mass of the French forces, so soon as the latter had been drawn away sufficiently into the open from their fortified positions along the Hauts de Meuse and the Vosges.

Moltke thus hoped to open the campaign in the West by a decisive victory in Lorraine, after which he intended to transfer the bulk of the Sixth and Seventh Armies to assist the right wing Armies against the remainder of the French forces not engaged in the Lorraine battle and against the British and Belgian forces in Northern France. For this purpose a mass of rolling stock was in readiness on both sides of the Rhine behind the Lorraine front. He would then be in a position to fight the second and final battle in front of Paris.

By the 17th, however, the French offensive had sufficiently developed to show its weakness. It had become abundantly clear that this was not the offensive of the mass of the French Armies. Also, reports arriving at Coblenz pointed to large French concentrations along and west of the Meuse about Mézières and Hirson. Moltke's "victory-castle-in-Lorraine" collapsed like a pack of cards,

and he decided to revert, before it was too late, to Schlieffen's turning movement through Belgium. The Fourth and Fifth Armies were ordered to resume their former rôle as the left wing of the offensive mass and the Sixth and Seventh Armies were again given the responsibility of protecting the left flank of the wheel.

For the moment it might seem that Moltke had finally abandoned all his projects in Lorraine, yet it was not so. He appears to have been obsessed by the idea of a victory there and it continued, like a magnet, to hold his attention away from Paris—with fatal results.

The Battle in Lorraine, 20th-23rd August.—It was now left to the Bavarian Crown Prince to decide how he should best protect the left flank of the German mass of attack against the offensive of the French First and Second Armies, approaching the Nied position. He chose to take the offensive against them, and on the 20th of August the Sixth Army advanced from a line Wallersberg—Lautersingen and the Seventh Army from about Pfalzburg and Schirmeck in the general direction Baccarat—Raon L'Etape. Their advance met the offensive of the French First and Second Armies on a general front Delmé-Dieuze-Sarrebourg.

On the 19th, the French First and Second Armies had arrived in front of the Nied position, and the German heavy batteries opened against the advancing French columns at a range of over seven miles. That night the French Second Army reached a front Delmé—Dieuze—Lagatte with the First Army on its right north and south of Sarrebourg. On the following morning, the 20th, the French began the assault. So little resistance had been met with during the advance that the French commanders seemed to think that the Nied position could be carried in one rush with the bayonet without artillery preparation. They paid dearly for their rashness, the German heavy batteries and machine guns causing severe losses in the attacking ranks. At midday, to add to the confusion of the French, the German Sixth and Seventh Armies suddenly appeared on the scene.

The French Second Army between Morhange and Lagarde received the brunt of the attack of five corps of the German Sixth Army[3], and at 3 P.M. was ordered back to a position twelve miles in rear. During the night it withdrew still farther, exposing the left and rear of the French First Army, which was therefore compelled to retire. On the following day, the 21st, orders arrived from the French Higher Command for the general retirement of the First and Second Armies to the fortified positions along the Meurthe covering Epinal and Nancy respectively.

[3] For further details of this German offensive, *see* "Bayerischen Löwen im Weltkrieg," Gärtner; "Wir Draussen," Ross; "Bayern Kämpfe," Rutz; "Das 6 Bayerische Inf. Regiment im Weltkrig," Lang.

By the 23rd these armies were taking up their new positions and again turning to face the enemy. The offensives into Alsace and Lorraine had both failed, nevertheless they had held strong German forces in front of them, a fact that was shortly to prove of the utmost importance.

II

The Germans Gain the Initiative in the North.—The withdrawal of the French First and Second Armies on the 20th-22nd of August from Lorraine was not entirely due to the pressure of the German Sixth and Seventh Armies. On the 19th, General de Castelnau had been ordered to send two of his corps northward toward Mézières and Hirson, and the order from the French Higher Command for the two Armies in Lorraine to retire was issued on the 20th, irrespective of the progress of the battle between the Nied and the Sarre.

The French Higher Command was in fact at that moment confronted by a series of events which withdrew its attention from its offensive plans in Lorraine and demanded the employment of the mass of its Armies farther to the north.

The German and French operations during the period of concentration had been directed against each other's left wing, swinging counter-clockwise against the two extremities of the battle front. The French general idea was to deliver a decisive battle with superior numbers against the German forces in the area Thionville—south of Metz. Metz would then be invested leaving the main forces to turn north against the left flank and communications of the German northern Armies advancing into Belgian-Luxemburg and west of the lower Meuse. In order to gain the initiative in this operation, the First and Second Armies were to advance as early as possible into Lorraine threatening Metz from the south and reaching out towards the Rhine. The right flank of this movement was to be covered by the VII. Corps from Belfort, which was to advance by Mulhouse and destroy the Rhine bridges south of Colmar. Should these preliminary operations succeed, the French Armies were then to attack simultaneously on a united front northeastward between Luxemburg and the Rhine. The German Sixth and Seventh Armies, however, had effectively checked these operations, and by the 18th, before the French could further develop their plan, they had lost freedom of action.

The Germans, on the other hand, had had an easier task. Once the resistance of the Belgian frontier forts had been broken, the wheel of their offensive mass into France could begin. On the 17th, the last fort of Liége was entered and the gateway into

Belgium was open. The German First and Second Armies poured through it and the roads lay free in front of them to the French frontier. They had thus gained the initiative and the French Higher Command had to submit to the new situation which was thus forced upon it. It ordered the First and Second Armies to withdraw on Nancy and the Vosges, and to send two corps to support the French forces on the Luxemburg-Belgian frontier. Instead of attacking towards Metz, the Third and Fourth Armies were to take the offensive northward from about Sedan and Montmédy into Belgian-Luxemburg against the left flank of the German Armies advancing into Belgium. The French Fifth Army and the British Army on the Sambre were to coöperate with this offensive.

The French Higher Command, however, owing to an inadequate intelligence service, had made a false appreciation of the German plan of campaign and still more of the German forces confronting it. Instead of six German Corps which they imagined were opposing the nine corps of the French Third and Fourth Armies, there were twelve. It is not surprising, therefore, that their offensive failed, and, on the 24th, the French centre withdrew towards the Meuse.

The failure of the French offensive in the Ardennes left the French Fifth Army and the British Army completely isolated on the front Charleroi-Mons, forty miles to the north. Attacked on the 22nd and 23rd by the German First, Second and Third Armies advancing concentrically from the north, north-east and east, the allied left wing narrowly escaped disaster.

General Joffre then ordered a general retreat on the whole front and, on the 25th, issued the instructions which resulted in the movement of the bulk of his forces westward to prepare for the battle against the German right wing in front of Paris.

The Effect of the Frontier Victories on Supreme Command.—The three battles fought in Lorraine, in the Ardennes and on the Sambre between the 20th and 24th of August were proclaimed throughout Germany as great victories. The leading Berlin newspaper had a big headline "Frankreich's Rückgrat Gebrochen" ("France's spine broken"), and this was the universal opinion. Such, also, was the belief at Supreme Headquarters. In their peaceful hotel in Coblenz, 200 miles from the atmosphere of the battlefield, it was impossible to feel the pulse of the operations and form any individual opinion on their progress. They had to rely on reports written in the flush of excitement after the battle, irrespective of the extent of the victory. With such material it is not surprising that a wave of optimism was created out of all proportion to the facts. The Supreme Command was thus led astray by the magic of imagination and mistook the shadow of victory for the reality.

On the 25th, Moltke considered that the "great decisive battle in the West had been fought and decided in Germany's favour, and that the moment had arrived when forces might be sent to the Eastern front[4]."

The Pursuit in Lorraine Continues.—This attitude of mind had a direct influence on the operations in Lorraine. Empty rolling-stock sufficient for transporting six corps lay ready near the Rhine with which the greater part of the Sixth and Seventh Armies might have been transported after their victory in Lorraine to reinforce the right wing Armies, as had been intended. Such a transference of force, however, now seemed a waste of time. The operations were to take the form of a triumphal progress through Northern France against a completely demoralized opponent. The Sixth and Seventh Armies, therefore, were ordered to follow on the heels of the French and break through on the Upper Moselle at the Charmes gap. The experience gained in the attack on Liége had diminished the German's respect for fortifications, and it was believed that the French troops were in no condition to make a stubborn resistance. A break through the eastern barrier of France, combined with the turning movement towards Paris, would lead to the envelopment of both the enemy's flanks and speedily end the campaign in the West.

Such was the dream of the Supreme Command, on the 24th–25th of August. The reality, however, was very different. In Lorraine there had been no question of a decision. The French First and Second Armies had not accepted battle; in the Ardennes the French Third and Fourth Armies had been withdrawn before the battle could develop; and on the Sambre, the French Fifth Army and the British Army had retired before the concentric attack of the three German Armies could take effect. In no case had the battle been fought out, nor could there be any suggestion of a decisive victory. They were all frontal attacks against a yielding enemy, or what the Germans call "ordinary victories."

On the 24th, therefore, when the German Sixth and Seventh Armies were ordered to continue the pursuit towards Lunéville and St. Dié respectively, they met strong opposition soon after crossing the French frontier. Within forty-eight hours the French First and Second Armies had recovered and were ready to resume the offensive. The First Army, holding with its right the bastion of the Vosges covering Raon L'Etape and St. Dié, swung back its centre and left to a front Baccarat—Forêt de Charmes, astride the Meurthe, facing north. The Second Army, holding with its left the stronghold on the Grand Couronné de Nancy, withdrew its

[4] Major-General Tappen, "Bis zur Marne."

centre and right to the Saffais—Bayon line, facing east. The fronts of the two Armies thus formed a right angle so that, whichever the Germans attacked, the other could counter-attack them in flank. Both positions were of great natural strength, but between them, at the apex of the right angle was the Charmes gap, a depression of some twelve miles in width, offering an easy passage across the Moselle between the fortresses of Epinal and Toul. This gap was the German objective. While the Seventh Army attacked the French positions on the Vosges towards St. Dié[5], the Sixth Army was to march south-south-west, skirting the French defenses about Nancy and Bayon, and force the Charmes gap[6].

De Castelnau's order to his Second Army for the counter-offensive on the 25th began: "The enemy is moving towards the south, presenting his right flank to Nancy. It is essential to hold up this movement and take advantage of his present situation." The XV. and XVI. Corps were to meet the German advance in front by an advance towards the Mortagne, while the XX. Corps, under General Foch, delivered the attack from about Nancy towards Serres against the German right flank. The French First Army, holding the German Seventh Army east of the Meurthe with its centre and right, was to attack the German Sixth Army with its left, the VIII. Corps, from the south.

The counter-offensive was completely successful. The XX. Corps reached the front Serres—Frascati threatening Lunéville, whilst the other corps were able to prevent the Germans crossing the Mortagne in any strength. The fighting was severe. General Dubail says in his diary: "I told my corps commanders that, whatever the losses and however great the privations, they were to attack and attack again and keep on attacking." By the 27th, the strength of the German offensive was broken, and the idea of forcing the Charmes gap was for the moment abandoned.

The result of this brilliant defense by the French First and Second Armies was far-reaching. On the 25th, the German Supreme Command had decided to send two corps from the Western front to reinforce the Eighth Army in East Prussia. Moltke, in his report written in the summer of 1915 on these operations[7], writes: "I intended to take these reinforcements from the Seventh Army, which had made as little progress towards the Moselle as the Sixth. Both these Armies, however, consistently reported that they were opposed by superior numbers of the enemy, also the

[5] See the regimental histories of the 119th, 120th and 180th Wurtemburg Infantry Regiments.

[6] For further details of this German offensive, see note 3.

[7] Moltke's report was never published. This quotation, given by Foerster in his book, "Graf Schlieffen und der Weltkrieg" (p. 34), is the only portion of it that has yet appeared in print.

losses had been so heavy that no units of the Seventh Army were fit for employment elsewhere until they had been brought up to strength again. For these reasons, it was decided to send two corps from the right wing (the Guard and XI. Reserve that had been set free by the fall of Namur), to the Eastern front. I admit that this was a mistake, and one that was fully paid for on the Marne."

The German right wing which was to be kept at the greatest possible strength had already been deprived of three corps, the III. Reserve and IX. Reserve at Antwerp, and the VII. Reserve at Maubeuge, so that the loss of another two was a serious item. By the 28th, the German First, Second and Third Armies had but twelve, instead of seventeen, corps advancing on an eighty mile front. Quite apart from the Ersatz divisions and the reinforcements from Lorraine with which Schlieffen's plan provided to support them, they were now marching on Paris with some 90,000 combatant troops less than originally intended. Of these, it is no exaggeration to say that the absence of 30,000 at the battle of Marne was in great measure due to the defense of the Charmes gap by the French First and Second Armies.

III

The Sixth and Seventh Armies Remain in Lorraine.—In the meantime the German mass of attack was continuing its triumphal pursuit through Northern France with giant strides. By the 28th, the First to Fifth Armies had reached a general line east to west, from Verdun to the Somme, about Péronne and Amiens. The continuous fighting and marching, however, was beginning to have its effect. The dwindling ranks caused General von Kluck to report to the Supreme Command that his First Army was reaching the limits of its powers of endurance, and he begged for reinforcements. He waited in vain, however, for the arrival of the forces from Lorraine which, according to the original plan, should have been already moving up close behind to his assistance. Moltke considered that the French forces about Paris might be ignored[8], and that the French Higher Command had not sufficient fresh troops at its disposal to make any offensive from Paris worthy of the name. In his orders, issued from Coblenz on the 27th-28th of August, he gave his mass of attack general objectives forty and fifty miles ahead, and trusted to the weary feet of his right-wing Armies to capture Paris rather than to the brains of the Supreme Command. From this time until the eve of the battle of the Marne he paid little heed to his right wing; from all the reports of the

[8] See "Der Marsch nach Paris," Kluck.

enemy's headlong retreat it seemed to him that here, at any rate, he had but to hold out his hands and the ripe fruit of victory would fall into them.

The news of the reverse in Lorraine had, however, caused much concern. "The question again arose of what was to be done with the Sixth and Seventh Armies: whether they were to be withdrawn on the defense or to continue the attempt to break through the French line of fortifications, an operation which, if successful, was full of great possibilities. The whole matter was thoroughly discussed between the Supreme Command and the Sixth Army Commander. In the hope that the break-through would succeed or that at least a great part of the French Army would be held, thereby favouring the advance of our right wing, it was decided to continue the offensive[9]." The rolling-stock in the railway sidings by the Rhine, therefore, remained empty and idle, and the Sixth and Seventh Armies prepared for another offensive against the French eastern barrier.

Moltke's point of view is clear. He believed his Armies to be in pursuit of a beaten enemy[10]. The resistance between Nancy and the Vosges was regarded as only a temporary check. The Fifth Army, about to advance south of the Meuse through the Argonne towards the Upper Marne would threaten the rear of the Verdun-Nancy line and compel the withdrawal of the French there. Moltke had no doubt of this. "Verdun," according to his orders issued to Armies on the 28th, "was to be invested," and, when the enemy withdrew, the Sixth Army was to cross the Moselle between Toul and Epinal, and advance south-west towards Neufchateau, the Seventh Army remaining on the defensive to prevent any enemy breaking through between Epinal and the Swiss frontier. He considered that the French right wing would withdraw to a flank, southward, towards the triangle of forts, Langres-Dijon-Besançon, where it would re-organize and possibly, as he foresaw in his order of the 28th, make another offensive into Lorraine to relieve the pressure against the French left wing and centre.

In such circumstances the idea of transporting corps from the Lorraine front to the right wing[11] found no favor at Supreme Comamnd. The fact that the French, relying on the defensive

[9] See "Bis zur Marne," General Tappen. Major-General, then Colonel, Tappen was at this time chief of the Operation Section of Supreme Command, and is therefore in a position to give first hand evidence.

[10] Bülow, commanding the Second Army, reported that the French retreat was like a route (fluchtartig).

[11] This would take at least a week. The railways in Northern France took time to repair; by the 29th of August trains could not run beyond Mons, by the 31st beyond Cambrai, by the 10th of September beyond St. Quentin. The troops would, therefore, have at least two or three days' march from their place of detrainment to reach the battle-front.

strength of their eastern fortifications along the Moselle, were already taking troops from their First and Second Armies to form a new, strong offensive wing north of Paris[12], was unknown to the Germans. They had no idea that Verdun and Paris, which Moltke spoke so glibly of investing, were to become the two counter-buttresses of a vast fortress, from the northern wall of which the French counter-offensive was soon to be delivered.

Preparations for the Attack Against Nancy.—The offensive of the Sixth German Army was to be directed against the Moselle between Toul and Epinal. Its right wing was to capture the Grand Couronné de Nancy by a frontal assault, and thus prepare the way for the break-through of its left wing farther south through the Charmes gap, between Bayon and Charmes, across the Moselle. The offensive was to be delayed as long as possible to give the Fifth Army time to advance through the Argonne behind the French positions on the Moselle; it was hoped that the French would then automatically retire from the front of the Sixth Army. In the meantime preparations were made for the assault on the Nancy position. The Supreme Command ordered seventy heavy batteries to be sent forward on the 30th of August from the Metz and Strassbourg fortresses and the Nied position and placed at the disposal of the Sixth Army. On the 2nd of September, however, the Bavarian Crown Prince expressed his doubts to the Supreme Command as to the success of the plan for breaking through the line of the Moselle. The Fifth Army, instead of marching southwest in rear of the Nancy positions, had been compelled to wheel eastward by the counter-attacks of the French Third Army, which swung back pivoted on Verdun. The weight of its pressure southward was thus lost and its right instead of marching on Vitry le François lay in a general direction on Bar le Duc. Not only did this imperil the success of the assault on Nancy, but it also drew the Fourth Army out of its south-westerly course, thereby creating a gap of over forty miles between the German Fourth and Second Armies which the three corps of the Third Army were quite unable to fill. This was in fact the main reason which caused the Supreme Command to sanction the inward wheel of the First and Second Armies that was to lead them past the east front of Paris into so many and great difficulties.

Moltke, however, allayed the misgivings of the Bavarian Crown

[12] The 55th and 56th Reserve Divisions left the Hauts de Meuse on the 26th-27th of August for Montdidier and Amiens. The VII. Corps (14th Division and 63rd Reserve Division) left Belfort on the 26th of August for the same destination, on the dissolution of General Pau's Army of Alsace. In addition, the XVIII. Corps and half IX. Corps left the Second Army (about Nancy) on the 18th of August for Mézières and Hirson to fill the gap between the French Fourth and Fifth Armies.

Prince. The offensive of the Sixth Army would, in any case, hold the French in position while the German mass of attack continued its wheel into Central France. The final decision could not long be delayed.

Supreme Command Hears of the French Concentration at Paris.—On the 3rd of September, Sixth Army Headquarters reported to Supreme Command "no rearward movement noticeable behind the enemy front, also no rail-transport: strong enemy masses, infantry and artillery, in and behind the enemy position." That evening, however, reports of a contrary nature reached Luxemburg[13]. Colonel Tappen writes: "Information began to come through of heavy traffic, apparently troops, along the railways behind the French front moving from the eastern frontier towards Paris. The possibility of an attack from Paris against our right flank would have to be reckoned with." This led to the Supreme Command order of the 4th of September. By it, the German First and Second Armies were to wheel westward to a position between the Oise and the Seine in order to face the north-east front of Paris, and hold the French assembling there. The Third, Fourth and Fifth Armies were to coöperate in the attack of the Sixth Army against the French Armies holding the eastern frontiers.

Moltke Definitely Abandons Schlieffen's Plan: 4th of September.—By this order, Moltke Definitely abandoned Schlieffen's plan that till now had so successfully inspired the operations. He had failed to comply with its fundamental need, the maintenance of a right wing as strong as possible, with the result that he was unable to meet the French concentration about Paris offensively. He returned, therefore, to his conception of two decisive battles—the first, with his centre and left wing against the French eastern Armies, and the second, against the remainder of the enemy's forces about Paris. While the first decision was being fought, the First and Second Armies were to remain on the defensive, and, to assist them in the final battle, he ordered Seventh Army Headquarters with the XV. Corps and the 7th Cavalry Division to be transported at once from the Lorraine front to coöperate from the north against Paris, on the right of the First Army.

The whole plan was stage-managed like a pageant. It was to be a fitting conclusion to the first phase of Germany's progress to the position of conqueror of Europe. The Emperor was to attend the assault on Nancy and enter the town in triumph: a bodyguard of a regiment of the Guard Cuirassiers, dressed in its white uniforms, was ready behind the front to accompany him. Two days were allowed for the consummation of the great victory; on

[13] Supreme Command moved here from Coblenz on the 30th of August.

the 7th, the Emperor was to be at Châlons, where he would give his congratulations in person to the Third Army; he would then proceed to the First and Second Armies and make with them the grand triumphal entry into Paris. All the other sovereigns of Europe had in the past been invited and honored there, he said, except himself; he would now invite both himself and his Army.

IV

The German Offensive Against the French Eastern Armies: 4th–8th of September.—The battle which began against the circle of heights that cover Nancy on its eastern side, the Grand Couronné, thus formed part of the greater battle to be fought by the five German Armies, the Third, Fourth, Fifth, Sixth and Seventh, which was to crush the French force, and, as the Supreme Command believed, the mass of the French Armies, in the area Châlons-sur-Marne-Verdun-Nancy. The third, Fourth and Fifth Armies, pivoted on the left of the Fifth Army about Verdun, were to wheel and attack south-eastward towards the Upper Meuse. The attack on Nancy was preparatory to the advance of the Sixth Army across the Moselle westward. Even if the attack on Nancy failed, the offensive of the Third, Fourth and Fifth Armies would, it was thought, bring the decision.

On the 4th, the right of the Sixth Army reached the French advanced positions along the northern and eastern slopes of the Grand Couronné. The great strength of the position lay in its complete command of the Seille valley, so that it was almost impossible for the Germans to find sufficient artillery positions from which to cover the assaulting infantry. The Germans, untrained in position warfare, attacked with an inadequate artillery preparation and had extremely heavy casualties. On the 5th, the failure of the 4th was repeated. On the 6th, the French counter-attacked from Drouville and regained ground from the III. Bavarian Corps. On the 7th, fresh German divisions were brought up from Metz for another assault on the 8th against the Mont d'Amance, the southern bastion of the Grand Couronné, which also failed for the same reason. At times the French resistance was indeed almost broken. General de Castelnau had the orders for a general retreat from Nancy ready in front of him for his signature, but at the last moment wiser counsels prevailed[14], and his Second Army remained in position.

On the evening of the 8th, the plan of breaking through south of Nancy across the Moselle was abandoned by the Germans. The Commander of the Sixth Army wished to continue the offensive

[14] See General Dubail's "Quatre années de commandement," pp. 98–100.

but the Supreme Command had suddenly appreciated the extent of the French offensive in front of Paris and decided to send further reinforcements to the right wing. The I. Bavarian Corps of the Sixth Army was ordered to entrain at once, and other corps were ordered to hold themselves in readiness to be transported to the western flank. On the 9th, the Supreme Command sent the following order to the Sixth Army: "The attack against the Nancy position is not practicable. All available units of the Sixth Army will be organized as rapidly as possible for employment elsewhere. Preparations for the occupation of a defensive position behind the present front will therefore be made as soon as possible."

If, as may be said, the fortified positions about the Grand Couronné and on the northern slopes of the Vosges, which command the approaches to the Charmes gap, mark the grave of Germany's early ambitions, so also they were the cradle of that form of position-warfare which was soon to alter the whole aspect of the war on the Western Front. The French line of trenches, covered by obstacles, and supported by an entrenched and concealed artillery, spread rapidly in the weeks that followed. The Germans withdrew into the Seille Valley and constructed similar fortifications: by the middle of November this trench warfare was in full progress along the entire front from the North Sea to Switzerland.

The offensive of the German Third[15], Fourth and Fifth Armies had been equally unsuccessful. The Third and Fourth Armies had been held back by General de Langle de Cary's Fourth Army. The General realizing the danger that threatened the French eastern Armies, of which his own formed the left wing, took up a strong position along the Rhine-Marne canal between Vitry le François and Revigny. The Germans, not expecting resistance, made no organized attack against the position and the French were able to hold it until the decision on the Marne had been gained. The advance of the German Fifth Army south-eastward from a front Laheycourt—St. André was also effectively held up by General Sarrail. His Third Army with its right clinging on to Verdun and its left on the Rhine-Marne canal was in no enviable position. Its brilliant defense was due in great measure to the admirable handling of the artillery and to the timely support of the XV. Corps sent to its assistance by the Second Army.

On the evening of the 8th, the Emperor waiting behind the Nancy battlefront—the chief actor awaiting his call behind the wings of the stage—returned with his White Cuirassiers to Metz. The great pageant of victory of which his theatrical entry into Nancy

[15] Less one and a half corps assisting the advance of the Second Army on Féré Champenoise.

to avenge his ancestor, Charles the Bold, formed the prelude, was to remain forever unacted.

On the 9th, he went back to Luxembourg where he heard Colonel Hentsch's report on the fighting on the Marne and of the retreat of the First and Second Armies[16]. His comments on it have not yet been given to the world.

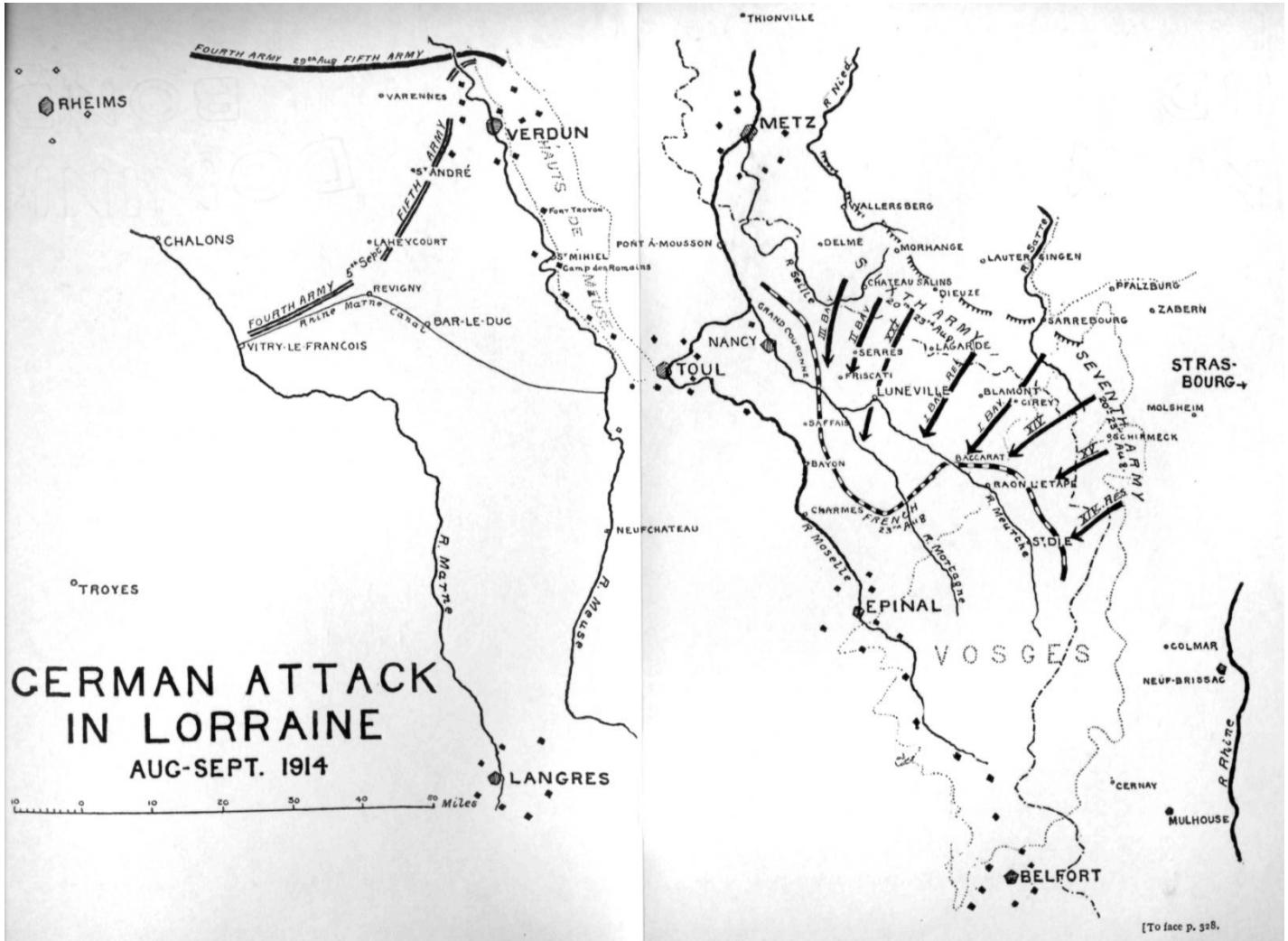
The Allied Offensive from Paris: 5th–9th September.—It is difficult to realize that during the battles on the Ourcq and the Marne from the 5th to the 8th of September, the German Supreme Command had no idea of their importance. Nevertheless such appears to be the case; not a single order was issued from Luxembourg to the First or Second Armies during that period; they were left to fight out the decisive battle of the war by themselves. It was imagined that they could easily hold the weak French forces about Paris until the decision had been gained by the five German Armies south-east and south-west of Verdun. They had no idea of the extent of the lateral displacement of the French strength from east to west.

From the 1st of September onwards a continuous stream of trains had in fact carried divisions from the French right wing to form a new Army, the Sixth, which was to assist the French Fifth Army and the British Army in the counter-offensive against the German First and Second Armies. By the 5th of September, the French had thus assembled four Armies (Sixth, British, Fifth and Ninth), a total of twenty-eight divisions[17] to attack the right wing German Armies, a total of twenty divisions. Simultaneously, the German offensive against the eastern fortresses was delivered by five German Armies, a total of thirty-eight divisions against thirty-three French divisions.

The period 5th–8th of September was most critical, and the situation presents a strange paradox. For twenty years the German plan of campaign had been based on the fundamental idea of drawing the French into the open and avoiding an attack against their eastern fortresses. The German Army had been trained for years past almost entirely for offensive action in open warfare mainly on this account. Its system was entirely unsuitable for the assault on strongly fortified areas. And yet, when the hour of action arrived, we find the mass of the German Armies engaged about those very fortresses against a strongly entrenched enemy while the offensive in the open was being delivered by the French with a numerical superiority. The two German right-wing Armies had to fight a

[16] See article "The Seapegoat of the Battle of the Marne, 1914." Reprint from *The Army Quarterly*, London, England, in the January-February, 1922, FIELD ARTILLERY JOURNAL.—Editor.

[17] Six of these were reserve divisions, and the IV. Corps was still on the railway.



GERMAN ATTACK IN LORRAINE

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defensive battle against the concentric attack of the four Allied Armies with no prepared system of defense, whereas the numerical inferiority of the French eastern Armies was compensated for by the great natural strength of the positions they occupied.

The result of the two simultaneous battles, the French offensive on the Marne and the German offensive against the Verdun-Nancy-St. Dié defenses, was to bring a common decision. They reacted directly on each other. The German Supreme Command had manœuvred its Armies into a false position. It had underestimated the recuperative power of its opponents and exaggerated the extent of its frontier victories. The unbounded self-confidence, and the loose handling of the reins of command that followed, led it to disaster. It had allowed its much-weakened right-wing Armies to be surprised by an Allied offensive of superior numbers, while the mass of its Armies was engaged in an attempt to envelop the French eastern Armies defending the eastern fortresses. Its left wing Armies had not been intended for such an operation; they had neither the artillery, nor the equipment, nor the training for the assault of fortified positions, and while they were receiving their initiation in position warfare between Nancy and Bayon and southwest of Verdun, the decision was rapidly arrived at in the open warfare on the Marne, and the whole German advance brought to a standstill.

GENERAL LUDENDORFF ON THE GERMAN PLAN OF CAMPAIGN, AUGUST, 1914*

[EDITOR'S NOTE.—*The following article is believed to be of interest in connection with the article entitled, "The Development of the German Plan of Campaign, August–September, 1914," published in this number of the* JOURNAL.]

THE German plan of campaign which was put into execution in August, 1914, and its development have been dealt with at length by two articles in this review.[1] In them it was shown that the idea of the great wheel which was to sweep round Paris, enclose the French Armies and drive them up against the Swiss frontier, was evolved by the Chief of the General Staff, Count Schlieffen, and adopted as the official plan in 1905. When he retired in 1906, his successor, General von Moltke, adhered to the plan. In the course of time, however, the German Army increased in numbers and nine divisions more than existed in 1905 became available. Of these von Moltke allotted eight to the left wing (the Sixth and Seventh Armies) in Lorraine, and one, with another withdrawn from the force originally destined to act against Russia, to the right wing. Thus the right, the striking wing, was two divisions stronger than von Schlieffen originally designed it to be.

In tabular form, neglecting cavalry divisions and Ersatz and Landwehr formations, the figures were, counting in divisions, active and reserve:

	1905	1914
France, right wing (First to Fifth Armies).....	53	55
France, left wing (Sixth to Seventh Armies)....	9	17
Russia	10	9

The substantial addition to the left wing was doubtless made because the Great General Staff had at least some inkling of the French plan, and some one in authority wished to spare German soil from the horrors of invasion. Regardless of what might have happened in Lorraine if the extra eight divisions had not been there, it is now argued in Germany that von Schlieffen would certainly

* Reprint from *The Army Quarterly*, London, England, October, 1921.

[1] Vide "The German Campaign in the West, 1914" (April, 1921), and "The Development of the German Plan of Campaign, August–September, 1914" (July, 1921).

have allotted them all to the striking wing and would have won the war. Actually, up to and including the 1st of September, all went exactly according to the plan of 1905, except that the Germans were a trifle ahead of the line fixed for the thirty-first day of mobilization. Then apparently they thought that they had won the war, and made grave mistakes. These do not, however, affect the value of the initial plan.

In the March number of the *Süddeutsche Monatshefte*, Herr Eugen Zimmermann, the former Under-Secretary of State, in an article entitled "About Schlieffen's Plan," goes so far as to examine the question "who is to blame for Schlieffen's ingenious plan not being carried out, which was expected to ensure victory in Germany?" He is mainly concerned in attempting to show that the leaders of the Government did not bring pressure to bear on the General Staff to increase the forces for the defense of Alsace and Lorraine and for covering Baden. The opinions of Herr Zimmermann on military plans and their execution appear to be as valuable as those of our own home-grown politicians, and we need not waste time over them. He puts the whole of the blame for failure on von Moltke and offers Germany the consolation that "it was very bad luck that Count Schlieffen was not born twenty years later than he was."[2]

Herr Zimmermann, however, quotes opinions which he solicited from various eminent men, and these are of interest as showing that the dispute as to who lost the war still continues between the civil officials of the Government and the soldiers.

General von Freytag-Loringhoven, the historian, and General von Bernhardi both have a great deal to say, although nothing to the point. The former general protests that the failure to win the war was not the fault of the General Staff; the latter says that the alteration of the plan—for the better protection of Baden—was the fault of Bethmann-Hollweg. Von Bernhardi's paper was evidently shown to the ex-Chancellor before his death, for in a letter to Herr Zimmermann he writes:

> "The question of an alteration of the Schlieffen plan of campaign was never discussed between me and the General Staff during my time as Chancellor. Whether, and on what grounds, such alteration was made is wholly beyond my knowledge. General von Kuhl's very interesting account of the genesis of the Schlieffen plan, to which I refer you, was therefore quite new to me. The observations of General von Bernhardi are

2 He was 73 years of age when he retired in 1906, died in 1912, and would have been 81 in August, 1914, had he survived.

entirely wrong. The artificialness of his suppositions will not have escaped you. Actually, they have no foundation whatever."

Prince Bülow also disclaims any share in the development of the plan. He writes:

"I never meddled with military details, and Count Schlieffen just as little tried to influence my conduct in affairs of State."

General Ludendorff's letter, which is the principal reason for drawing attention to the *Süddeutsche Monatshefte*, is as follows:

"I still believe that the right wing was never weaker than Count Schlieffen made it. We had a heavy increase in the reserve formations and then again the XX., XXI. and Bavarian III. Corps.[3] But the proportion was altered to the disadvantage of the right wing. That is correct. I expressed my concern about this to Moltke on a General Staff tour. He considered, however, that he must protect Baden, and that the XV. and XIV. Corps would still reach the right wing in time. That was correct. In our numerical inferiority we had to increase our forces by mobility.

"It must be added that in Moltke's time a raid of the French VII. Corps into Alsace became more and more probable. Here was opportunity offered for a nice little minor success at the opening of the war—which we must not undervalue.

"If we study the events and the dates in 1914, we shall find that the corps which were left in Alsace could easily have got up to the right wing in time. Only power of leadership was required. The Supreme Command in 1914 did not possess this.

"It was the same in Lorraine. There, too, a brilliant victory was to be gained, and the troops were up to time everywhere, but leadership was lacking. The left wing, according to Schlieffen, was to be very, very weak, and an enemy's attack might have had a success there too easily: we should then have been rolled up like the Bolshevik Army from Warsaw. (1920, German Editor).

"There is a tendency to get lost in theories and to forget that in the decisive moment the power of leadership is everything. Moltke's fault lies in the lack of this power, not in the alteration of a plan.

"Moltke's deployment was also correct, if in his advance he had pushed the troops farther north or north-west.

"Schlieffen—and Moltke also—stuck tight to Thionville.[4]

[3] Added to the German Army after 1905.

[4] The pivot of the wheel according to the plan.

> As in the execution of the plan Moltke did not reinforce his right wing, he did not swing sufficiently clear of the fortress, and, so far as that goes, Schlieffen did not either. If the operations were carried out after the battle of Lorraine as Moltke devised, then the armies had to be pushed westward from Thionville, that is, had to leave go of Thionville; that was the right and proper course. Then the right wing could have been stretched out as far as required. Even the Schlieffen plan breaks down in this clinging to Thionville.
>
> "I have not until now spoken out in this matter, but place the above at your disposal."

Postscript.—"If Moltke had not sent the Guard Reserve Corps and the XI. Corps to East Prussia, all would have gone well. If he wished to send something, he should have taken the corps from the left wing. Thus again, 'leadership.'"

General Ludendorff's views seem very much to the point, and there is only one criticism to make: the Army next to Thionville, which would have been responsible for the gap and its own left flank had the German right wing been shifted clear of the *Feste,* was the Fifth. This was commanded by the German Crown Prince and it went very near defeat and had to be drawn back, even though it had Thionville to support it. Only the withdrawal of General Maunoury and his three reserve divisions to go west to form the Sixth Army saved the Crown Prince's force from being rolled up on the 24th of August, 1914.

Thus the solution suggested by Ludendorff would not have ensured victory; it might even have led to a disastrous defeat. The Germans lost the war, and the final result would no doubt have been the same whatever their generals did. They lost from the moment they violated the neutrality of Belgium.

Among the statements made by Herr Zimmermann, the following are of interest. When von Schlieffen retired the names of the following officers were put before the Kaiser by the Chief of the Military Cabinet as qualified to succeed him: General von Bülow (then commanding the III. Army Corps), General von Bock und Polach (formerly commanding the Guard Corps), General von Hindenburg (then commanding the IV. Army Corps), General von Besseler (Inspector of Engineers, Pioneers and Fortresses), General von der Goltz. The Kaiser, however, selected von Moltke's "because he believed the name would have a terrifying effect on hostile countries." Of all the prominent German generals in 1914–1918, only von Moltke and von Kluck were not Staff College graduates.

ARTILLERY FUZES

BY J. H. WOODBERRY, MEMBER ARMY ORDNANCE ASSOCIATION

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IN artillery fire the usual mission is destruction of the enemy and his protection. Much depends upon the accurateness in placing projectiles at the desired point of destruction at the time required, and there is much dependence placed in the explosive charge and type of projectile used; yet with all the refinements of guns and gunnery, explosives and shells, in the final analysis, the effectiveness of artillery fire is measured directly by the final action of the fuze. Fuzes are, therefore, of the same relation to artillery as the balance wheel is to the highly specialized mechanism of a watch. Without an efficient system of fuzes, the splendid technical accomplishments in ranging apparatus, powerful and accurate guns and scientifically designed projectiles are all futile. Fuzes possess no spectacular interest and occupy but a small place in the make up of an army, yet there is perhaps no other unit of artillery matériel which requires higher technical skill in its perfection or offers more difficulties in its design.

In the design of gun carriages, fire-control instruments, etc., there are certain known requirements to be fulfilled. These problems are solved by the scientific application of natural laws. Upon completion of one of these devices, trials are made, errors or weaknesses developed, and other sources of trouble become apparent in the performance. In fuze design, however, there are so many hidden requirements to be met, and such an abundance of potential errors lurking in every delicate piece, that laying down a successful design by pure laws of natural philosophy becomes practically impossible. Solution with this mass of uncertainty existing is still further obscured in its final stage by the necessity of destroying the article to be tested in testing its operation. In other words, instead of reaping satisfaction through the appearance of the article with all of its splendid perfection, it becomes necessary to blow it to atoms to see whether or not it works. If it works, well and good; if it fails, the evidence is gone. In testing, it must be attached to an explosive shell and fired away to prove its usefulness.

In fuze design it is rarely possible that the first models will prove satisfactory. Usually some degree of success will follow the initial attempt, thus adding a little impetus in development work, but ordinarily the process is a slow and painful one, fraught with many disappointments and defeats. The proposition of locating the defects is a matter of serious concern. Such questions as these are to be

answered: Did it fail because the primer did not fire? Did it fail to arm? Did the delay pellet burn through? Or was it perhaps a failure of the booster or detonator? Maybe it was a faulty loaded shell, or perhaps the shell tumbled in flight, or the fuze unscrewed, or the impact was bad, or something gave way under the stress of fire. Was the premature due to a badly loaded shell or a porous shell base? The designer will swear by all the laws of nature and accompany his oath with all sorts of practical tests to show that the detonator was in a safe position when the gun blew up, yet something must have happened; the survivors of the gun crew will attest the accurateness of screwing the fuze home into the shell, of using the proper propellant, of the shell being properly protected with a base cover, and the like. Nevertheless the wreckage is appalling proof that something went wrong. What happened is seldom revealed by an examination of the débris. This is the usual preliminary reward of the most feasible designs.

But fuzes can be made which will function properly, they have been made, and they are still being made. So then, what is the secret solution of fuze design? You fire them and they fail, or something goes wrong and your gun is blown to pieces. You examine the drawings, and all seems well.

But the solution of the problem, the reason for the mishap, yet remains to be discovered. When failures occur, or prematures shake the staunchest hopes, the thing to do is to go home and think it over. The fuze will usually divide itself into major problems such as mechanical functioning, workmanship, detonating ability, and the like. These points are separate studies. Other fuzes will be made exactly like those which fail. They will be fired inert for recovery and examination; they will be armed by spinning on the bench at gun speeds and will be dropped on plates to simulate the "set back" of the gun, they will be tested for safety and in every other logical and illogical way which may possibly disclose the defect. By making these endless experiments some fault is usually detected which will explain the possible malfunction, yet in numerous cases, after all have reached an agreement as to cause, it happens in subsequent test that the fault is still with us, or maybe it has been superseded by some other unexpected occurrence.

It may happen that after six months' or a year's hard work the design will be discarded through inability to correct its faults, but, nevertheless, the experience gained in this series of experiments lays the foundation for the next design, and now and then in the future turns out to be of unexpected value.

The development of fuzes does not rest with the successful test of experimentally made models. A satisfactory performance with the limited number is indeed an accomplishment, but the real test is

a service test. The few fuzes made up for the initial try-out are usually made up by skilled workmen on precision machines; tolerances are held to the most favorable size and finishes of the highest order appear on all surfaces. They are hand made, as it were, and are nursed to maturity as pets. But when the sterner requirements of service are presented, the fuze must be made on a practical production basis. They must be manufactured on production machines and probably by inexperienced or at least uninterested help. Drawings, specifications and gauges tell the operator all that he wants to know about the job, and having complied with his interpretation of the drawing, etc., his responsibility rests. But to the fuze designer there is no rest in his mind until the first few lots have been manufactured and have satisfactorily passed the test. He then has his reward.

Drawings and specifications are, therefore, the fixed aim of the fuze engineer. These are indeed all that he will have left to show for his efforts when development has been completed. The fuzes have all been shot away and have gone up in smoke. In developing a fuze, therefore, the minutest details are mountains of importance to the engineer and require his concentrated attention. A draftsman has no place in an experimental shop, other than to transcribe the lines, figures, and notes indicated to him by detailed sketches.

It may be of interest to those who are mechanically inclined to illustrate a few of the principles utilized in fuze design, so a general description of the typical fuzing system will be given. A fuze may be defined as a device for exploding projectiles at a desired place. Detonating fuzes are used with high-explosive shell, and time fuzes, which are not usually of the detonating type, are used principally with shrapnel. Detonating fuzes are classified as Point fuzes and Base fuzes depending upon their location in the shell. They are still further divided into types known as inertia-operated fuzes and supersensitive or quick-acting fuzes. In time fuzes there are two general classes; those operated by clock work, and those which depend upon a slow-burning powder train for operation. The latter type is the more common.

The principle of operation of a detonating fuze is as follows: During the journey of the projectile, some attendant force, such as linear acceleration, rotation, angular acceleration, or air pressure is utilized, first to render the fuze safe while in the bore of the gun, and then to prepare the fuze for firing upon impact. When a fuze strikes a target offering sufficient resistance, a primer is fired either by the forward movement of a contained plunger or by compression on the nose of the fuze. The flame from the primer sets off the detonator, and the detonator being of fulminate of mercury, in turn initiates an explosion in an auxiliary charge of powerful yet safe

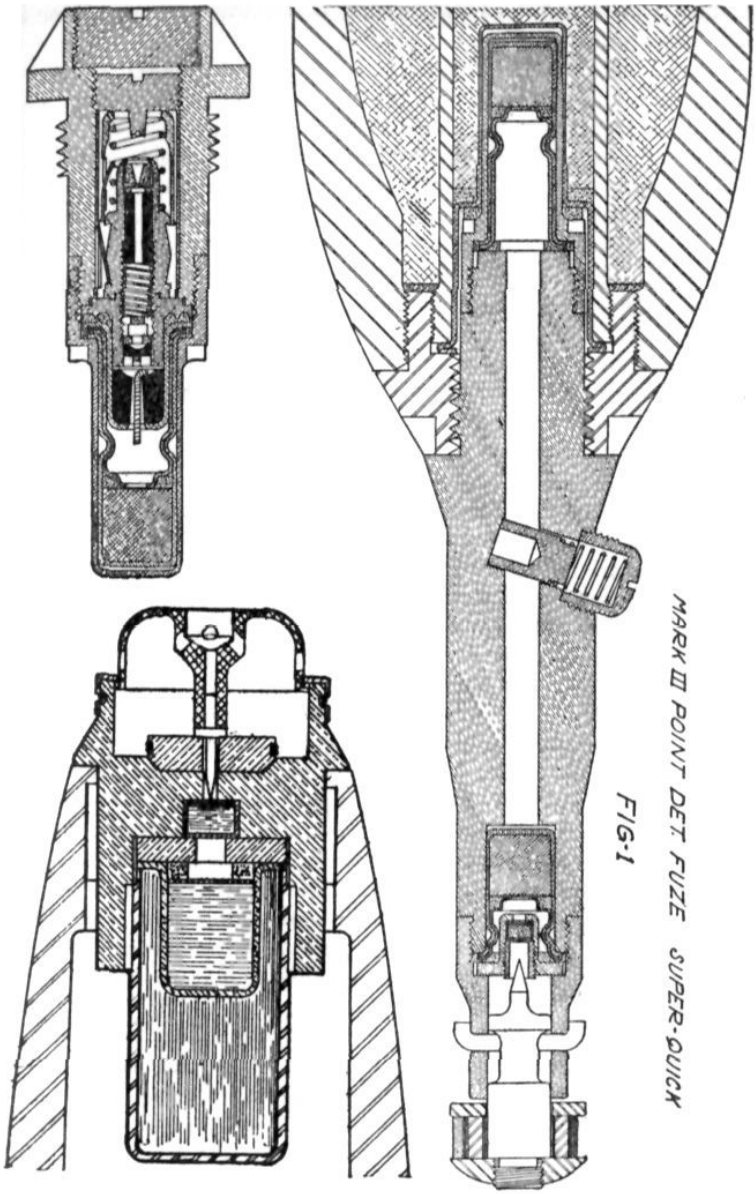

FIG. 2.—MARK IV POINT DETONATING FUZE, DELAY ACTION

FIG. 3.—37-MM. FUZE, SUPERSENSITIVE

explosive. This auxiliary charge is usually of tetryl and is called a booster. It in turn detonates the shell charge. In delay-action fuzes a slow-burning powder pellet is inserted between the primer and the

detonator in order to slightly retard the transmission of flame to the detonator.

As an illustration of detonating fuzes; figures 1 and 2 are shown. Figure 1 is a quick-acting fuze, known as the Mark III Fuze. This fuze was extensively used in the World War by both the United States and France. A brief description of its operation is as follows: Upon firing, the two half collars between the head and the body of the fuze are held in place by a thin metal strip, wound about the half-collars in a direction counter to the rifling of the gun. Attached to the end of this spiral is another segment of a collar, which also acts as a support to the head as the projectile is forced forward into the riflings. Then, at an increasing speed, it assumes a combined rotational and longitudinal motion. The reaction to linear acceleration causes the head to bind tightly against the collars. At the same time the angular acceleration of the projectile causes the lug on the tap to resist rotation and lag behind, tending to wrap the tape tighter about the collars, thus resisting the effect of centrifugal force which tends to separate the collars and expand the tape. When the projectile emerges from the gun, linear acceleration dies away and changes direction, and immediately the collars under the influence of centrifugal force attempt to unwind the ribbon, by outward pressure. This is aided by centrifugal force on the lug and tape also, as angular acceleration likewise ceases as the projectile emerges from the gun, and the tape then unwinds under the action of centrifugal force and frees the collars. In the remainder of the flight, the firing pin is restrained from striking the primer by a shear wire. Upon impact, however, the pin is jammed into the primer, and the flash therefrom is immediately transmitted to the upper detonator, then through the channel to the lower detonator which detonates the booster charge and consequently the shell charge. While in flight the safety shutter is thrown open by centrifugal force, allowing free passage of the flame from the upper detonator to the lower one. The shutter is placed on an angle with respect to the axis of the fuze so that linear acceleration in the bore will prevent centrifugal force from opening it until it clears the gun.

Figure 2 shows the delay-action inertia fuze. This fuze was likewise used extensively during the war. The arming operation depends upon the reaction of the safety sleeves to acceleration. Upon firing the gun, the inner casing compresses the safety spring and unlocks the prongs of the outer casing from the lower flange of the plunger. The prongs on the inner casing engage the upper shoulder of the plunger and retain the safety spring in a compressed condition. As soon as the shell leaves the gun, linear acceleration changes direction owing to the cessation of powder pressure, and the pressure exerted rearwardly on the projectile by the air. Thereupon the plunger

attempts to move forward but is restrained by the spring in the rear end of the plunger which is also attached to another part of the fuze. In this position the plunger rests until the projectile strikes a resistance. Then the plunger, under the influence of its own mass, continues its motion forward, and causes the primer to be stabbed by the firing pin. The flame from the primer ignites the delay pellet, and after burning through spits a flame through the delay pellet to the detonator. In non-delay fuzes, the delay pellet is omitted.

Another interesting fuze is that designed for use in small projectiles from one airplane against another: Figure 3 shows such a fuze. Its novelty resides in the utilization of air force to render it safe in flight. Upon firing, the pin and its holder rest on two half discs which are normally held together by a spring wire wrapped about them. Linear acceleration causes these two blocks to hug the bottom of their seat, resisting centrifugal force until the projectile is out of the bore. Thereupon they fly outward and leave no material barrier between the firing pin and the primer. The air pressure on the nose of the fuze in flight is enormous, and the most natural thing for it to do is to move rearward against the primer. Such is not the case, however, as will be seen later. It is true that the air pressure is sufficient to drive the pin rearward, were it not opposed, but, fortunately, the designer takes into account the difference between dynamic and static force, and therein lies the safety of the fuze. The air flowing against the head of the fuze exerts a pressure dependent upon the shape of the nose for its effectiveness. The rounded corners, therefore, lessens the effective pressure. Now, through the perforations in the centre of the nose, air enters the cavity under the cap, and at a pressure equal to that against any other part of the nose. But this pressure is static. The air therein has practically no movement, a characteristic of its static pressure being that its force is exerted equally in all directions, and hence the total force opposing this dynamic force of air is that of the static pressure over an area equal to the cross section of the head. The total force being independent of the interior shape gives a greater restraining force naturally, than the rearward force externally, and the firing pin flows in the air in a forward position. Upon impact with the target, such as the wing of an airplane, the flow of air into the cavity is shut off and by reason of the vents on the side of the cup, the pressure is immediately released entirely. The inertia of airplane linen is then sufficient to drive the firing pin into the extremely sensitive primer and cause the shell to explode.

Since the conclusion of the war great strides have been made in fuzes, particularly in the safety and detonating qualities. It is contemplated that the present types of fuzes will eventually be replaced by those of a safer type for firing, and one which will be

more efficient in completely detonating the shell charge; but until these designs have been adopted a description of the fuzes will be withheld for obvious reasons. It may be interesting to note, however, that in these new designs the detonators are in a position remote to the booster, and should a detonator fire prematurely in a gun or while handling, no damage will result to the fuze, other than the destruction of the detonator. Another new feature of these fuzes is their ability to detonate a shell with a large air gap existing between the booster and the shell charge. Such conditions often exist in the service when the shell charge compresses under the forces of setback and leaves the booster suspended in air. In existing fuzes, such an air gap is fatal to detonation; but with the new fuzes it has been found that a gap of six inches in shell loaded with picric acid, amatol, or TNT does not affect the quality of detonation to any noticeable degree. A further improvement is made, in that it is possible, with a simple change in the position of the nose of the fuze to be made at the gun if desired, to have the fuze give superquick action or delay action at will. This will simplify the fuzing problem of shells, and reduce the transportation of several types of fuzes in time of war.

LECTURE ON INTELLIGENCE

BY LIEUTENANT-GENERAL SIR G. M. W. MACDONOGH, K.C.B., K.C.M.G., ETC., ETC.
(PRESENT ADJUTANT-GENERAL)

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I DO not propose to tell you that intelligence won the war, but I will suggest to you the reverse proposition, namely, that it was had intelligence that lost the war, and with your permission I will make later on a few remarks on the opening phases of the campaign of 1914 with the object of proving that proposition.

The value of a good Intelligence Service has been appreciated from the earliest times, and the principles on which it has been erected are the same now as they were in the time of Moses. It has always been necessary for a commander to be well informed of the nature of the country on which he is about to operate, and of the strength of the armies and of the reserve of his enemy before he can formulate a reasonable strategical plan. You will all remember that Moses sent out from the wilderness of Paran one man from each of the twelve tribes for the purpose of searching the land of Canaan. The instructions which he gave to his intelligence agents were similar to those which would be given at the present day. He told them to reconnoitre the country, he gave the routes which they were to follow, he told them to report about the inhabitants, whether they were weak or strong, whether the population dwelt in tents or in fortified cities, and what supplies of food and fuel were to be found in the country. They obtained all these particulars and the way in which they presented their reports gives us a very important lesson. They did not confine themselves to stating what they had seen, but they drew conclusions and said that the enemy was far too strong for the Israelites to have any chance of beating them. That was not their job, and their interference in matters with which they were not concerned gave rise to just as great trouble 3500 years ago as a similar action would today. The lesson is that it is the duty of the intelligence agents to collect information, but it is for the commander-in-chief, or rather for his staff officer in charge of intelligence, to draw deductions from it. I shall say nothing more about ancient history but go straight on to the Great War.

I will venture to say that the chief reason why the Germans lost the war was because they had a bad intelligence system. This service was in charge of a certain Major Nicolai, and it failed from the very outset of the campaign. As far as the eastern frontier was

concerned, it grossly overestimated the time that the Russians would require for the mobilization of their armies, for it led the German higher command to believe that Russia would not be in a position to advance in force into Galicia and East Prussia before the middle of September, and that consequently there would be some six weeks available in which to defeat the enemy on the Western Front before it became necessary to turn towards the East. The whole Austro-German plan of campaign was based upon this assumption, and at its outset von Moltke informed Conrad von Hotzendorf, the Austrian Chief of the Staff, that he considered that the decisive action in the West would be fought about the thirty-ninth day after mobilization, *i.e.*, about the 9th of September. I may say parenthetically that this forecast of the operations branch of the German staff was extraordinarily accurate, as the battle of the Marne was being fought on that date, but that battle was lost, not won, and the reason why the Germans lost was that the intelligence branch had failed. Far from having to wait until the middle of September before advancing, as the Germans had expected, Rennenkampf's army commenced to invade East Prussia on the 18th of August, that is, on the same day as the Germans commenced their advance westwards from their positions of concentration, on the German-Belgian frontier. A very few days later, Ivanov's group of four Russian armies entered Galicia and on the 25th of August battles were in progress along the whole of the Austrian northern front, resulting by the middle of September in the withdrawal behind the San of all the Austrian forces.

Intelligence regarding the Western Front was equally faulty. Little or nothing was known of the movements of the British Expeditionary Force. On the 20th of August, by which date, as you all know, four British divisions had not only landed in France, but had concentrated about Le Cateau and were about to advance on Mons. German General Headquarters issued a communication that though a British landing had taken place at Boulogne, it was believed that a disembarkation had not yet been effected on a large scale. Three days later when von Kluck arrived before Mons he was unaware that the British were holding that city, and were drawn up along the Mons-Conde Canal, in fact, he had been informed by his cavalry only a few hours previously that there was no enemy within fifty miles of that position. From this it is clear that the German front line or tactical intelligence was as bad as its strategical intelligence. One reason why their strategical intelligence was bad was that the British intelligence authorities had not been asleep and had arrested all the important German agents in the United Kingdom the moment hostilities were declared. All through the period of the battle of the

Mons and Le Cateau and for some days subsequently, von Kluck persisted in the belief that the British were based on Boulogne, Calais and Dunkirk, and it was owing to this misapprehension that after the battle of Le Cateau he directed his pursuit south-westwards towards Peronne, in the hope of severing their communications, instead of pressing southwards through Saint Quentin on the heels of the retreating British.

The estimate made by the German intelligence of effect of the opening battles of the war on the morale and upon the powers of resistance of the Franco-British armies was as faulty as their knowledge of their movements. Major General von Tappen, who was head of the operations section at German General Headquarters, tells us that on the 25th day of August von Moltke considered that the great decisive battle in the West had been fought and decided in Germany's favor, and that the time had come when forces might be transferred to the Eastern Front. The result of this miscalculation was that two corps were actually moved away from the German right wing on the 26th of August and were transferred to East Prussia, where they arrived some days after the victory of Tannenburg. That is to say, they were wasted as they were too late to do any good in East Prussia and they were absent from the battle of the Marne, where their presence might have exercised a decisive influence. Not merely were these two corps actually taken away, but von Moltke intended to transfer eastwards four more corps, but as these corps had to be withdrawn from the front line and important events took place, these orders for their departure were cancelled, and they returned to their armies.

An equally grave mistake on the part of the German intelligence was their failure to appreciate the importance of General Maunoury's 6th Army, which the French commander-in-chief commenced to build up north-west of Paris during the last days of August. Von Kluck seems to have considered it to be of minor importance, or, at any rate, to have thought that after the defeat which he inflicted upon it on the 29th of August, followed by its retreat from Amiens and the Avre on the 30th, had rendered it innocuous. The Supreme Command was equally ill-informed, otherwise it would not have permitted von Kluck to have swerved south-eastwards of Paris, and to have crossed the Marne on the 3rd of September and then to have advanced half-way between that river and the Seine, as he did on the 5th of September. It was only on that date that they seem to have realized that danger might be anticipated from the Paris garrison and from General Maunoury's army, which had advanced on that day to a line running north and south through Dammartin, that is to say, half-way between Paris and the Ourcq, and was being

rapidly reinforced by troops from the French right wing. It was then that von Moltke issued orders, which caused von Kluck to withdraw north of the Marne, and to leave that gap between his own and von Bülow's army into which the British, who were supposed to be demoralized and incapable of an offensive, at once advanced. It was this British advance threatening to cut the German line in two, which was the direct cause of the German retirement from the Marne.

To recapitulate, if the German intelligence service had been efficient it would have anticipated the date of the Russian advance, and would have enabled more adequate steps to have been taken to meet it in the East. In the West it would have reported on the departure and ports of disembarkation of the British Expeditionary Force and this information would probably have induced the German Admiralty to take steps to interfere with the movements It would not have allowed von Kluck to blunder into the battle of Mons, but would have indicated the British positions and would have given him an opportunity of bringing up his right flank corps and of enveloping the British left. It would have given accurately the direction of the British lines of communication and would thus have enabled von Kluck to have pursued after Le Cateau in the most dangerous direction. It would have appreciated the gap between the 4th and 5th French armies on the 22nd of August, and would have pointed out to the Supreme Command that the advance of the 3rd German Army Corps across the Meuse about Dinant might have resulted in the cutting off and surrounding of the Franco-British armies west of that river and have produced that second Cannæ of which von Schlieffen and other German strategists had dreamt. It would have made a better estimate of the morale and spirit of the British and French armies after the opening battle of the campaign. It would have prevented von Moltke from falling into the error that he had already won the war in the West and that a transfer of troops from the Western to the Eastern theatre on the 25th of August was permissible. It would have appreciated the great importance of the garrison of Paris and of Maunoury's army long before the 5th of September, and it would have noticed the transfer of large bodies of troops from Alsace and Lorraine to the vicinity of Paris. It would thus have prevented the creation of that false strategical position in which the Germans found themselves on the 5th of September, and it would have prevented the complete reversal of the Schlieffen plan. The essence of that plan was that the Germans should have on their right wing a sufficient superiority over the French left to enable them to deal the latter a knock-out blow. Owing, however, to the withdrawals which had been made from the 1st, 2nd and 3rd German

Armies, the retention of an unnecessary force with the 6th German Army in Lorraine, and the transfer of French troops from the Eastern to the Western extremity of their line, the German right flank armies at the battle of the Marne were actually weaker than their Franco-British opponents. I would not like to say that the German intelligence should have known all about the matters which I have just detailed, but I do say that they might and ought to have known far more than they did, and that consequently the German failure to win the war during its first few weeks was directly due to the shortcomings of the German Intelligence Service.

Having now told you how the German intelligence failed in 1914, I should like to say a word as to how the British intelligence succeeded in 1918. You will remember Lord Allenby's great campaign in Palestine in that year, and you may have wondered at the audacity of his operations. It is true that in war you cannot expect a really great success unless you are prepared to take risks, but these risks must be reasonable ones. To the uninitiated it may sometimes appear that the risks taken by Lord Allenby were not reasonable. That, however, was not the case, because he knew from his intelligence every disposition and movement of his enemy, every one of his opponents' cards was known to him and he was consequently able to play his own hand with the most perfect assurance. In these circumstances victory was secure.

I hope you will not think that in this or in any other remarks which I may make I am taking away the real credit of victory from him to whom it is above all due, that is, from the British soldier, English, Irish, Scotch, Welsh, Canadian, Australian, New Zealander or Indian. No commander, however determined, no operations staff, however brilliant, no intelligence, however omniscent, could have gained success or have prevented defeat had it not been for the splendid gallantry of our men. It was they who had won the war, and all I am claiming is that it was the good work of our own intelligence and the bad work of the enemy's which rendered it possible for them to do so.

The public has been often regaled with stories of the Secret Service. It is far better from me to depreciate the service, as I think I may claim to be its founder, at any rate in recent times, and I received inestimable assistance from it in the war. That service has one great value, namely, to act as a test of the reticence of those connected with it, and I much regret that many distinguished men have failed when that test has been applied to them. All I intend to say of the Secret Service is that its essence is secrecy and the less said about it the better.

I should like, however, to warn you against supposing that

an Intelligence Officer ever gets like the heroes of Mr. William Le Queux's novels or that the Secret Service is the backbone of intelligence.

Sensationalism enters but little into its work, its results are produced by hard work, great diligence and untiring watchfulness, and the painstaking collection and collation of every possible form of information. Nothing is too small to be unworthy of the attention of Intelligence Department and no problem too big for it. Even the most unlikely rumors should be forwarded by intelligence agents to Headquarters, for it is there alone that their worth can be appraised.

I remember one case during the war, when most important information was held back by the officer in charge of a group of agents abroad because he thought it too good to be true—it was true all the same, and if he had transmitted it, it might have had an important effect on the issues of the campaign. Do not suppose that I wish you to think that all these rumors should be believed, they are often set about by the enemy for purposes of deception, but even then important deductions may often be made from them. I remember during the latter part of the first battle of Ypres receiving from Lord Kitchener most circumstantial reports of the despatch and arrival of German reinforcements on our front. These reports emanated from Amsterdam and created much alarm and despondence in London when Lord Kitchener communicated them to the Cabinet without having them first properly verified. I well recollect Mr. Asquith coming to my office in St. Omer about this day seven years ago to ask me about them, and my telling him that I felt sure they were direct from the Great General Staff and that their object was to conceal the withdrawal of large masses of German troops from Flanders to Poland, and I was able to assure him from incontrovertible information in my possession that the battle was practically over.

Intelligence personnel may be divided into two main groups, a very large one, which collects information and whose main characteristic is acquisitiveness, and a very small one which extracts the substance from that mass of facts and fiction. The mental requisites of this last class are (1) clearness of thought, (2) grasp of detail, (3) a retentive memory, (4) knowledge of the enemy, (5) the power of projection into his mind, (6) imagination tempered by the strongest common sense, (7) indefatigability, (8) good health, including the absence of nerves, and (9) above all others, absolute impartiality. A high intelligence officer who allows himself to have any preconceived notions or prejudices is useless. He must look at friend, foe and neutral alike, that is, merely as pieces on the chessboard. I remember one of the very best intelligence officers I ever

had failing at a critical moment because he had become so imbued with the idea of German efficiency that he was incapable of realizing the significance of their great defeat by the British 4th Army at Villiers Bretonneaux on the 8th of August, 1918. I know no quality that is so rare and so valuable as this of impartiality or keeping an absolutely open mind. Englishmen seem to have a strange facility for identifying themselves with the ideas of the extreme nationalist parties of the peoples amongst whom they are living. I remember, when I was D.M.I. the cases of more than one officer attached to the armies of our allies, whose reports were almost valueless as they would look at everything from the ultra-national standpoint, who could see no fault in the army to which they were attached and, who appeared to be ignorant that there was any theatre except that in which they found themselves. Speaking broadly and neglecting many important accessories, intelligence may be divided into two main parts—offensive intelligence, in which we are attacking the enemy and endeavoring to find out everything concerning him, and defensive intelligence, in which we are doing our utmost to prevent him acquiring information about our service. Both of these divisions are equally important, and I regret that time will prevent me from saying anything at all about the latter.

If you were to ask me which is the most important function of the offensive intelligence, I should probably surprise you by saying, that it is the building up and constant verification of the enemy's order of battle. When we went to Flanders in August, 1914, we knew very little of what reserve units the enemy might bring against us. We knew, of course, of what his regular corps consisted, and that, behind them there stood large numbers of Landwehr Esratz reservists and Landstrum, but we were very uncertain as to how they would be organized, and what new units, if any, would be formed. If we were uncertain of these points, you may imagine how far more uncertain the Germans must have been about our own organization. It very soon became apparent that there were many units in the field of which we knew nothing, and that we must, at once, collect every scrap of information that would enable us to construct the enemy order of battle. The advent of the four new German corps in the middle of October, 1914, made this all the more necessary.

I dislike mentioning the name of any living person, but I think I may be permitted to do so in the case of one who is dead, and to whom I should like to pay the most sincere tribute of affection and admiration. This work of building up the German Order of Battle was taken over by the then Captain Edgar Cox, in my opinion one of the most brilliant officers that has ever passed out of the

R.M.A.[1] into the Royal Engineers. He combined in an unusual degree an exceptionally quick and accurate brain with an almost tireless body. He used to sit far into the night compiling every shred of information, and it was entirely due to him that in November, 1914, we were able to issue the first edition of the German forces in the field, which shortly became THE Vade Mecum of every intelligence. From that day on Cox went forward, and I think that Lord Horne will agree with me in saying that when, as the youngest colonel in the army and with the rank of a brigadier general, he went to France in January, 1918, as head of the Intelligence at General Headquarters his clearness of exposition of the German plans made an almost electrical impression on the commander-in-chief and on the Army commanders. His untimely death by drowning on the 26th of August, 1918, robbed the British Army of its finest Intelligence brain and myself of a very dear friend.

I find I am now drawing to the end of the time allotted to me, and that I have barely touched on the fringe of my subject. I should have liked to have told you something of the work of the R.F.C.[2] in the early days of the war They were then a very small and very excellent band. Many of them, including their very brilliant leader, David Henderson, we shall never see again, but they have left an imperishable name behind them. In those early days, as they were so few in number, David Henderson used, whenever possible, to send the pilot or observer to see me after any important reconnaissance. I remember particularly two which they made and which were of the first importance. One over Brussels, and to the west of it, just after the German occupation of that city, when they saw a great force correctly estimated at a corps, marching along the Brussels-Nihove road and then turning south-westwards towards Garmont. This was the German Second Corps of the 1st Army, von Kluck's right flank, which, if Sir John French had not wisely fallen back from Mons might have enveloped the British Expeditionary Forces. Again, and even more important, was their reconnaissance on 3rd of September, 1914. Up till then we had thought the Germans were marching on Paris, but on that day our British aviators saw von Kluck's corps turn to the south-east. I shall never forget myself watching those reports on the maps in my room in Melun, and being stupified to see great columns stretching across the map through Manteuil and Betz and La-Ferte and Milon, marching towards the Marne between Chateau-Thierry and Trilport. It was this information which made it possible for Joffre and Gallieni to plan those movements which resulted in the victory of

[1] Royal Military Academy.
[2] Royal Flying Corps.

the Marne, the "turning point of the World War," as even German writers call it.

I should like also to tell you of the services of the topographical section, of the superhuman efforts which it made, and of its success in supplying the army with maps during the retreat, of the survey section of the sound-ranging section and of all the numerous developments that flowed from it.

Then there was the censorship, a most irksome business. But one which obtained information of untold importance to the nation, besides preventing the leakage of our own secrets. Then there was the propaganda department, which Ludendorff admits to have produced disastrous results on the morale of the German troops and nation, and which, was chiefly the work of the intelligence directorate.

The whole story is one of enthralling interest, but I doubt if it can ever be adequately written. I hope that what I have told you may give you some slight idea of what a vast concern it was, and how great was its importance. I think I may say, too, with truth, that starting from the humblest beginnings it expanded, thanks to the zeal and talents of its many distinguished workers, some of whom I am glad to see here tonight, into the best intelligence service the world has ever seen.

I fear you may think I want to take credit to myself; that is far from my intention; I was a mere cog in the wheel, but I do want you to give all possible credit to all those hundreds, nay thousands, of workers who made it what it was. I was its father during all but two months of the war, and I am more than proud of my children. Any honors I have gained I owe entirely to them, and I thank them from the bottom of my heart for all that they did for the glory of the Empire and the honor of the British name.

OPERATIONS OF THE HORSE BATTALION, 15TH (GERMAN) FIELD ARTILLERY, IN NORTHERN FRANCE, 1914 (Concluded)

BY LIEUTENANT-COLONEL A. SEEGER

ARTILLERISTISCHE MONATSHEFTE, SEPT.-OCT., 1921, TRANSLATED BY COLONEL OLIVER L. SPAULDING, JR., F. A.

THE days following the taking of Lille were, for the cavalry, only the beginning of a series of engagements, which continued until the great trench system was complete from the Swiss border to Nieuport in Flanders. Not until then was the cavalry gradually drawn out of the trenches and distributed among the armies, in reserve, or sent to the Eastern Front.

The General Staff compilation on the battles and engagements of the World War includes all the operations of the latter half of October under the name of the battle of Lille. In these hot actions the newly formed Sixth Army was struggling to hold what had been gained, and repulse the strong counter-attacks of the English and French, which had as their object to assure possession of the ports of Calais and Dunkirk, as a base for their shipping on the Channel. The German troops engaged were the 7th, 13th, 14th and 19th Army Corps, the 25th and 48th Reserve Divisions, and all the effective cavalry remaining on the Western Front.

At this same time operations were extended farther northward, by the battle of the Yser in the last half of November. Here fought the "young regiments," mentioned in the bulletins of October 21st as going into action singing "Deutschland über alles." These were the troops included in the mobilization plans as the last and youngest drafts of the 22d, 23d, 26th and 27th Reserve Corps, composed of volunteers, mostly students, who had joined the colors in August and received a special training of only two and a half months. Naturally their instruction was far from complete; their infantry armament was up to date, but their artillery was weak, and inferior in both training and armament. The batteries had only the old laying apparatus—a disadvantage from which many of the newly formed batteries of 1915 suffered, seriously affecting both rapidity and accuracy of fire.

Artillery ammunition was short, causing much anxiety in some cases. It was very strictly rationed, and sometimes, in active operations, a battery was allowed only from thirty to fifty rounds a

BATTERY E, 5TH F. A., CAMP BRAGG, N. C., FIRING PERCUSSION SHRAPNEL FROM 155-MM. GUN (G. P. F.)
Photograph Shows Projectile in Flight, to Left of Tree.

5TH FIELD ARTILLERY, CAMP BRAGG, N. C., FIRING 155-MM. GUN (G. P. F.)
Photograph Shows Gun in Position of Full Recoil.

day! One may readily imagine that the infantry got but little effective support.

On the 18th, 19th and 20th the 7th Cavalry Division was designated as reserve for the 26th (Würtemberg) Infantry Division, in action west of Lille, but was not called upon. We remained inside the old ring of forts, at Haubourdin, looked to our shoeing, our equipment and our ammunition supply, caught up with our neglected diaries, and wrote to the depots for our much needed replacements. Up in front, the gallant Swabians of the 125th Infantry were fighting for possession of the Radinghem chauteau. On the 21st we moved north again, and passed through Lille at daybreak in several columns, noting as we passed the great damage done by our artillery fire in the neighborhood of the railway station, while the citadel quarter was uninjured. We moved by Wambrechies and Quesnoy-sur-Deule, and about noon entered the Lys valley south of Comines, where we halted to await orders to go into line. Here on the Franco-Belgian border, and about to go into action, it was found that we had no maps, and we had to get them from the troops that we relieved. These were on a scale of 1/300,000, and were inadequate for the position warfare that was beginning. We took over the positions of Bavarian horse artillery, which moved a few kilometres farther north to take part in the fighting east of Ypres. One battery to a kilometre front was about all we could get then, while the next year there were fifteen or twenty to a kilometre on each side.

We should have had the new Belgian 1/60,000 maps, taking the place of the French 1/80,000. For lack of them, my batteries were unusually clumsy in getting into position, and came under long-range shrapnel fire while moving up. My own staff got its share of this fire, and had to move by the flank at a gallop, across country. Here we had an object lesson of the value of good jumping horses, but found unexpected difficulties with the broad muddy Flemish ditches. The poorer jumpers refused to take one of these, and the rest of us, who had found cover on the other side, could do nothing to help them; we had several men wounded, and a horse killed. I could not help thinking of the time we had spent in training horses and men to take hurdles, when as a matter of fact they are not nearly so much of an obstacle as ditches. One can generally get around them somehow, but water courses are different.

As a lieutenant, I always wondered if this training was not overdone. Putting draft horses over hurdles merely teaches them something that they can never use. The horses that were best at these water jumps were those that came out of my 2d Battery, which had been trained under that splendid horseman von Chappuis. As I have already noted, this characteristic persisted in that battery

almost to the end of the war—at least, as long as there remained many of the old horses.

Between Tenbrielen and Houthem all three batteries found positions facing Zandvoorde, which was visible from a great distance, and which the English seemed to be preparing for obstinate defense. The country was typical Flemish plain, much cut up with hedges and watercourses. It was much easier to find a gun position than an observation station. For this purpose we found the numerous scattered farm buildings best, for the enemy's artillery had not yet gotten into the habit of taking them as its first target. One after another, these buildings disappeared, and within a year the whole appearance of the country had changed. I came back to this once pleasant region in January, 1916, and could not find my way by the map; new roads had been built by Russian prisoners out of the ruins of the villages; great camps had been built; and where our batteries had been hidden in October, 1914, there were sheet-iron buildings, drill grounds, and the whole fortification system of the second and third lines. This was especially the case in the neighborhood of Tenbrielen and Houthem. Throughout the war this country was the scene of heavy fighting, not less notable than that at Verdun and on the Somme for obstinacy, and for the numbers of men engaged and the amount of ammunition expended.

The inhabitants had for the most part remained, except in the actual fire-swept areas. The Flemish peasants seemed to prefer to share the risks of war with our soldiers, rather than leave their homes prematurely. In many places they had to be driven out by force. Our relations with the civil population were very good, much better than in the French speaking parts of Belgium. Our Rhinelanders and Westphalians found their dialect very similar to Flemish, and readily established friendly relations, much to the advantage of both parties.

Our cavalry skirmish lines were now established in the swampy trenches, only a few hundred metres from the enemy who was generally quiet enough, but on the alert to take advantage of any exposure on our part. But we could never get a look into the English artillery positions; we had no air observation, and could do nothing against the enemy's guns, beyond the hills. The cavalry commanders were always complaining of us, and demanding impossibilities; they could not understand that the conditions that we were now meeting called for methods of reconnaissance and combat that were not in our textbooks. The trouble was not in the troops, who did their very best to accommodate themselves to the requirements of trench and position warfare, but rather to the novelty of the situation, and to failure to develop our artillery along the right lines

before the war. The enemy was pretty much in the same situation, but we cannot deny that he had a certain advantage in his means of observation, particularly air observation. It was not until much later that we succeeded in getting our eyes off the ground well enough to be again masters of the situation.

My guns often worked up very close to the enemy, but did not gain very much by it. One of our cavalry commanders said that he would not be satisfied until they were all in the skirmish line! He had no idea of the proper use of our arm, nor of the danger of losing guns—we had only twelve in all—if the enemy should break through our thin line some night. Again and again I, as the senior artilleryman, had to bring up this point of view at division headquarters.

We could see, and constantly reported, that Tommy was rapidly making all this Ypres country into a fortress to protect his seaports; nevertheless, late in October, an attack was ordered with inadequate strength, and with only such artillery preparation as we could give with light guns and little ammunition. The result was a discouraging failure; we lost many men in front of the enemy's wire, for with his commanding position and good field of fire his defense was easy. The attack had been intended to assist another in the adjoining sector, at Gheluvelt and America Farm, where more and more Germans were coming in to attack Ypres from this side. But four years later we were no further ahead. We watched the beautiful old city gradually fall into ruins, saw stone after stone, tower after tower, crumble, but we never got into it. Ypres remained an unattainable goal for us, although its capture would have been only another "ordinary" victory if we had not pushed clear on to the coast. And yet our cavalry had been there in August, and again in September, when the whole country was clear and no one dreamed of a "race to the sea"; when one might have gone almost unopposed to Dunkirk, to Gravelines, and even perhaps to Calais!

How different things might have been, if Fate and the Reichstag had given us a stronger army on mobilization! A few additional corps, and we might, without weakening the main force marching upon Paris, have gained the coast by rapid marches, and upset the whole English and French war plan.

We remained only a week in the Comines-Wervicq-Ypres region. We were relieved to put stronger troops in our place, to cooperate with the newly formed reserve corps in an attack upon Ypres. After our departure the 38th Landwehr Brigade and some of the Rifle battalions took the strongly fortified Zandvoorde position, after bombardment by 15- and 21-centimetre batteries. Our division, which had been given a few days' rest near Roubaix, allowed us to visit the position after its capture, and we particularly

noted the great effect of our heavy calibre fire, and the slight effect of field guns upon such strong works. It almost made us regret every shot that we had fired, other than those at living or moving tragets; in those days artillery was expected to fire as long as it was in position, whether there was any prospect of effect or not.

During the five days that we spent about Roubaix and Turcoing, we found not only good quarters and tables, but also reasonably satisfactory relations with the people. The war had not yet touched this country, and everything was as in time of peace. The land was cultivated, and the factories still running in some places. The large factory owner, with whom we were quartered, expressed great anxiety, fearing that the German supply officers would take over his large stocks of supplies of all kinds. We, who were to be his guests for a few days only, assured him that we would not touch anything; but that the Line of Communications would find everything, and take whatever was needed for the army.

On November 3d we celebrated St. Hubert's Day, according to the old cavalry custom, with a hunt near Turcoing, where the country was very well adapted for it, and all mounted officers took part. Later there was a jumping competition, and Lieutenant von Chappuis' horses, prize winners at the International Horseshow at Malmö, were easy winners. In the evening there was a banquet in honor of the day at the chateau.

The next alarm came at a most inopportune time. We were busy with replacements and remounts, and with dismounting our guns after their hard service, when in the night of November 3d–4th we were called to Warneton to relieve the Guard cavalry. The staff went ahead in automobiles to reconnoitre positions, so that there might be no delay in occupying them at night.

We were assigned to the region just south of Messines, which had already been the scene of many bloody battles. In front of us lay Ploegsteert wood, later so famous. Little digging had been done, and there was no position, properly speaking. The enemy had been encountered here only a few days before, and we had been unable to push farther west, or to capture Kemmel Hill, which commanded the whole country thereabout. It never was captured until 1918, and we had to give it up again in the summer of the same year.

Warneton, our division headquarters, was under heavy calibre fire by the English. The principal targets were the bridges over the Deule and the Lys Canal, which here forms the boundary between France and Belgium. We found ourselves in a "windy corner," for the fire was uninterrupted day and night, not only upon our lines but far into the rear areas. Communication with Lille, from which

place we were supplied, was impossible by day, and even at night the fire on the main road was heavy enough to compel the construction of detours.

We went into position as before Zandvoorde, and took over from the Guards all the telephone equipment already installed. Our colleagues from Potsdam had everything in good shape, and turned over to us good sketches of the enemy's positions. Our horse lines were, according to later ideas, dangerously near the front, often in the farms close to the guns or only a few hundred metres in rear. The limbers of one battery were even placed in the buildings of a factory near the Bas Warneton railway station, which was daily under shell fire. But at that time we had not become accustomed to the idea of sending the limbers miles away from the guns; we had too strong a horse artillery spirit to take kindly to separation from our horses.

So, in these last days of October and first days of November, the fight continued for Ploegsteert wood and Messines ridge. We supported the 52d Würtemberg Infantry Brigade when it stormed Messines. Here a Würtemberg field artillery regiment especially distinguished itself, as related by Stegemann in his second volume. The 6th Battery of the 65th Field Artillery advanced its guns with the prolonges into Messines, under heavy fire; and, in spite of severe losses in men and matériel, drove the enemy out of the houses by direct fire with howitzers at point-blank range. The regimental history, published in the spring of 1921, mentions this as one of the most noteworthy exploits of the regiment. The battery commander, Captain Heuss, was killed in the village street, and with him a whole gun crew, while laying the piece.

After bitter fighting, the village of Messines finally fell into our hands. But all the buildings quickly crumbled into dust; even in the two weeks that we spent there, we could see every day the effect of the guns of both sides.

Our division, with four cavalry regiments, had to hold a long line connecting Saxon and Würtemberg infantry troops; our strength was small, and the line too thin to stand a serious attack. Besides, our cavalry at that time had no bayonets, hand grenades, or other armament for close fighting on foot. Fortunately, no serious attack came, and there was little heavy artillery fire upon our light trenches, so that the losses were not great. But Warneton fell an unresisting prey to the enemy's artillery, and the staffs there felt no security. A shell struck the house occupied by headquarters of the 26th Cavalry Brigade, and the roof of the church, which was alternately hospital and stable, threatened to fall at any moment. We were not overly secure in our deserted brewery, but declined the offer of

the division, to move artillery headquarters farther to the rear, for the situation made it necessary for us to be well to the front.

But we made no important attacks. Ploegsteert wood was soon developed by the enemy into an impassable obstacle. Farther north there was continuous heavy fighting on the high ground, where a determined effort was being made to get control of as much as possible of the Channel coast before winter. Our new divisions of the 22d to 27th Reserve Corps, however, proved not to have the strength for this, and our enemies very properly credit this defense to themselves as a victory. General Buat, the French Chief of Staff, in his recent book on "The German Army in the World War," points out that we should certainly have been successful on the coast front, if we had had available in August the corps that we raised for the operations of October.

On November 21st we were relieved, after fourteen days in line. The 15th Army Corps had come up from the Aisne to take over the whole line southwest of Ypres. We had already fought with them in August in the Vosges, and now had the opportunity to renew acquaintance with these comrades from Alsace and Lorraine, who, in spite of their very mixed matériel, had a record second to none.

For about a week we had comfortable and quiet quarters east of Roubaix, between Tournai and Courtrai. This country was little touched by the war. Our predecessors here, the Guard cavalry again, were assigned to garrison duty, and went into winter quarters at Antwerp—a fate which fell to us a year later, when much against our will we formed a part of the Army of Occupation in Belgium, and remained for seven months, from October to June, in Brussels, Namur and Liége.

On November 25th we got marching orders again. The division was assembled at Tournai for "a considerable march," whose destination, being unspecified, gave us a constant subject for speculation. We passed through Orchies, which had recently had to pay a heavy penalty for outrages inflicted upon our helpless patients in hospital there; then south of Valenciennes and by way of Le Cateau to Guise, still without any hint of where we were going. Finally, at Liart, we were told that we were to take train at Sedan. Thus we cut across the lines of communication of the whole German army, and for the first time got an idea of the work of the troops in rear, who collected all that the front lines needed.

On November 30th we passed through Mézières and Charleville, marching at attention and in our very best order, in case anyone should come from General Headquarters to look us over. But no one reviewed us; and except for many foreign military attachés, who watched us with the eyes of connoisseurs, we saw nothing of the

machinery of command which was quartered in the old Prefecture, the splendid palace of Mézières.

Sedan having been given as our next stop, I seized the opportunity to take my officers for a ride over the battlefield of 1870, which I had visited and thoroughly studied in 1908, at the time of the first Morocco crisis. It was a pleasure to describe to my comrades the great drama of the heights of Illy, which on September 2, 1870, brought the first phase of the campaign to a glorious end, and set us on the way to the coronation at Versailles. In December, 1914, we were full of hope and confident of victory; none of us dreamed that the war would last so long, or have such an end. Only too quickly did the two days pass, before the trains were ready for us. I took my officers to Bazeilles, and to the heights of Frenois, where King William had received the sword of Napoleon; our quarters lay just below, and the traces of the fighting of the previous August were still plainly to be seen. I wanted to move my headquarters to the little chateau of Bellevue, but was prevented by the town mayor of Sedan, who said the emperor's orders were not to touch that chateau at any time during the war. Looking back now, I doubt if the enemy would have been so considerate in our place.

We also visited the cottage at Donchery where the interview of September 1st, between Bismarck and Napoleon, took place. The old woman who had then owned it was still living there, and told us, doubtless for the thousandth time, of her experiences. In the visitors' book was the signature "William II—Sept. 14"; and the woman showed with much pride four gold pieces that the emperor had given her.

Finally, on December 4th, we entrained at Sedan, taking the "stirrup-cup" for our journey at the Croix d'Or, facing the statue of Turenne and the Prefecture, where Napoleon wrote his famous letter to "Monsieur my brother." Our destination was Saarburg! The fortune of war had decreed that we return to our own garrison, and spend almost the whole winter in our own barracks. We did not go into the line for any length of time until June, 1915, and in the meantime were reserve for Falkenhausen's army; we were employed in several different places, but never left our station for long. I doubt if any other German troop unit had the same luck. We celebrated Christmas of 1914 in our own club; then, before New Year's, went to Mühlhausen in Upper Alsace to play a short engagement, returning home early in January.

We established ourselves in our own old quarters, very much as in peace time, got the best of rest for men and horses, and generally refitted. And thus ended, for us, the manœuvre warfare of 1914, at the same place where it had begun on August 2d.

THE GERMAN ARTILLERY AT THE CHEMIN DES DAMES IN 1918

BY COLONEL J. P. MULLER

TRANSLATED FROM THE FRENCH OF AN ARTICLE APPEARING IN THE REVUE D'ARTILLERIE FOR MARCH, 1922, BY CAPTAIN PAUL C. HARPER, FIELD ARTILLERY, U. S. ARMY

THE attack was conducted by four army corps of three divisions each, making twelve divisions, supported on the west by the Crepy Corps of two divisions and on the east by the First Army. The four army corps were designated by the letters A, B, C and D. (See Figure a.) The army prescribed, for each corps, the division into groups of Ika, Aka and Feka and their sub-divisions.[1] The following table shows this allotment:

CORPS	GROUP	NUMBER OF BATTERIES						
		77s and light howitzer	Heavy howitzer	210 Mortars	Guns of 10 to 15 cm.	Heavy mortars	Misc.	Total
A	Ika	63	16	12	—	—	3	127
	Aka	15	5	—	2	—	—	
	Feka	—	—	—	9	2	—	
B	Ika	99	30	15	2	2	2	198
	Aka	27	4	—	8	—	—	
	Feka	—	—	—	9	—	—	
C	Ika	146	29	20	3	2	—	268
	Aka	42	6	—	11	—	—	
	Feka	—	—	—	9	—	—	
D	Ika	62	16	4	—	1	—	151
	Aka	51	—	—	—	—	—	
	Feka	—	—	—	17	—	—	
Crepy	Ika	73	19	10	6	—	1	181
	Aka	39	14	—	14	—	—	
	Feka	—	—	—	5	—	—	
	TOTAL	617	139	61	95	7	6	925

To these 925 batteries another 59 batteries (Ika) must be added given to Corps "A" some days before the attack for the reduction of the Fort de la Malmaison, besides mountain batteries, wheeled batteries, eleven batteries (Barbara)[2] of long-range, high-power artillery of which six were 24-centimetre railroad guns, four were 17-centimetre and one was 15-centimetre guns. Thus a grand total of 1100 batteries was attained.

In the majority of attacking divisions a group of 96 n/A guns

[1] Ika—Batteries whose mission it is to fire on trenches, strong points, etc. Aka—Batteries whose mission is counter-battery work. Feka—Batteries firing on distant or flank objectives.

[2] Barbara long-range batteries firing on the most distant objectives.

was mounted on wheels before the beginning of the fire for effect as infantry accompanying artillery. In some others the units to which this task was allotted participated first in the fire of the Ika batteries.

The divisions in position were charged with the preparation of all works; their artillery commanders were designated to become commanders of the Aka artillery. The corps artillery commanders

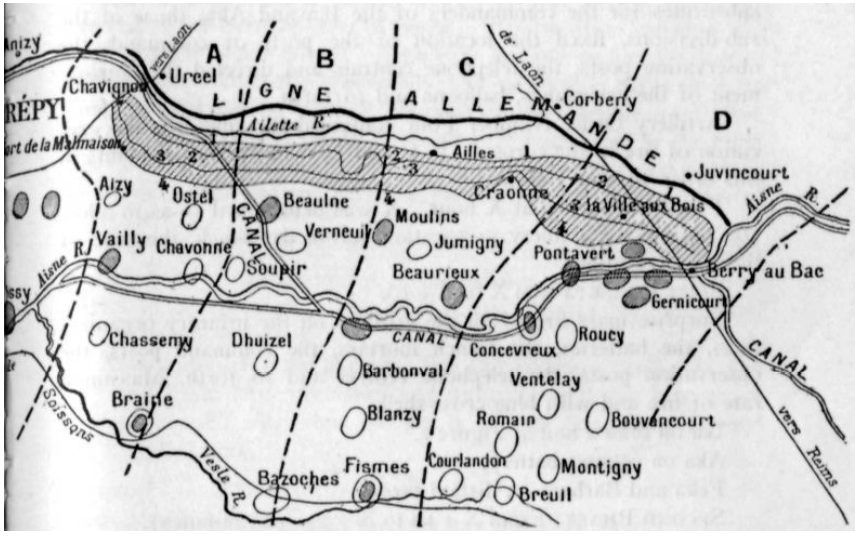

FIGURE A.—GERMAN ATTACK OF MAY 27th 1918.

Infantry position (French).
Targets fired on by Feka and Barbara from X hour to X 120.
Targets fired on by Barbara after X 120.
Targets continually fired on by Barbara.

began to function a good while before the attack and from this time on the divisions worked under their supervision. Each corps had an artillery adviser (Artilleristischer Berater). The reinforcing batteries found their positions all prepared. The batteries were brought up in large part by railroad and then installed in positions protected from sight and shell-fire. While the more advanced guns were being put into their pits the German artillery found excellent assistants in the frogs of the Ailette River, who croaked by thousands.

In order to hit the southern slopes of the French position with the rolling barrage it was necessary to push well forward the bulk of the artillery. Hundreds of batteries, then, many of them closely

massed, were placed immediately behind the front lines. The unhoped-for success of the attack was due beyond a doubt to this disposition. A number of pieces of the army heavy artillery were also pushed far forward in order to be able to reach the railheads, the distant headquarters, and so forth.

The orders issued by the artillery determined the organization of the command, designated the commanders of the Aka and Feka, the substitutes for the commanders of the Ika and Aka, those of the sub-divisions, fixed the location of the posts of command, the observation posts, the telephone centrals and directed the employment of the aeroplanes, balloons and so forth.

Artillery Order Number Four contained the rules for the execution of fire in the corps A, B, C and D. The principal points in this order were as follows:

Fire to be opened at X hour. X was determined so as to allow 160 minutes of artillery preparation before day-break, the time of the infantry attack.

FIRST PHASE: From X to X + 10.

Surprise mass fire of all the artillery on the infantry organizations, the batteries, the trench mortars, the command posts, the observation posts, the telephone centres and so forth. Maximum rate of fire and with blue cross-shell.

Ika on lines 2 and 4, Figure a.

Aka on counter-battery.

Feka and Barbara on distant targets.

SECOND PHASE: From X + 10 to X + 75 -(65 minutes).

Increase of counter-battery fire, continuation of fire on the important command posts, the camps, the headquarters and so forth; fire on the bridges (mixed shells).

Ika and Aka on the French artillery in the proportion of about three batteries on one (Aka continuing as before).

Feka and Barbara the same as before. The trench mortars on the barbed wire, the front line trenches and so forth as far as the available munitions permit.

THIRD, FOURTH AND FIFTH PHASES: From X + 75 to X + 160 - (85 minutes).

Fire to reduce the infantry trenches preparatory to the assault, counter-battery fire conforming to plan.

Ika fires successively on the lines of trenches 1 to 4, Aka and Feka continue their fire; Barbara, after X + 120, shortens its fire and instead of firing on objectives north of the Vesle fires on objectives north of the Aisne.

At X + 150 the batteries group themselves for the rolling barrage.

SIXTH PHASE: After X + 160.

Rolling barrage, in two lines, formed by Ika except the mortars and heavy pieces of high-angle fire: the fire of the mortars jumps from one centre of resistance to another ahead of the barrage while the heavy pieces of high-angle fire receive special objectives. The trench mortars (light) join in the barrage which they accompany to the limit of their range. The medium and heavy trench mortars cease firing.

Ika (sub-divisions a) make bounds of 200 metres, Ika (subdivisions b) fire on the crest of position after position and then also make bounds of 200 metres. After each 200 metres bound a halt of six minutes; a kilometre is covered, halts included, in about 40 to 50 minutes. On the far side of the crest of the Chemin des Dames, Ika (a) sweeps the slopes to the south and south-west of the crest, Ika (b) fires on different points of the terrain such as ravines and so forth. Each battery executes the barrage up to the limit of its range.

Aka and Feka join the barrage at the time that Ika (a) reaches its objectives. The movement of the barrage can be accelerated by means of rocket signals sent up by the infantry but only after passing south of line 4.

Ammunition for the barrage: Ika (a) ordinary shell; Ika (b) Aka and Feka, blue cross-shell and ordinary shell, the blue cross-shell to be used only when the fire is at least 600 metres beyond the friendly infantry.

* * * * * * *

The batteries designated to cover any unknown French batteries which might disclose themselves, took part in the attack. They became available for their special mission as soon as notified by balloon, aeroplane or any observatory as to the location of such batteries.

No adjustment or preliminary control took place before the attack and the weather, moreover, was very overcast. The army order confined itself to designating the lines to be fired on, it was left to the corps to apportion the targets; the corps reported their dispositions to the army.

Artillery Order Number 5 prescribed the different methods of fire to be used: fire on the infantry positions, blinding fire with smoke shells on the observatories and so forth. As regards the fire on batteries the Aka was ordered to fire irregularly on a zone 50 metres beyond and 50 metres this side of the objectives as well as ten metres to the right and ten metres to the left.

During the phase (from X + 10 to X + 75) when Ika took part in the counter-battery work, the Aka batteries fired on the exact line

of their objectives (line z, Figure b). The Ika batteries which superimposed their fire on that of the Aka fired on lines echeloned from 100 metres to 200 metres in front of and in rear of the target (lines x, y, v, w, if there were four Ika batteries; x, y, w, if there were three batteries; x, y if there were two). Ballistic data were given for a battery of average

w	200m	w
x	100m	x
z	Objective	z
y	100m	y
v	200m	v

Figure b.

altitude and the same weight of a litre of air was given to all batteries. The wind was given on the ground.

The army reserve artillery consisted of the Barbara high-angle fire batteries and the batteries that were not horse-drawn. The First Army and the Seventh Corps had also to furnish the batteries for the advance after the lines were broken through. The divisions had, for the same purpose, a regiment of field artillery, a heavy battalion as well as infantry and mountain guns. The other batteries remained at the disposition of the corps.

Each battery was to be stocked in its position (not counting green cross-shells) with two days and a half of fire (Tagesraten) for the field guns, two days of fire for the light howitzers, the heavy howitzers, the 10-centimetre guns and the 21-centimetre mortars. The allotment in detail for the principal calibres was as follows:

Subdivisions	Kind of Projectile	Batteries				
		Field gun	Light howitzer	Heavy howitzer	10 cm. Gun	21 cm. Motar
Ika	Ordinary type	2,650	2,000	750	420	—
	Special—blue cross	2,350	2,000	250	480	—
	Special—green cross	560	450	100	120	—
Aka and Feka	Ordinary type	500	400	200	420	350
	Special—blue cross	2,000	1,600	800	780	—
	Special—green cross	250	200	100	120 (a)	—
			(a) Aka only			

Concerning the execution and results of the attack Colonel Bruchmüller expressed himself as follows:

"The fire of all groups opened at two o'clock in the morning (German time). It was well placed and less than ten minutes after it had started the observatories and information sections had already

reported numerous explosions in ammunition dumps and in batteries. Later it was reported that a number of guns had been destroyed by shell-fire. The enemy artillery was so completely dominated that our infantry suffered very little, during the assault as well as in the jump-off trenches. On our right flank only, during our fire for effect, we had heavy losses caused by the artillery situated far to the west outside of the sector of attack.

"The fire directed against the infantry organizations was equally well executed, as well before the assault as during the barrage. We did not have any serious checks caused by machine guns or trench artillery. In one of the corps the attack was halted, however, but it was resumed after a short artillery preparation conforming to the directions of the technical adviser. The army long-range heavy artillery succeeded, either by cutting the track or damaging the matériel itself, in preventing the removal of fourteen enemy railroad guns.

"After having passed the enemy trench systems, the infantry pursued the attack without pause and some scattered units reached the Aisne. Then this river was crossed and the Marne was finally reached. The accompanying batteries and those which had been pushed far forward rendered the greatest services during this movement."

WHAT THE FRENCH ARTILLERY SHOULD HAVE BEEN ABLE TO DO AT THE CHEMIN DES DAMES

Were we fully prepared, at least as far as concerns the artillery, for the attack of May 27th? It would appear that we were not.

In the first place all our artillery, with the exception of some long-range, heavy guns were on the right (north) bank of the Aisne. This was a mistake, not only because the principle of echeloning the artillery in several lines was violated, but also because a river is controlled only if both banks are occupied and are not under fire.

Besides, there were no silent batteries, practically all having disclosed their location. Moreover, hardly any positions were occupied except old ones, whose exact location was known to the enemy since our attack of October, 1917. On the 27th of May our batteries, at first taken under fire by one enemy battery each firing gas shells, found themselves ten minutes later when they were ready to reply, subjected to the fire of three batteries each. The French are in agreement with the Germans in saying that the French artillery could hardly fire at all and as they were ordered to hold their ground at any cost they were captured with all their ammunition.

What dispositions, then, should we have made? It must not be forgotten that the French high command knew that the attack was

impending on the 26th, in the evening. To attempt to stop it the French command should have recalled how the Germans had operated in their break through at Saint-Quentin on the 21st of March, 1918. Having been so successful on that occasion it was altogether probable that they would put on their attack in the same way, applying Von Hutier's methods which we knew so well.

On March 21st they had massed all their infantry in the front lines. It was on the front lines, then, that the French artillery should have fired on the 27th of May. Yperite (mustard gas) should have been used. A mass fire of fifteen minutes at the maximum rate with all the artillery available (we had about 260 batteries on the front attacked) would doubtless have been sufficient to stop the enemy attack. If there had been no Yperite available a more prolonged fire (one hour) with phosgene or some other shell would have had chances of success. But of course this would not interfere with firing also at a great distance on paths and roads of approach.

In place of this almost all the batteries were ordered to execute on May 26th fire of counter-preparation offensive, that is to say, that the heavy artillery fired at great distances, ten and twelve kilometres, while the trenches of the front line were covered by the 75s only. This fire could not cause great loss to the enemy as he was in trenches and dug-outs.

For a counter-offensive preparation under these conditions the flat trajectory artillery should fire *at long range* because the distant objectives are uncovered (troops on the march) and the high-angle fire artillery should fire *at short range* because the closer objectives are defiladed and sheltered.

It seems that a position such as that on the Chemin des Dames could be organized advantageously as follows, so far as concerns the artillery.

There should be several artillery positions, at least two, the first being where it actually was in this case, the second south of the Aisne with the battery emplacements at such distances that the great majority of guns could still fire on the enemy first lines north of the river. The batteries north of the Aisne should be cut into sections, well separated. The first sections, or platoons, which are those nearest the enemy, should alone do the ordinary routine firing and make it appear that they are complete batteries by every possible means such as false pieces, extremely rapid fire, and so forth. The second platoons should be silent and be placed near the first platoons. There should also be false batteries.

In addition there should be rapid-fire batteries or pieces installed with machine guns on their flanks in such a way as to cover every part of the right bank of the river, especially the approaches to the

bridges. These batteries could be given very strong lateral protection. (A battalion of 105s was placed this way on the 4th of April, 1918, enfilading the valley of the Avre for about five kilometres.)

In case of an attack of which we have advance information, the first platoons, whose location is of course known to the enemy, should be withdrawn to the vicinity of the batteries on the south bank of the river, if there is sufficient time to execute the movement, and put in emplacements supplied with ammunition, shelter for the gun crews and installations permitting the immediate opening of fire. The firing books of these first platoons should contain the data necessary for firing without delay on the passages which might be forced. Explicit orders should be prepared for taking under fire rapidly and successively the designated objectives, for establishing barrages, and so forth. The second platoons on the north bank and the batteries on the south bank would thus all be firing on the enemy infantry. The second platoons left on the north bank should open fire simultaneously, at least in each divisional sector, so as to prevent the enemy's discovering their location. Rapid fire should be used.

Above all, use should be made of gas and smoke shells. It should be recalled that the German blue cross-shell has a considerable explosive effect as well as being very irritating because of its gas. We should have something similar in our ammunition.

If the enemy attacked he would perhaps take our front line trenches, already evacuated, but that would be all, and they would be rendered untenable by our artillery of which a good part would retain its liberty of action. If it proved to be a false alarm we could start all over again and occupy our old positions.

In case of a complete surprise it is quite possible that a large part of the second platoons (silent sections) would remain unharmed as well as the batteries on the south bank. The first platoons would be unable to fire.

All the artillery should be made to fire on the most dangerous objective, the enemy infantry, as it would be certain that the preparation would be short and therefore the assault troops could not be far away. The high-angle pieces would fire on the enemy works sheltering the infantry (with Yperite especially), while the long pieces would fire at the more distant targets with high explosive and shrapnel.

We would add that batteries of machine guns should be organized in good shelters at about 3000 metres from the enemy front lines, the angle of fall permitting the bullets to reach the attackers in their trenches. Rapid fire by each machine gun (twenty to thirty strips with the Hotchkiss and rest intervals of two or three minutes)

would make the terrain very difficult to cross for the attacking troops. The enemy, even at the start, will not advance 200 metres in four or five minutes across the shell-holes. He will then be under a fire of maximum intensity when all the machine guns fire together.

The enemy guns would not discover these little shelters, spread over the terrain at three kilometres from the front lines, and on a depth of some hundreds of metres. It would be from behind these machine guns and suitable shelters that counter-attacks would start in certain cases if the situation called for it.

The methods of employing artillery practiced by Colonel Bruchmüller proved successful on the Eastern Front at Przasnysz in 1915, at Lake Narotch and Wittonitz in 1916, in eastern Galicia, Riga, etc., in 1917, and on the Western Front at Cambrai in 1917, at Saint-Quentin, Armentieres, Chemin des Dames and the Marne in 1918, and their study cannot but be instructive to us.

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DISCUSSIONS

Obsolete Views on Problems for the Field Artilleryman

COLONEL I. A. FISH, F.A.R.C.

COLONEL BUNDELL'S article in the November-December, 1921, number of the JOURNAL on the problems of the field artillery presents the current theory of the action of field artillery very clearly and concisely and outlines a course of training adapted to that theory. I have been out of touch with the development of opinion which led to the adoption of this theory and my views of combat are still those formed during the war from personal experience and from foreign officers of artillery with whom I came in contact, who had great experience in war. As these ideas are radically different from the current theory they may be at least of historical interest. I think a great majority of officers who had immediate connection with the operations of light artillery during the summer and fall of 1918 had similar views *at the end of that summer* and before their opinions were modified by subsequent discussions and experiments.

I think, as Colonel Bundell, that we should consider the function of light artillery with an interior division making a frontal attack on an enemy. And that the flanks should be considered as protected by other troops, by natural obstacles or the time of movement of large bodies.

As Colonel Bundell in his article says, "The question to be considered is primarily how best to assist the infantry to close with its enemy in the offensive battle of large units." The first thing to be considered is the resistance which the infantry now meets and its own means to overcome this resistance. At the outbreak of the war the rifle was practically the only arm of the infantry, and an infantry line could carry in the course of a day's attack about as many rounds as it could fire. A soldier in defense had the advantage of concealment until he began to fire, when he necessarily exposed his position, but mechanically he was on a par with a soldier in the attack. Attacking infantry could gain fire superiority over defending infantry if it had more men on the line, as the volume of fire depended on the numbers of rifles. As a practical matter, ammunition supply was chiefly a problem of redistribution of ammunition of the attacking echelon so that none of the men were ever entirely without ammunition. Such a line could maintain a continuous fire during its advance superior to the fire of the defense. It could increase its rates of fire within certain limitations, but excessive

rapidity caused loss of control and effectiveness. When it encountered an unexpected resistance of great strength, such as a trench full of riflemen, unexpectedly discovered, the line so armed might lose fire superiority if unassisted and the chief assistance required of the artillery during an advance was to give the assistance of its fire to that of the infantry, to maintain or regain superiority at the crises of the combat. To get this support the technic of raffales of fire of batteries always ready to fire shrapnel at short range and moving rapidly and frequently to new positions was the most effective. If these conditions of infantry combat still existed, the same technic would still be proper and the conclusion of Colonel Bundell's article would be unassailable.

The introduction of automatic arms has, however, upset the balance between the infantry fire of the offense and the defense. It has greatly increased the volume of fire which can be delivered in a given length of time by the same force of men. To the attack this is of importance. Bursts of great intensity can be fired by an attacking line armed with automatic weapons. Any target which such a line can see can be subjected to an intense burst of fire. However, the capacity of the line for sustained fire has not increased for the total number of rounds that the line can carry has not been increased and the ground that can be swept and the length of time the line can maintain superiority over a given force is still the same. The limitations of transportation across the battlefield still limit the fire of the attacking infantry.

To the defense, however, automatic weapons have given immensely increased power. A single machine gun in actual combat fires as many rounds as fifty men can carry in the attack. A few men, a couple of machine guns and a wagon load of ammunition in a bit of brush, behind a rock or in an open hole can bring the fire of a pre-war company to bear on an attacking line. Such a unit is exceedingly difficult to locate and its fire is effective at a much greater range than that of the rifle company. This has led to the deep organization of which Colonel Bundell speaks.

In the last German defenses which I saw, the machine guns were placed in cover, usually so as to fire at a considerable angle and range. The actual lines of resistance were imaginary, being formed by the fields of fire of various groups of guns and could not be passed unless some of the guns were neutralized or silenced. In other words, the units of defense were of small frontage and widely dispersed, had great fire power, which they used so as to make a zone impassable to the attacking infantry. This was the last defense we saw and the one we must expect to meet at the beginning of a new war. The so-called strong points (really combat groups) which formed the frame work of this system of defense did not

give any appearance of being organized for defense and were in many cases unlocated after they had opened fire.

To meet this system of defense, the attacking infantry has powerful portable weapons, automatic rifles, Stokes mortars and infantry cannon of various types. (To an artilleryman accustomed to consider the great moral value of explosive projectiles and to the demands for accompanying guns, it seems as though the allowance of infantry howitzers or cannon should be increased.) However, all these means are under the same limitation: the necessity of bringing up their ammunition over the broken ground and under the fire which the defense puts on the front line, and especially on the ground over which it has just passed. These weapons in proper combination should have ample fire power to meet any crisis of the action. Their power can really equal that of the field guns in such emergency. Their problem is that of transportation of ammunition and is imposed on them by their lack of range. If the targets can be seen, an infantry howitzer or even a 37-millimetre gun can put a machine gun out of business as easily as a 75. No small group can fight under the fire of a machine-gun company which sees the target and has ammunition.

The problem of ammunition transportation cannot be solved as easily by the artillery as by the infantry. The artillery accompanying gun weighs 4000 pounds as against about one-tenth of that weight for the infantry howitzer, and one-fifth for the pack howitzer. The extra weight is entirely useless at short range.

The attacking infantry then does not now require, as it used to, the bursts of artillery fire to subdue discovered targets. It has practically equal and much more mobile weapons for that purpose and can deliver bursts of fire that are sufficient. But this attacking infantry cannot now gain and maintain fire superiority over the defense.

Although in bursts of fire it can outshoot the defense, it cannot maintain a fire superior or even equal to the fire of the defense. It cannot carry with the attack sufficient ammunition to neutralize the undiscovered units of the enemy by zone fires and the machine guns of the defense are not seen even when they fire. Repulsed infantry often has no idea where the fire came from and has not even attempted to reply to it. It is too late when the infantry has been stopped. Good infantry does not stop for the first few bullets. It tries to fight back and push on and often it suffers crippling losses before it realizes that the line must stop until the obstructing machine guns are silenced. The casualties thus sustained are prohibitive. The attack is always in sight; the defense always hidden. The infantry is decimated in its effort to find out where to shoot. If you wish to see the result of this sort of thing read General Sumerall's

discussion of the operations of the various large units which he commanded, with and without efficient artillery support.*

The field gun has one quality which none of the infantry weapons possess and that is range. It can fire its projectiles as far as the infantry can advance in one day. It can fire all day on an enemy from a position on which ammunition was accumulated in the night before the attack and is under no disadvantage to the defense in the matter of ammunition supply. The field artillery can, therefore, do what the old infantry did for itself—gain and maintain fire superiority, and should not try to do what the old infantry could not do but the new infantry can do—meet the crises of the action by bursts of fire. The proper rôles of the two arms in the fire fight have been reversed by the introduction of the machine gun and the automatic rifle. The infantry may expect and should demand that the artillery maintain fire superiority over the machine guns of the enemy which cannot be located and silenced by the infantry's own weapons. No method of front line information yet devised or imagined can discover these in time to fire on them as known targets. These conditions require a deep rolling barrage and thoroughly organized systematic fires which will cover all probable positions from which fire may be brought on the infantry.

Limitation of objectives for divisions was not, so far as I am aware, found to be unnecessary, as Colonel Bundell assumes. It is true that a halt in the advance gives an opportunity to the counter-attack, but it is also true that if the attack has not run out of range of its guns counter-attacks can be beaten off with comparative ease. It is also true that the advance of a single line is limited by the endurance of the men. There must be a pause, if only to eat or pass lines, and daylight is essential to the advance. These pauses must be provided for whether the objectives of the army corps are limited or unlimited. We are, of course, speaking of advance in battle, not pursuit of a disorganized enemy.

The war showed that infantry which attempted to advance without a definite plan for coördination of arms was invariably defeated, if the enemy was still an organized force. We must not assume that we will not meet properly organized resistance, or that we can pass over it in a manner already proven to be impractical. There will be no stop as long as an advance is possible, but advance is impossible when the range of the rolling barrage is passed or the guns cease firing.

It is probable that the division will have more supporting artillery in future wars than in the past. An examination of the new tables of organization indicates this. The reduced strength of the

* See—"Notes on the Employment of Artillery and Machine Guns in Offensive Operations" FIELD ARTILLERY JOURNAL, April-June, 1919.—Editor.

units of divisional infantry indicates a shorter period of engagement for each division in major operations, that is greater depth, as Colonel Bundell says. This means more complete units in reserve. This means more artillery regiments available from the reserve division for assignment to the front line units.

The long period of stabilization had nothing to do with the road and railroad nets of France. They were characteristic of a densely populated and highly developed country. If we take part again in a war of great peoples, it will be in a densely populated and highly developed country with similar road and railroad facilities, as a decision can only be gained in a vital territory of such peoples, which is of that character. The whole line of communication of the American Army in France was not short. It was about 4000 miles long.

If our infantry divisions are asked to attack, supported by only 12 batteries of 75s and a few howitzers in the next war, they will get licked just as infantry divisions were licked under the same conditions in the last war. The only fire yet devised which will maintain fire superiority over an undiscovered unit of automatic weapons is the zone fire of field artillery.

The matter of communications will be no more difficult in the future than in the past. It was and will be extremely difficult, but it must be undertaken by the artillery and the infantry must not be expected to assume it. It involves forethought, exhausting labor, and many casualties, but communications have been maintained in the past with an attacking line and they must be maintained in the future. This problem can be solved and the artillery should not try to avoid the problem by moving the guns away from their ammunition. Such short movements will not reduce the difficulty. The liaison breaks at two points—between infantry company and battalion headquarters and at brigade or division headquarters. The second break can be avoided by requiring the artillery personnel to maintain connection through the artillery commander at infantry brigade headquarters to the artillery regiment. The first is due to the enemy and cannot be eliminated except by defeating the enemy. It is one of the hazards of battle and will occur no matter where the guns are located. The long line back from the attacking echelon to the battery gives little trouble during the attack. It is in defense that it is hard to maintain. The real obstacles to communications will exist no matter where the guns are located, but if they make short moves there will be the added difficulty of having both ends of the chain mobile instead of just the infantry end.

When the artillery undertakes short moves it loses its one advantage over the infantry weapons. That is range. To a second position ammunition must be brought over the battlefield across

the original infantry front. Ammunition cannot be brought up in artillery caissons in the daytime in important quantities in any big fight. If artillery ammunition can be brought up so can ammunition for the infantry weapons and the great weight of the artillery matériel need not be moved.

An actual experience with what General Sumerall considered a proper proportion of artillery may be considered in determining the practicability of Colonel Bundell's system of tactics. The sector of about 1800 metres average was supported by 104-75s and 40-155 shorts, and some long guns. These numbers are from recollection of the units involved. Suppose the 75s had moved so as to keep a maximum of 3000 millimetres from the infantry. It would have required displacement of all the guns twice for an advance of 7 kilometres which took place. The first displacement would have required the movement of the guns and about 30,000 rounds of ammunition. For the second displacement, starting from No Man's Land and ending in No Man's Land, the movement would have required the shifting of all the guns and 15,000 rounds of ammunition. The caissons would all have been empty that night. Such movements are impossible on the battlefield. No commander who directs a large unit of artillery to move forward during an advance has a right to expect it to fire efficiently again that day. It may be able to support him again but probably it will not. That is on a battlefield, not a manœuvre field.

As Colonel Bundell says, troop movements should be made at night. Displacement of large masses of artillery is a troop movement, not a part of the attack, as the movement of the guns has no offensive value and they fight only when stationary.

The artillery must be able to move rapidly and surely at night and supply its new positions before morning. It must not be tied to the dumps. The whole organization must be able to go forward as fast as an attack can progress each twenty-four hours. But the movement must be made in long moves when the fire of the guns is not required and it can be successfully accomplished in a night and not by short moves in the daytime when fire is required and the new battery positions cannot be supplied.

To sum up then, in modern battle, if the infantry is to advance at all the fire of the defense must be neutralized, whether the exact location of the units has been determined or not. This can only be done by zone fires. Rolling barrage and covering fires are both necessary, these cannot be fired by the infantry because it cannot transport the necessary ammunition across the battlefield. For these fires it will call upon the artillery and to shoot them the artillery must stay still and shoot—not make short moves in crowded

columns across the fields to make the technical duties of liaison less difficult.

Of the six problems which Colonel Bundell gives as pressing it seems to me that only the last two had any appreciable influence on the last great battles of the war and that they alone will arise in the first battles of the next war, if we fight with the present weapons. The real problems of the artillerymen are:

First, keeping open his communications with the advancing infantry; and

Second, moving rapidly to, occupying and supplying positions at night in a restricted and congested area; and

Third, and above all, to shoot well by the map by observation and by topographical operations without obstruction or prepared maps.

Other problems may be presented in advance and rear-guard actions or in minor wars, but on the solution of these three will depend success in fulfilling the main mission of the artillery by neutralizing the automatic weapons of the defense during the infantry advance.

Does not Colonel Bundell make the mistake that the German light and horse artillerymen made before the war, and allow the love of horses and brilliant manœuvre to obscure the prosaic mechanical business of shooting when and where the fire is most required? This business the German foot artillery and the French light artillery put first during the same period.

CURRENT FIELD ARTILLERY NOTES

Ordnance Notes*

The 75-mm. Pack Howitzer and Carriage, Model 1922.—The wooden model of the new carriage has recently been completed at the Rock Island Arsenal, the design embodying all desirable features noted as a result of tests of the 1920 material[1] described in July-August issue of the *Army Ordnance*).

The ballistics, the limits of elevation and traverse remain the same as in the 1920 carriage; however the entire carriage and howitzer have been redesigned.

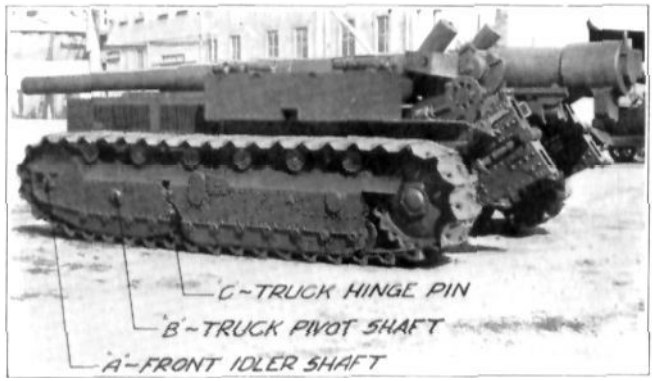
The new howitzer has a side sliding breech block with a Tasker firing mechanism mounted on the right side which is operated from a mechanism on the carriage. The recoil mechanism is of the modified Puteaux type. A cast steel tubular sleigh supports the recoil cylinder below and the recuperator cylinder above and is provided with feet for engaging the recoil slides in the cradle. The recoil and recuperator cylinders are permanently seated in a forging at their forward ends. The howitzer is inserted in the sleigh and through the forging when assembled to the carriage. Lugs in the forging engage similar lugs on the howitzer when the latter is rotated 30 degrees and at which point all the strain of recoil is taken. In this manner the entire recoil mechanism is made to recoil with the howitzer, thereby increasing the recoiling weight nearly 40 per cent, over that of the 1920 carriage without increasing the weight of the carriage or cradle pack load. This increase in recoiling weight resulted in a decrease in piston rod pull of approximately 1600 pounds.

The cradle has a constant length of recoil of twenty-eight inches. The cradle contains the recoil slides and a lug for attaching the piston rod at the forward end. The cradle has two projecting arms on each side which are seated and locked to an elevating are on each side. The two elevating ares are trunnioned in the upper element of the trail. The tipping parts being pivoted at their extreme rear, balance is effected by means of a spring equilibrator located directly behind each elevating are and within the trail flasks.

The elevating mechanism consists of two spur pinions engaging the two elevating arcs. A worm wheel is mounted on the same shaft with the two pinions and is rotated by its worm, one pair of

* Reprint from *Army Ordnance*, March-April, 1922.

[1] See March-April 1921 FIELD ARTILLERY JOURNAL.



155-MM. GUN—8-INCH HOWITZER MOTOR CARRIAGE,
MODEL OF 1921

bevel gears and a handwheel on each side of the trail. The limits of elevation are –5º to +45º.

Axle traverse is employed and is accomplished in a similar manner as in the 1920 carriage with the exception that a ball nut is used in place of the ordinary acme screw thread. A total traverse of 5 degrees is allowed.

The two trail flasks are of box section in this carriage and are hinged to permit folding as in the 1920 carriage. No seats are provided for the gunners. The standard 29-inch artillery wheels are used.

The howitzer and carriage are to be packed in four pack mule loads and are: the howitzer, cradle, trail and wheels and axle. The standard pack harness with aparejo will be used with a redesigned super-frame for accommodating the various loads.

Spring Release Incorporated in Track Mechanism of 155-mm. Gun, 8-inch Howitzer Motor Carriage, Model 1921.—As originally designed and built, no spring release feature was incorporated in the track mechanism of the two pilot 155-mm. gun, 8-inch howitzer motor carriages, Model of 1921. The omission of this spring release feature in the track mechanism of this motor carriage was done deliberately and in the interests of simplicity of design. It was hoped by means of the particular design of the front truck to eliminate the necessity for a spring release.

The front truck on this motor carriage is very flexible and it was considered that the extra tension in the tracks due to packing of the track shoes with dirt, rocks, etc., would cause the front truck to rotate upwards about its axle arm at B[2] and thus give the necessary slack in the track to permit of its proper functioning.

When the track loads up with foreign material—dirt, stones, snow, etc., a compensating additional length of the track is required. It is impossible to obtain any stretch of the track which is on the ground since that portion is carrying the weight of the vehicle. The increased tension in the track is therefore communicated along the top of the track to the front idler. When this happens, if the mechanism should always function as anticipated by the designer, this increased tension would be transmitted as pressure against the axle shaft carrying the front idler. This shaft centre at A[2] being above the axle arm of the front truck B a backward thrust at A would tend to rotate the entire front truck about B as an axis; the link connection at C permitting of the rotation of the front truck about its axis at B either up or down. An upward rotation of the front truck about its axle arm at B as an axis approximates a buckling of the jointed truck mechanism and would introduce a considerable

[2] See illustration of 155-mm Gun—8 inch Howitzer Motor Carriage Model of 1921.

amount of slack in the track which was considered sufficient to compensate for any loading up of the track shoes.

The action of this front truck was actually tested soon after the completion of this motor carriage by loading up the tracks with dirt and crushed rock. The mechanism functioned as anticipated by the designer and the track satisfactorily cleaned itself.

The packing of a caterpillar track with snow is a far more difficult problem than the packing of the same design of track with mud, sand, dirt, rock, etc. During the past winter therefore tests were made at the Aberdeen Proving Ground, Maryland, to investigate the action of the track and truck mechanisms of this motor carriage when operated in deep snow. It was found that the track links continued to pack harder and harder with snow from which all of the moisture had been extracted by means of the pressing action of the sprocket teeth so that it became impossible for the track to clear itself of this hard packed snow and ice. The front trucks also failed to function in the snow as anticipated. While a certain amount of slack was probably introduced into the track, it was not sufficient and this condition added to the continued loading up of the track links, finally resulted in the actual breaking of the track on one side and the fracturing of the casting which retains the idler yoke on the other side.

From an examination of the accompanying illustration, it will be noted that there is a critical point in the anticipated method of functioning of the front truck which would always result in breakage of some part of the truck or track mechanisms. It can be seen that this occurs when the action line of the force at A due to increased tension in the track passes through the centre of the axle arm at B. In this position there would be no tendency of the front truck to rotate and the power of the motor in the carriage eventually results in the snapping of the track.

As a result of these tests of this motor carriage in the deep snow a spring release mechanism has been designated in the Ordnance Office and will be incorporated in the front trucks of these two motor carriages. The addition of this spring release feature in the track mechanism of this motor carriage will insure clearing of the track under almost all conditions of operation. It, however, will not insure satisfactory operation of this track for long periods in deep snow.

In connection with the study of these tests in deep snow, investigation was conducted of the provisions made by the manufacturers of commercial tractors to insure the satisfactory operation of their tractors in deep snow. It was found that a design of track shoe was used having an almost entirely open tread which eliminates any

possibility of snow or ice packing between the teeth of the drive sprocket and the track links. In addition to this feature of the design of the track shoe to permit of positive clearing this snow shoe has a large sharp grouser as an integral part of the shoe for traction on ice. It would therefore appear that for active operations in winter weather a different type of track shoe would have to be used than is employed during the remainder of the year.

A spring release feature will be incorporated in the track mechanism of these two pilot motor carriages in the near future so that upon receipt of the top carriages and recuperators at the Aberdeen Proving Ground, Maryland, from the Rock Island Arsenal, Ill., these two motor carriages, one mounting the 155-mm. gun Model of 1920 and the other the 8-inch howitzer Model of 1920, will be in satisfactory operating condition to enter upon the exhaustive firing and manœuvring tests to which these army motor carriages will be subjected during the coming summer.

Motor Carriage Running Gear for High Speed.—The test of the 75-mm. gun—105-mm. howitzer Motor Carriage Model 1920, at the Aberdeen Proving Ground has demonstrated that the conventional type of running gear of the caterpillar type is not satisfactory for continuous service at the high speeds desired. Originally, this type of construction was developed for slow speed work and up to certain limits was satisfactory. The demand for higher speed, quiet operation, and light weight makes it necessary to consider a form of construction which will stand up under these conditions.

When the 75-mm.–105-mm. Motor Carriage was built, the high speed, quiet operation and light weight characteristics were striven for, but the method used to secure these results was to modify the conventional type of running gear rather than develop anything new. The truck frames were made as light as possible, the track shoes were cut down to a very thin section without reinforcing against shock due to striking stones, the track rollers were thinned down to a minimum. In addition, quietness of operation was secured by the use of rubber pads on the face of the shoes, and on the rims of the track sprockets. The result of these modifications secured in some measure the desired results; that is, the weight was reduced, and as a result higher speed resulted with the power available. The rubber features helped reduce the shock to the vehicle and reduced the noise of the running gear.

The results gained, however, were at the expense of reduced life of the running gear. The test records show that the motor carriage was in the shop too often considering the mileage between trips to the shop. Forty-two per cent. of the failures for all causes requiring work in the shop over a certain period were for running gear failures. Obviously, this condition existing in any motor carriage does not

make for satisfactory performance. As the practical limit as to lightness has been reached in the conventional caterpillar running gear, it is believed that the solution for light weight, noiseless operation, and high speed must be found in some other type of running gear.

The conventional type of track has always presented a difficult lubrication problem. In fact it would be better if no lubricant were used, since the lubricant merely collects dirt and grit which acts as a grinding compound on the rubber surfaces. The track shoes must be reinforced to withstand road shocks and as they are of cast steel the section is usually heavier than necessary considering the strength required.

The first step in the simplification of the running gear consists in a new type of truck which will have for its chief characteristics, light weight, simple construction and the absence of surfaces requiring lubrication. Some experimental types of cable mounted tracks consisting of round cable or flat rubber and fabric, look promising. A design of this type which has recently been prepared in the Ordnance Office may be given a try-out on this carriage. This design of track which is generally of the cable mounted type has a number of novel features which should very materially improve the track performance and pave the way for a departure from the conventional type of track construction. It will be possible with this construction to incorporate rubber pads on the links of the track. The pads will be easily replaceable without removing the track from the vehicle. When the rubber pads are worn down, the track will function without them, and the vehicle can be continued in service until they can be replaced. The weight of the track will be much lower than the present design.

The truck rollers used at the present time are made of cast steel, machined to a thin section for lightness. The tests have shown that lightness was gained at the expense of strength. The flanges sheared off. The closure to bearings was not satisfactory, with the result that when operating in water, water entered the roller and soon rusted the bearings and gudgeon, so that lubrication had no effect.

The truck roller now proposed will, if practicable, be rolled section, thus securing great strength from a minimum section. Annular ball bearings will be used in place of roller bearings. The closure has been improved so as to be effective against the entrance of water.

Instead of placing the rubber on the wheel surface, the rubber will be an insert between the inner and outer portion of the roller proper so that a cushioning effect will be secured without wear directly on the rubber surface. While this idea of a rubber cushion truck roller is not new, as embodied in this design, it has several

novel features, advantage being taken of previous attempts along the same line.

Lubrication of the ball bearings in this design will be assured, since the closure is effective against the entrance of water and the leakage of oil. The central portion of the roller will contain an oil well which will serve for many miles of running. The well is replenished from a fitting in the outside end of the gudgeon.

The present type of single truck frame will be retained, but the method of fastening the truck gudgeons will be improved. While it would be possible to adopt a double truck frame for this carriage, it is believed that with a new light weight cable type track, rubber cushioned truck rollers with better bearings and positive lubrication, satisfactory performance will be obtained without any additional alteration to the running gear.

EDITORIAL

Announcement of Award, Field Artillery Prize Essay Competition, 1922

THE Committee of Award, nominated by the Chief of Field Artillery, consisting of

Colonel G. LeR. Irwin (F.A.), Inspector General's Department, U. S. Army,

Lieutenant-Colonel Joseph F. Barnes (F.A.), General Staff, U. S. Army,

Major Wm. H. Dodds, Jr. (F.A.), General Staff, U. S. Army, have carefully examined the essays submitted for the 1922 FIELD ARTILLERY JOURNAL Prize Essay Competition, and made the following award:

First Prize: "Artillery Ammunition Supply," by Major Vincent Meyer, Field Artillery, U. S. Army.

Second Prize: "Some Aspects of American Field Artillery," by Major Wm. E. Burr, Field Artillery, U. S. Army.

For honorable mention: "Impressions of a Corps Munitions Officer," by Captain Wendell L. Bevan, 1st Field Artillery, U. S. Army.