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EDITED BY

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

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Montfaucon, France, October 2, 1918. Observer, Lieutenant S. G. Auspach, 115th F. A. Plotter, Lieutenant J. S. Lovejoy, 55th F. A. Brigade (See Current Field Artillery Notes This Issue).

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SOME OBSERVATIONS CONCERNING THE USE OF ACCOMPANYING BATTERIES DURING THE WORLD WAR WITH SOME PERSONAL EXPERIENCES

BY MAJOR RICHARD C. BURLESON, FIELD ARTILLERY, U. S. ARMY

AWARDED SECOND HONORABLE MENTION, FIELD ARTILLERY JOURNAL PRIZE ESSAY COMPETITION, 1921

THE operations during the World War brought the Infantry and Field Artillery of the United States Army together in serious combat for the first time since field artillery had been armed with matériel with which the indirect method of fire could easily be used.

The use of the accompanying battery requiring the most intimate liaison was first attempted during this war, and it was but natural that the expected results were obtained in only very few cases.

In the study of the problem of the accompanying battery, it must be remembered that its use requires that the following be developed to the highest degree of efficiency.

1. *Mobility*.
2. *Knowledge of Field Artillery Firing*.
3. *Liaison*.
4. *Initiative*.

While the above headings are only four in number, it will be realized by military students that they are very formidable. Under these headings the writer will attempt to point out some of the reasons why accompanying batteries of the Army of the United States were not a success during the World War.

MOBILITY

To manœuvre rapidly on the varied terrain of the field of battle, so as to reach the prescribed positions with the least possible delay and without serious losses, and be in condition to deliver the different kinds of fire effectively requires that batteries be extremely mobile. This requires hours and days, yes, better, months of training of horses and men.

The Drill and Service Regulations for Field Artillery, 1916, state 1st, "Using well trained horses, one hundred and sixty hours of instruction are required to train a driver so that he can be classed as qualified"; and 2nd, "The time required to train thoroughly a remount for the artillery service depends upon so many conditions; such as the animal's age, conformation, condition, capacity, and temperament, and the skill, zeal, industry and ability of the instructors and riders, that it can only be stated approximately. With young and undeveloped horses, two years can be profitably employed. Recourse should then be had to a more extended system of training than can well be embodied in these regulations, and free use should be made of the knowledge and skill of the graduates of the Mounted Service School. But in emergencies mature horses of good conformation and in excellent condition can be molded in about three months' time, under competent instructors and riders, into animals fulfilling fairly well the requirements of the artillery service."

Of course, none of the conditions above held true for the problem in hand. Trained riders, there were none; competent instructors, there were very few. And even then, we haven't even a prophet who has ventured an estimate as to the time required to train horses and men to the standards required when both are received untrained.

Of the horses issued to the regiment commanded by the writer, more than two-thirds of them were received on the day prior to the departure of the regiment for the front. So of course it was impossible to train either horses or men.

From observation of some six or seven brigades of field artillery, I would say that the horse situation in the Field Artillery of the Army of the United States in France was about as follows: "One hundred thousand horses from the farms of France who had never seen an American, and one hundred thousand Americans who had never seen any kind of a horse.

It must be also remembered that this great mass of untrained men and animals from which the Field Artillery of the Army of the United States had to be formed had to be trained and directed by very few trained officers of the Regular Army. (At the outbreak of the war there were only two hundred and eighty-eight officers in the Field Artillery of the Regular Army who had had more than one year's service in that branch.) Of course the officers of the Regular Army were assisted by the junior officers who were hard working and willing, but unfortunately untrained.

From the above it will easily be seen that to develop the required mobility with the horses and men available during the World War was simply an impossibility, and I do not believe that any of the officers of the Field Artillery of the Regular Army who made a

study of the subject ever thought that such mobility could be developed.

As stated above, only an organization possessing the mobility to advance rapidly over difficult terrain and to occupy positions efficiently, could be expected to solve the accompanying gun problem satisfactorily; and such we did not have. Therefore, the first cause for the failure of the accompanying battery in the Army of the United States during the World War was the lack of mobility of the field artillery of that army.

KNOWLEDGE OF FIELD ARTILLERY FIRING

In considering this phase of the problem, it should be remembered that to develop a battery commander who is thoroughly competent to conduct the fire of a battery under all conditions requires a great deal of time. In fact it requires years. The French frankly admit now that the principal reason why they did not fire shrapnel during the war but insisted upon the use of the shell was because they could not develop officers who could fire shrapnel efficiently in the time available. The number of field artillery officers in the Regular Army, National Guard, and Organized Reserve at the time of the entrance of the United States into the World War who could be said to be even proficient in all kinds of field artillery firing was very small indeed. Of the two hundred and eighty-eight officers of the Regular Army referred to above, approximately two hundred of them had been through the course at Fort Sill; and I think that I am correct in stating that only about eighty-five per cent. of them completed the relatively simple course at the School of Fire for Field Artillery at that station with such grades as to be classed proficient by that school. And in this connection, it must be remembered that practically all of the officers of the Regular Army who completed the course at Fort Sill prior to April, 1917, were given at least field rank during the World War, and were in command of battalions, regiments, brigades, divisions or corps; or were on the staffs of such units; or were directing the training of the officers who were temporarily in the service of the United States. Thus it will be seen that practically all of the battery commanders of the Army of the United States during the World War had to be developed after the outbreak of that war.

A very brief study of the problem of conducting the fire of a battery of field artillery discloses the fact that while the mechanism of the conduct of fire is relatively simple, the application of the same on the manœuvre field, not to consider the field of battle, is very much more difficult. In fact, I think that I am safe in saying that it is one of the most difficult problems that confronts the field artillery officer.

It must also be realized that the problem that confronted the field artillery at the time of its reorganization for the World War was that of attacking and defending lines which had been fixed in position for more than two years, and that on ground about which everything was known. The instruction of the battery commanders and lieutenants of the Field Artillery of the Army of the United States followed the natural line, that relating to map and precision firing; and the amount of instruction in the open field methods of conduct of fire with its rapid changes of position and quick, but only approximate, adjustment of fire was, unfortunately, for the reason given above, very limited. To expect the young and inexperienced officers to quickly adapt themselves to an old but, unfortunately to them, strange method of the conduct of fire about which they knew very little, was expecting too much; and I think that it would be well to remind the reader at this point that "one only does those things well that one has been accustomed to doing."

The conduct of fire of a battery of field artillery involving great displacement of the observing station from the firing battery and from the target, the location of which cannot be accurately determined, requires the greatest possible skill, and I am sure that I will not be contradicted when I say that there was not one battery commander in the Field Artillery of the Army of the United States at the time of the offensives during the summer and autumn of 1918 who could even satisfactorily fire such a problem.

From the above it will easily be seen that to expect the battery commanders of the Field Artillery of the Army of the United States during the World War to have more than a superficial knowledge of the conduct of fire of a battery of field artillery was to expect the impossible. Therefore, the second cause for the failure of the accompanying battery in the Army of the United States during the World War was the lack of knowledge of field artillery firing among the battery commanders and lieutenants of that army.

LIAISON

Liaison, that majestic and monumental word which during the World War was first brought to the close attention of the officers of the Army of the United States, means only contact, but a contact so intimate that the word has long been used by the French to describe the illicit relationship existing between a man and his mistress. Such a contact is intimacy to the last degree, and such is the contact and relationship that is required between the infantry and its supporting field artillery on the field of battle, if such problems as that of the accompanying gun or battery are to be solved satisfactorily. Such contact and relationship can only be established through long and

intimate association. This relationship must be so well established that each reposes in the other the most implicit trust. In order that such a trust can be established, it is absolutely necessary that both arms thoroughly understand, at least, the limitations and possibilities of the other.

To any one who had any chance to observe the Army of the United States during the World War it was patent that neither the field artillery nor the infantry had more than a superficial knowledge of their own arm, and that they were, in general, profoundly ignorant of the brother in arms. To expect that liaison would be maintained under such circumstances was to expect the impossible.

Due to the shortage of trained officers on the front, it was the general practice to use as liaison officers those officers who could best be spared, and naturally this important work was, in general, done by the officers who were least qualified in their own arm.

I do not believe that I am wrong in stating that due to the inexperience of the liaison officers, the lack of trust in them by the commanding officer of the unit to which they were assigned, and the problems of his own arm (which at the time preëmpted the mind of the commanding officer of the infantry unit) caused the infantry to fail to use the field artillery liaison officer as much as should have been done.

It is believed that in view of the statements made above, that to expect that liaison would be established between the Infantry and Field Artillery of the Army of the United States during the World War was to expect the impossible. Therefore the third cause for the failure of the accompanying battery in the Army of the United States during the World War was the lack of liaison between the infantry and its supporting field artillery in that army.

INITIATIVE

Of all the attributes of a successful battery commander, it is believed that initiative is the most important when considering the problem of the accompanying battery. And when we consider this question, we must first realize that the battery commanders of the Field Artillery of the Army of the United States during the World War were in fact mere babies groping valiantly but vainly in an immense mass of necessary and valuable information. That they did so well is only due to the fact that the American adapts himself to new things more readily than any other nation.

In order that an officer or any other person in any line of work can develop initiative, he must first thoroughly understand all things that bear on the problem at hand. Any other initiative is only misnamed, being in fact mischievous activity, and is, in general, more

of a hindrance than a help. How often are we disgusted with the busy bodies who only having a smattering of information on some subject, are always trying to make an impression of profound knowledge of the matter, when, in truth, they are only displaying their ignorance and hindering the completion of the work.

In view of the facts brought out above, it is not reasonable to expect that the battery commanders of the Army of the United States during the World War would possess very much initiative. Thus we have the fourth and final reason why the accompanying battery in the Army of the United States was not a success during the World War.

The writer had the privilege of witnessing the following attempts to use the accompanying gun and battery during the World War.

On the morning of September 26, 1918:

Several days prior to the attack on this date, I was informed that my orders for the attack would include the detailing of a platoon of field artillery to act as accompanying artillery with each attack battalion of infantry of the infantry brigade which my regiment was to support in the attack. After making a study of the regiment which, at that time, had been under my command less than two weeks and during which time the regiment had been marched from the Vesle Front to the vicinity of the Argonne Forest, I decided to select two batteries as they more nearly approached the ideal accompanying battery as laid down above than the others of my regiment. So in pursuance to the instructions that I had received, I warned these two batteries that they would probably be used on accompanying battery work in the attack that was to take place shortly. At that time, I went over with the battery commanders of these batteries the line of work that would probably have to be undertaken on such a mission, and told them that they should go over the information that I had given them with their lieutenants. I was very careful to impress upon these officers that they must keep my headquarters informed, while they were detached from the regiment, of any changes that they found necessary in the prescribed program.

On the afternoon of September 25, 1918, I was informed by the brigade commander of the brigade that I was to support that there would be three attack battalions of infantry. Having this information, I gave orders that the accompanying artillery would consist of three platoons and selected the lieutenants who were to command each platoon. In detailing the lieutenants I was very careful to select the ones who, at that time, were considered by me to be the best lieutenants in the regiment. I also selected what I thought was the best

captain to have general supervision of the work of the platoons and to have charge of the maintenance of liaison with my headquarters.

Due to orders from higher authority, we were forbidden to make any reconnaissance of the roads or the terrain in the immediate vicinity of the trench system, which at this point had been in the same place more than three years. (This was done so as to prevent the enemy from finding out that the American Army was in that sector and to insure that the coming attack would be a surprise.) Accordingly, after a study of the maps supplied, I selected the route to be followed by the accompanying artillery and gave instructions that I was to be kept informed of the progress of the accompanying platoons and as to the condition of the roads, as I was expected to advance the regiment over the same route. As stated above the trench system had been in position along this front for more than three years, and as this sector had been one where the attacks by mining and counter-mining had been used extensively during 1915, the maps supplied indicated that No Man's Land here consisted of a succession of very large craters. However, the map did indicate that an old road leading across the trench system at this point was still passable, and that was the route of advance selected.

But naturally strange things happen. The platoons moved out at the designated hour, and after advancing about one thousand yards, or to the trench system proper, found that the selected route was impassable. In fact two weeks later when I had an opportunity to see this route it was hardly passable then, although it was one of the main routes for communication and supply on the corps front, and the engineers had been working on it night and day since the day of the original attack. This necessitated a change in route for the platoons, one which carried them into the sector of the adjoining brigade, but which was required if the platoons were to do the work that they had been detailed to do. Of course, I was not informed that this change in route had been made, in fact the morning passed without my headquarters receiving a word from the accompanying platoons. It was naturally assumed that they were doing the work upon which they had been assigned, and that they were blowing the Germans off the map.

At about 11.00 A.M. I was given orders to move my regiment forward to support the infantry, as the attack had progressed as per schedule. As soon as I received this order, I started on a reconnaissance so as to check the terrain that I had selected from the map for the positions of the battalions if the attack succeeded, and directed that the battalions follow me promptly, designating as the route to be followed the one leading across the old trench system at this point and the one selected for the accompanying platoons to advance

over. Almost immediately, I encountered the impassable trench system with its continuous line of enormous mine craters, and was compelled to take the same route that the accompanying platoons had taken. After advancing along this route about fifteen hundred yards, I encountered the accompanying platoons in sheltered position in the forest consolidated under the command of the captain who had been detailed for the purpose of supervising only the work of the platoons and of maintaining liaison with my headquarters. The platoons were approximately twice as far from the old trench system as they had been when they started to advance, and were in the sector of the adjoining brigade. Of course the officers were sitting on their horses and the drivers were, as usual, following the example of their officers. Immediately I gave orders that the platoons advance, and that at the gait used by accompanying artillery when changing position, the trot. I moved forward at the gallop, and on reaching the old trench system I found that the crossings had not been completed by the engineers. The platoons arrived about this time, and observing that the infantry was being held up by a machine-gun nest about fifteen hundred yards beyond the old trench system, I directed that a platoon be placed in position and that the enemy machine-gun nest be silenced or destroyed. Due to the fact that the platoons were only furnished with large reels of wire weighing about 180 pounds, I directed that an officer, accompanied by two signalers, go forward and conduct the fire. The officer and the signalers advanced to within three hundred yards of the enemy machine-gun nest and directed the firing of about twenty shots. The enemy machine-gun nest was driven from position and the infantry advance was continued on that part of the line. This is the only occasion I have ever heard of that signal flags were used to transmit the data for the conduct of fire of a battery of field artillery during the World War, and I am sure that the bravery displayed by the officer and enlisted men who occupied the forward observation station was the finest I have ever seen. Immediately after they reached the forward observation station and began to send data with the signal flags the enemy machine guns turned their fire upon them. They literally cut the ground out from under their feet, but the signaling was not interrupted for an instant, and fortunately none of the party were even wounded.

Had it not been for the fact that I encountered these platoons on my reconnaissance, they would not have fired a shot or occupied a position the entire day, but probably would have remained on their horses until nightfall and then being out of their own sector would have been lost. The commanding officer of the unit failed to establish contact with the infantry that he had been detailed to accompany;

the commanding officer of the unit failed to send a message of any kind to my headquarters during the five hours he was out of contact with it. He was satisfied to *sit on his horse* alongside the road in a well sheltered position and wait for something to turn up on this, one of the most important days of the Meuse-Argonne Offensive. I believe that my arrival or hunger are the only things that would have caused him to show any initiative. His unit failed for two reasons: NO LIAISON and NO INITIATIVE.

On September 27, 1918.

Due to a change in conditions during the afternoon of September 26, all of the infantry of the division was placed under the brigade commander of the brigade occupying the sector into which I had moved my regiment on account of the impassable trench system on the front occupied by the brigade that I had originally been directed to support, and I was directed at about 6.00 P.M. on that date to report to him for instructions. During the night of September 26-27, I visited his headquarters and reported to him. Among the orders he gave me at that time was one directing me to detail one battery to act as accompanying artillery and to have it report to him on the morning of September 27, for further instructions. Due to the failure of the battery detailed on similar work on the previous day, I selected another battery and gave it orders to report as directed. When I gave the battery commander his instructions I warned him that the only purpose of an accompanying battery was to assist the infantry in overcoming the resistance encountered, and that he must assist the advance of the infantry in every way possible. The battery moved out promptly at the designated hour, and I preceded it for some distance reconnoitering and marking the route. When the battery had reached a point within a thousand yards of our front line I was called away on other work in connection with my regiment and I ceased to control it. From reports made by the battery commander to me, it appears that he reported as directed and was told to place his battery in a position in readiness where it was sheltered by the banks of a stream. The battery remained in this position the entire day without being given an order to go into a position to fire. In this case the commanding officer of the infantry of the division was accompanied by a liaison officer from my headquarters. At nightfall the battery was directed to rejoin the regiment. The cause of failure in this case was due to the fact that the commander of the infantry to which it was attached failed to use it. However, if the battery commander had had the required initiative he would have insisted upon being used. The unit failed for two reasons: NO LIAISON and NO INITIATIVE.

On September 28, 1918.

During the late afternoon of September 27, I received orders directing me to detail a battalion to act as accompanying artillery with the infantry. Due to the fact that the two units which had been on this work had failed in every way except in the case where I personally directed the placing and firing of the platoon on the afternoon of September 26, as shown above, I was very careful to call to my headquarters the battalion commander and the battery commanders of the battalion selected by me for the detail. I minutely called to their attention the causes of the previous failures and impressed upon them the requirements of accompaning artillery, and insisted that they get on the job, and that I would hold them responsible that they give the infantry the support asked for. In order to increase the mobility of the unit, which was poorly horsed, I directed that certain stores and vehicles properly guarded be left behind. At the designated hour the battalion moved out. After advancing for some two thousand yards, the battalion commander was directed to move his battalion to the left and rear and to take up a position. This was done, but in the meantime I had moved the one battalion remaining under my command forward, and as a result the two battalions were on approximately the same East-West line, and the only effect was to divide the artillery unit into small units and to thereby lessen the power of the divisional artillery. The battalion remained in the position it had been directed to take up during the day without having been given a target to fire upon, although it suffered some loss from enemy artillery fire. This unit failed to perform its mission because it was not used by the infantry and because the commanding officer did not have the initiative to insist upon being used. The unit failed for two reasons: NO LIAISON and NO INITIATIVE.

On or about October 4, 1918.

At this time I was informed that a certain battalion of my regiment would report to the brigade commander of the brigade which the regiment was supporting to act as accompanying artillery. As the battalion was some distance from my headquarters, and for this reason I did not wish to delay the battalion in taking up its new duties, therefore I did not call the officers of the battalion to my headquarters for consultation and instructions. However, in transmitting the order to the battalion commander which in this case removed him from my immediate control, I enclosed a personal note to the battalion commander informing him that as he had been removed from my immediate control that he should move his headquarters to that of the infantry brigade with which he was to work as accompanying artillery, in order that the wishes of the infantry might be promptly carried out. This he did not do. The battalion did nothing for some

two days, when it was returned to my command. At this time I was informed by the battalion commander that one of the reasons and the principal one why he did not follow my suggestion to move his headquarters to that of the infantry brigade was because the infantry brigade did not have any designated point for its headquarters. I had also been hindered in my support of the brigade by this same fact. It was the custom of the brigade commander to wander over the sector accompanied by my liaison officer as well as by others of his staff during the day, and at nightfall he would direct my liaison officer to return to my headquarters, and at the same time give him instructions to meet him the following morning at a designated hour at some point in the sector, usually designated by some natural feature on the terrain such as a ravine, hill top or even a tree. I was also informed by the battalion commander that the only order that he had received calling for the use of the accompanying gun was one in which he was directed to place his battalion or at least a battery on the crest of a ridge and to drive the enemy machine guns from its northern slope. (At this time the crest of this ridge marked the front line of the infantry at this point and the northern slope was filled with machine-gun nests. In fact the enemy machine guns made it impossible for even a single infantry soldier to show his head above the crest line without drawing the fire of at least one machine gun, and due to their fire the infantry line was held at this point for about one week.) Of course he did not try to carry out such a foolish order, and was able to show the brigade commander that it was impossible to do so. This unit failed because it was not used by the infantry.

On October 31 and November 1, 1918.

At this time the brigade had been moved to another sector and had been attached to another division. As soon as the brigade was attached to the new division I ascertained from the Chief of Staff of the division which brigade my regiment would support in case we were sent into the line as we then expected. As soon as I received this information I made arrangements to send the officers that I expected to use on liaison work to live with the regiments with which they would work while in the line. This was done so that they could become acquainted with all the officers of the regiments, especially the staff officers of the regiment and the battalions, thereby increasing the probability of maintaining liaison during action. I had also had the opportunity to study the officers of my regiment during the past six weeks. So when I was directed to detail an accompanying battery with the brigade whose attack we were to support I was able to select the best officer in the regiment for this work. This officer had been in the National Guard for more than twenty years, and was one of

the few able battery commanders that I had the pleasure of seeing during the World War.

On the day of the attack the battery moved out promptly at the designated hour. After advancing about two thousand yards, it was found that the attack was held up, due to the division on our right failing to advance. Before the battery commander could withdraw his battery the support battalions of the brigade had been withdrawn to the position occupied by the battery, and the battery commander was forced to remain in this position, although it was without cover and was within one thousand yards of the enemy front line. The ground between the battery position and the enemy front line being absolutely devoid of any cover. From this position the battery fired upon several machine-gun nests during the afternoon. The following morning the attack was renewed and progressed with great rapidity. The division advanced about ten kilometres by 2.00 P.M., and when its advance was halted at that hour, the battery was in a direct fire position in the line of our support battalions.

This case was the one and only one that I saw in France where the accompanying gun was successfully handled, and I believe that the success in this case was due to the fact that the battery was commanded by an officer of long experience, who, in spite of the fact that his battery was very poorly horsed, was able to keep up with the infantry over an extremely long advance. The liaison in this attack was excellent. The infantry commanders, both regimental and brigade, were thoroughly on the job and the officer in command of the battery had INITIATIVE.

I desire to call to the attention of the reader the large amount of artillery that was detached from the regiment for accompanying battery work, as shown by the five operations referred to above. In two of the operations, one-half of the regiment; in one of the operations, one-fourth of the regiment; and in the other two operations, one-sixth of the regiment was used for accompanying battery work; and that in four out of the five operations the power of the detached artillery was lost to the division. The detachment of such a large portion of field artillery discloses nothing else than lack of knowledge of the tactics of field artillery by those who ordered such detachments.

In the critic of any problem, it is well to give a remedy for the faults disclosed. The remedy of the writer for the faults pointed out in this paper is the development of the four requirements of the successful accompanying battery and its officers as shown above, that is, MOBILITY, KNOWLEDGE OF FIELD ARTILLERY FIRING, LIAISON and INITIATIVE. These being developed, the problem is solved.

THE REGIMENTAL JOURNALS OF THE UNITED STATES ARTILLERY

BY MAJOR GENERAL SIR J. E. W. HEADLAM, K.B.E., C.B., D.S.O.

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[EDITOR'S NOTE.—*The expression of a favorable opinion of one's efforts is always encouraging, especially in these post bellum days when the Editor of a Service Journal comes in for a lot of hard knocks—and we know whereof we speak. Therefore we feel we may be pardoned in publishing the following comment on our Artillery Journals from the pen of an officer of distinction and one who has only the best interests of our arm at heart.*

Major General Sir John Headlam was, at the outbreak of the World War, conducting a School of Fire in Ireland, I think. He accompanied the British Forces to France, and became Chief of Artillery of the British Forces. He was then selected to go to the United States as the head of the British Artillery Mission. Here he did most splendid work, and the American artillery is under many obligations to him for his advice and untiring labor in assisting us in creating an enormous artillery force from practically nothing. Upon his return to England, after the close of the war, he was appointed upon several important commissions. After finishing this work he retired from active service, but still retains his interest in the field artillery. He is one of the best friends that our artillery has among the English officers.]

STATESMEN on both sides of the Atlantic assure us that a true friendship between the two great English-speaking nations would be the surest guarantee for the peace of the world; and those who know something of both nations are agreed that the great obstacle to such friendship is mutual *ignorance*. Can not we gunners take our share in breaking down the barrier by getting to know something of our brother gunners in America? Comparatively few had an opportunity of seeing much of them in France, for their "front" was far from ours, and fewer still have had the good fortune to visit them at home. But America is a country of which much may be learnt by an intelligent study of the press, and this applies even to the Regimental Journals which are far more outspoken, and therefore more illuminating, than our own. Of such journals the United States Artillery maintains two—the *Journal of the United States Artillery* and THE FIELD ARTILLERY JOURNAL, both of which are well worth our attention. The reason for the duplication is that when the separation

between "Coast" and "Field"[1] took place (about the same time as with us) it was complete. The two branches are now separate corps, each with its own "Chief," and naturally therefore its own Journal.

In appearance the two Journals are markedly dissimilar. That of the Coast Artillery has retained, with the original title of *Journal of the United States Artillery*, the severely professional appearance which distinguishes most of such publications the world over, confining its illustrations to a frontispiece, and eschewing advertisements. THE FIELD ARTILLERY JOURNAL, on the other hand, unhampered by tradition, makes a frank appeal to the eye. About the size and shape of our *Cavalry Journal*, its general "get up" is most attractive, paper and print being of the best, and the illustrations quite admirable. In addition to those relating to the articles, of which there are usually several pages,[2] there is always a frontispiece, often a subject of general interest—not long ago it was an excellent reproduction (in color) of the portrait of General Shrapnel at Woolwich. The advertisements, ranging in subject from a caterpillar tractor to a polo stick, no doubt make such luxuries possible—can not we follow suit?

In addition to these two strictly Artillery Journals there is a third of which mention must be made here, though it bears the title of *Army Ordnance*, for it is really the journal of what corresponds to our Directorate of Artillery. Its articles, always profusely illustrated, are well worth the attention of all those who are interested in the development of artillery materiél, but the object with which it has been established is perhaps its most interesting feature. To quote its motto, it is "Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace." This it is hoped to effect by maintaining the touch between the War Office (there was no Ministry of Munitions in America) and all those who were engaged in the production of munitions during the war, and keeping them up to date in such matters, so that, should the need arise, they may be ready to take up the work again.

The majority of the articles in the two Artillery Journals are on much the same subjects as those in our own, but there are perhaps more contributions from officers of the other arms, and the difference in the way the subjects are dealt with often "gives one to think." Papers on non-technical subjects—such as "Americanization," that great problem of the solidification of the purposes and outlook of all

[1] In the United States the Field Artillery includes our "Medium."

[2] The Photographs of every form of artillery tractor and "self-propelled mount" are of such interest now that the problem of mechanical transport for artillery is so much to the fore.

their mixed population *on the basis of the Anglo-Saxon tradition*—are more frequent, and there are many more extracts from foreign journals, English not excepted. In old days our "Proceedings" used to be filled with such translations, but there was an outcry that native talent was being discouraged, and they were banished. As usual, the pendulum swung too far. At this time especially, when we are all groping for the true lessons of the war, we can not afford to ignore the experiences of our friends—or of our enemies. And they are often such interesting reading, too! The story of a German horse artillery brigade in France, as told by its commander in THE FIELD ARTILLERY JOURNAL, must appeal to any gunner.

But criticism of individual articles is beyond the intention of this paper. Its object is rather to draw attention to those features of American regimental journalism which are most characteristic, and therefore most interesting to those who wish to find in their pages some clue to American mentality. The first thing that will strike such a reader is the freedom with which official matters are treated. Papers which with us would be "confidential" at least, if not "secret," and would probably never be allowed to emerge from the War Office, are issued to the Regimental Journals for the benefit of the officers at large, and what is more, they are discussed. Thus the Report of the Committee assembled in France after the Armistice to lay down the ideal organization and armament for the artillery of the field army—obviously a matter of the greatest interest to all—appeared in the Journals, and was followed by articles telling what action was being taken on the recommendations of the Committee! Again the recent reorganization of what corresponds to our Directorate of Artillery was described in the greatest detail, the description including a full explanation of the objects of the Chief of Ordnance in making the changes, and of his policy as regards the relations of his Department with "the Line." A still more striking example of the outspokenness of the American Journals, and of the way in which commanders take their confidence to an extent unknown to us, will be found in the last number of the *Journal of the United States Artillery*.

In America, as nearer home, shortage of personnel, lack of trained subordinates, ever increasing office work, and, as a last straw, the demands of education, have shorn regimental soldiering of many of its pre-war attractions. There has been a scramble to "get away from troops," to "do anything but straight duty." The Chief of Coast Artillery does not ignore the feeling, nor does he take exception to the grumbles in the pages of the Journal. On the contrary, he takes these latter as his text in addressing a personal "message" to his officers through the same channel. In this he puts the whole position

before them, tells them frankly that the transformation from the war to peace will demand still further sacrifice on their part, and winds up with an appeal to maintain the traditions and reputation of the Corps. It is a letter well worth reading.

The Annual Essay is a feature of both Artillery Journals which I think I am right in saying they have borrowed from us. The conditions for the most part are practically identical—with the addition of the valuable prizes of $150 and $100—but there is a characteristic development. Instead of being tied down to a subject this is *left to the competitor*, with the stipulation only that it should be a serious discussion of "some phase of the work of Coast Artillery affecting its future progress," or of "some timely Field Artillery subject or a tactical or technical Field Artillery study based on lessons of the World War." It seems worth consideration whether we might not try the experiment. It would no doubt render the task of the judges more difficult, but it would probably make the essays more generally interesting, and it *might* bring some really valuable contributions from men of ideas!

In the above notes on the Journals of the American Artillery I have endeavored to give a general indication of their scope in the hope of tempting my brother-officers to read them for themselves. I am sure that they will find them instructive as well as entertaining, for the problems of the writers are generally ours, though their solutions may be all their own! Better still if those for whom prohibition has no terrors would spend a leave in the United States—I can promise them a courteous reception and the most kindly hospitality. As President Harding told us the other day—"A common language and the common source from which we have taken our institutions have laid the foundation of accord." It remains for us to build upon that foundation by getting to know each other better.

TEST MARCH OF 1ST BATTALION, 83RD FIELD ARTILLERY

(5-Ton Tractor Drawn 75-mm. Gun Battalion)

BY MAJOR J. W. RUMBOUGH, 83RD FIELD ARTILLERY

DURING the period September 15th–October 30, 1920, the 1st Battalion, 83rd Field Artillery, completed the longest march ever taken by a 75-mm., 5-ton tractor drawn, artillery battalion.

The march was in the nature of a test of the 5-ton Artillery Tractor, which has now become familiar to most officers in the Service.

The distance covered during the march was 623.1 miles in 25 marching days, or approximately an average march of 25 miles per day.

The itinerary chosen was one which took the battalion over some of the roughest roads in Kentucky, Tennessee and Georgia which are passable for wheeled vehicles.

PREPARATION FOR THE MARCH

When it was decided that the 1st Battalion, 83rd Field Artillery, stationed at Camp Knox, Kentucky, was to proceed, by marching, to The Infantry School at Camp Bennings, Georgia, letters were directed to the State Highway Commissions of Kentucky and Tennessee, requesting information on the condition of roads, their practicability for automobile traffic and the strength of the bridges, etc., along the route which had been tentatively selected. The answers received indicated that in many places the repair of the roads, the grades to be negotiated and the bridges which had to be crossed were not of a type that would cause the route to be chosen for a pleasure trip, but were of a nature which would without doubt develop any defects which existed in motorized matériel.

After a careful study of the road conditions and the question of supply of the organization en route, it was decided that the column would march southeast from Camp Knox, passing through the towns of Springfield and Danville, Kentucky; cross the Kentucky-Tennessee border at a small town called Jellico, about thirty miles southwest of Cumberland Gap; thence south to Chattanooga; from there to Atlanta and then almost directly south to Camp Benning.

This route is not one that is considered the best by the automobile clubs, but in view of the nature of the march and the fact that the supply by rail could be accomplished with comparative ease, it was chosen.

As soon as the route was definitely decided upon letters were written to the postmasters at the various towns where the daily halts

were to be made, requesting information as to the location of suitable camp sites, and asking that they arrange with the local merchants for the supply of the necessary fresh beef, bread and ice for the command.

At the same time that the letters were addressed to the postmasters request was also made of the Quartermasters at Camp Knox,

TOWN	DISTANCE	GASOLINE	ENGINE OIL		TRANSMISSION OIL 600W	CUP GREASE
			MOB. A.	MOB. B.		
	Miles	Gals.	Gals.	Gals.	Gals.	Pounds
Camp Knox, Ky.						
Boston, Ky.	30					
Springfield, Ky.	32					
Danville, Ky.	28	3500	10	250	350	800
Brodhead, Ky.	30		10	250	350	800
Livingston, Ky.	18					
Bernstadt, Ky.	14					
Corbin, Ky.	21	3500	10	250	350	800
(Coal Creek), Ky.		3500	10	250	350	800
Jellico, Tenn.	31					
LaFollette, Tenn.	28					
Clinton, Tenn.	24¼					
Harriman, Tenn.	29¾	3500	10	250	350	800
Spring City, Tenn.	29½					
Sale Creek, Tenn.	29½					
(Dayton, Tenn.)		3500				
Chattanooga, Tenn.	28½	3500				
Dalton, Ga.	29¼		10	250	350	800
Adairsville, Ga.	30¾	3500				
Kennesaw, Ga.	33½					
Atlanta, Ga.	24⅔	3500				
McCollum, Ga.	$31^{7}/_{12}$		10	250	350	800
Luthersville, Ga.	31					
Chipley, Ga.	30					
Columbus, Ga.	31	1700				
Camp Benning, Ga.	$10^{1}/_{10}$					
Totals.		29,700	70	1750	2450	3500

Kentucky; Fort Oglethorpe, Georgia, and the Candler Warehouse (Atlanta Supply Depot) to ship the components of the rations other than those mentioned above to several points on the railroad near those stations. It being estimated that five days' rations, less beef, bread and ice, could be carried on the transportation with the battalion. The points selected for the ration dumps were at towns which the column was to reach at four, or five day intervals.

Letters were also written to the Standard Oil representatives of

Kentucky, Tennessee and Georgia to determine if the necessary supplies of gasoline, oils and greases could be purchased at various points along the line of march at which they would be required. It had been determined before this action was taken that the Quartermaster Corps was unable to locate these supplies in time to be available when necessary.

It was estimated that the carrying capacity of the Battalion transportation in gasoline, oils and grease was such that if the consumption of fuels was not greater than estimated, nine gasoline filling points and seven oil and grease filling points would be necessary.

The itinerary decided upon was as is shown in the preceding table. The amounts of fuel estimated as necessary at various points being indicated.

It is interesting to note the changes that were necessary both in the daily marches and in the amounts of fuels consumed. These are shown in the following table.

TOWN	DISTANCE	DATE	GASOLINE	ENGINE OIL		TRANSMISSION OIL 600W	CUP GREASE
				MOB. A.	MOB. B.		
			Gals.	Gals.	Gals.	Gals.	Pounds
Camp Knox, Ky.			1800		226	330	800
Boston, Ky.	30	Sept. 15					
Springfield, Ky.	32	Sept. 17	3460		100	157	
Danville, Ky.	28	Sept. 18	2125		82		800
Brodhead, Ky.	30	Sept. 20			287		
Livingston, Ky.	18	Sept. 21					
Bernstadt, Ky.	14	Sept. 22					
Corbin, Ky.	21	Sept. 24	7085	10	374½	101½	671
Jellico, Tenn.	31	Sept. 25	2204		99		
LaFollette, Tenn.	28.8	Sept. 28	2905				
Clinton, Tenn.	28	Sept. 29	30	10	240		800
Harriman, Tenn.	30	Oct. 1	3636	10	246	100½	300
Spring City, Tenn.	24.5	Oct. 2			100	175	
Sale Creek, Tenn.	24.6	Oct. 4	2605				
Chattanooga, Tenn.	28.4	Oct. 5	2500			148½	
Dalton, Ga.	37.3	Oct. 7	2400		395	151	
Calhoun, Ga.	20.1	Oct. 8	600				
Cartersville, Ga.	28.8	Oct. 9	3750				
Marietta, Ga.	21.5	Oct. 11	2135	½	27½		
Lakewood Park, Ga. (Atlanta)	25.8	Oct. 13	2935		499½	150½	400
McCollum, Ga.	26.7	Oct. 26					
Luthersville, Ga.	21.7	Oct. 27	2675		51		
Chipley, Ga.	26	Oct. 28	2800			50½	450
Columbus, Ga.	35.5	Oct. 29					
Camp Benning, Ga.	$10^{1}/_{10}$	Oct. 30					
Totals	623.1		44,945	30½	2735	1364½	4171

Due to the fact that the battalion was ordered to remain at Cartersville (Battery A only) and Lakewood Park (Atlanta) until the tractors had been overhauled and the county fairs taking place at those two points were over, the consumption of gasoline and other fuels up to those two points were taken into consideration in analyzing the question of fuel consumption per mile, while the consumption in Atlanta and at Cartersville was of necessity disregarded. The mileage obtained is discussed at a later place in this article.

ORGANIZATION OF THE BATTALION FOR THE MARCH

The organization of the battalion for the march was as follows:

Personnel.

Headquarters and Headquarters Detachment.
- Officers 2
- Enlisted 23

Battalion Supply Detachment.
- Officers 1
- Enlisted 14

Medical Detachment.
- Officers 1
- Enlisted 3

Battery A.
- Officers 2
- Enlisted 122

Battery B.
- Officers 2
- Enlisted 125

Battery C.
- Officers 2
- Enlisted 120

Matériel.

Headquarters, Headquarters Detachment and Medical Detachment.
- One Dodge Touring Car.
- Two White Reconnaissance Cars.
- One G.M.C. Hospital Ambulance.
- One 5-Ton Tractor, drawing reel cart.
- One Motor-cycle with side car (Indian).

Supply Detachment.
- Three F.W.D. 3-ton Trucks, with ammunition bodies.
- Two Liberty Tank Trucks (750 gallons capacity).
- One Artillery Repair Truck.
- One Motor-cycle with side car.

Batteries. (Totals for three batteries.)
- Three Dodge Touring Cars.

Six White Reconnaissance Cars.
Forty-two 5-Ton Tractors.
Three Artillery Supply Trucks.
Six F.W.D. 3-Ton Trucks, with ammunition bodies.
Three Dodge Light Repair Trucks.
Nine Motor-cycles with side cars (Indian).
Sixty Caissons.
Twelve Guns 75 mm., Model 1897 (French).
Six Personnel Trailers.
Three Machine Gun Trailers.
Three Rolling Kitchens.
Three 300-gallon Tank Trailers.

In addition to the above equipment each battery had a home-made water tank trailer, of about 200 gallon capacity.

DISTRIBUTION FOR THE MARCH

Due to the fact that it was known that the wheeled vehicles could not march in the same column with the tractors, the battalion was, for marches, divided into two columns. The leading column, which was known as the "Supply Column," was composed of all of the wheeled vehicles except the Battalion Commander's Dodge, three motor-cycles, the Dodge light repair trucks of the batteries, and the Hospital Ambulance. The Supply Column was under the command of the Battalion Supply Officer during the daily marches, who during part of the day had the Battalion Adjutant as an assistant in conducting the march.

The Supply Column was formed from front to rear as follows, the Supply Officer riding in the leading Dodge touring car and the Acting 1st Sergeant of the Supply Detachment in the motorcycle side car:

Three (Battery) Dodge Touring Cars. Cars in order of Batteries in Tractor Column.
One Battalion Headquarters Reconnaissance Car.
Six Battery Reconnaissance Cars. In order of Batteries in Tractor Column.
Two Battalion Headquarters F.W.D. Trucks.
Nine Battery F.W.D. Trucks. In order of Batteries in Tractor Column.
Three Artillery Supply Trucks. In order of Batteries in Tractor Column.
Three Supply Detachment F.W.D. Trucks.
One Artillery Repair Truck.
Two Liberty Tank Trucks. (Capacity, 750 gallons.)
One Motor-cycle with side car. (Acting 1st Sergeant.)

The Tractor Column was formed with the Battalion Commander's Dodge leading, followed by the three battery agents in motor-cycles.

The batteries were formed with the tractors in column and the Dodge light repair truck towed behind the last carriage, when it was not being used for repair work.

Each Battery Commander rode the leading tractor of his battery, while the Chiefs of Platoon rode motor-cycles, which were either towed, or else moved up and down the column, progressing by jumps.

The Hospital Ambulance was at the rear of the entire column, and would close on the Tractor Column, then halt and allow the column to gain sufficient distance to make it worth while for the ambulance to again move forward.

THE MARCH

As shown in the itinerary, the first march taken was from Camp Knox, Kentucky, to Boston, Kentucky. On this march the Tractor Column started as a whole and an attempt was made to keep the batteries closed up in column. It was soon seen that this method would have to be changed, as tractors which had to fall out for minor repairs, or adjustments, blocked the rear batteries, due to the fact that unlike horse-drawn vehicles which fall out of column, it was frequently impossible to move a stalled tractor to the side of the road. Another cause for stringing out the column was the necessity for halting the tractors in order to shift gears. The power of tractors in the batteries varied, and it was not until the Battery Commanders became familiar with the peculiarities of each of the tractors of their batteries that this trouble in the batteries was to a great extent obviated. The country over which the first march was made was hilly, and frequent shifting of gears soon resulted in the leading battery gaining ground, which could not be made up by the rear batteries during halts.

The Supply Column moved without difficulty until after the noon halt, when a heavy rain began, which lasted two hours and a half, turning the road into a sea of soft, slippery mud. The full supply of skid chains had not been obtainable at Camp Knox when the battalion left, though they were received at Boston the next day, and after the storm began it was frequently necessary for the drivers of the wheeled vehicles to dismount and assist the trucks in making the grades by pushing them by hand.

The camp site at Boston was in a meadow. The ground had become soft from the heavy rain, and as soon as the trucks from the Supply Column ran on it they began striking soft, deep mud concealed by the heavy grass. A number of trucks were bogged down before it was decided to give up the idea of having the trucks belonging to the various organizations go to the location of their camps. After this experience the Supply Column during the remainder

of the march was left on the road when the camp site was wet. When a rain came up after the battalion was in camp the trucks were moved to hard ground accessible to the road, or actually on the road itself.

During this march numerous difficulties were experienced with the tractors, both as a result of the inexperience of the drivers and as a result of faulty adjustments.

The diary of the march on this date contains the following remarks: Gas-lines frequently broke, due to the vibration. A fire was caused by a driver filling the left-rear, main tank of a tractor. Gasoline splashing on the kerosene tail lamp, located under this tank, became ignited, but fortunately did not do any serious damage. Only collapsible canvas buckets are issued for use in filling the tractor tanks. This causes wastage in filling and danger from splashing gasoline when night filling of the tanks is necessary.

Due to the number of minor repairs and adjustments which were necessary on the tractors, it was decided to lay over the 16th of September at Boston. A number of skid chains were received for the trucks during the 16th, though not an entire set for each truck.[1] During the remainder of the march a great many of these were lost. After they became worn they frequently slipped off in the deep mud and became buried; their loss not being discovered by the driver until he made his inspection of the truck at the next halt.

September 17th the battalion moved to Springfield, Kentucky, the Supply Column leaving camp five minutes before the Tractor Column, the latter moving as a unit. The roads were still slippery in places due to the rain of two days before, and the country was more hilly than that of the previous march, but the Supply Column trucks had little difficulty, the skid chains demonstrating their efficiency. Tractor troubles occurred, but not with the same frequency as during the first march, the adjustments made at Boston being responsible. Leaky gas-lines and gas-line connections were responsible for most of the delays on this march.

At Springfield the battalion wheeled vehicles and most of the tractors were forced to remain on the road—the only available camp site being too small for the entire battalion.

The third march, from Springfield to Danville, Kentucky, a distance

[1] This lack of proper skid chain equipment is very noticeable in the photographs of the trucks in the mud. Soon after starting the march the trucks were reduced to not more than two chains per wheel, instead of the full number eight per wheel which is the proper equipment for the truck, and this number was further reduced by losses as described until some of the trucks were practically helpless in mud. It is obvious that trucks operating under these conditions were at a great disadvantage and delayed the column more than they should have with full chain equipment.—EDITOR.

of twenty-eight miles, was over good roads most of the way. The country was hilly and the same trouble was experienced in having the column string out, due to having to stop the tractors when shifting gears.

The batteries left camp at ten minute intervals, and as a result no trouble was experienced by the "lame-duck" tractors of the leading batteries blocking the road for the batteries in rear. The interval of ten minutes between batteries was found to be too great, and after this march the interval was reduced to five minutes during the remainder of the march.

The column remained at Danville over Sunday, taking this opportunity to wash the vehicles, repair gas-lines and complete the installation of 3-inch boiler pipe to replace the mufflers in Battery B. Battery C had used this method of carrying the exhaust gases over the drivers' heads from the beginning of the march, and had no cases of the drivers being gassed—while a number of men in the other batteries had suffered from this.

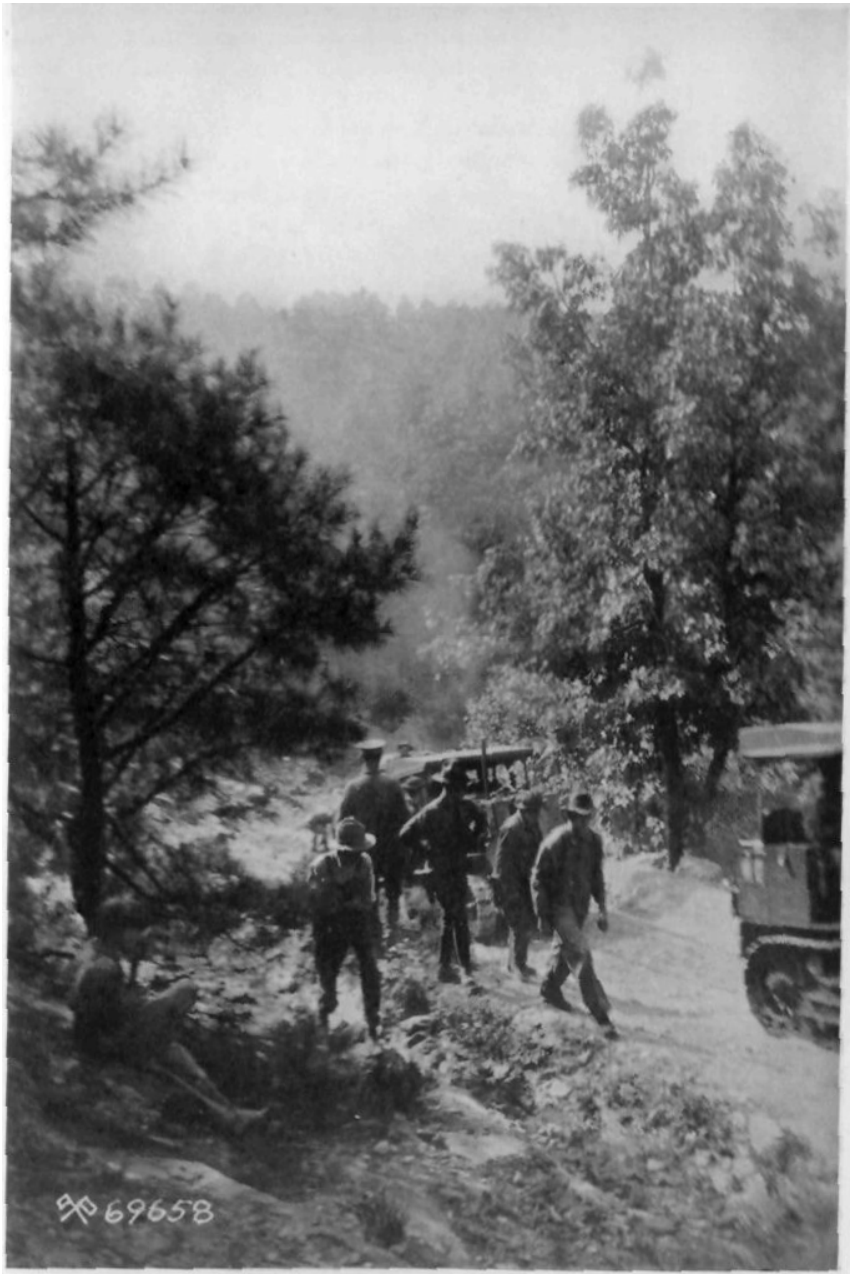
Battery B had tried turning the mufflers from a horizontal position to a vertical one, bolting them to the armor. This proved to be unsatisfactory, as the vibration soon broke the heavy mufflers. Battery A wired their mufflers in a vertical position. This also proved to be unsatisfactory, as the vibration soon worked the wire loose, and it was only by giving them constant attention that they were kept in place.

The boiler pipe that was installed to replace the mufflers was four feet long and three inches in diameter. It was flared at the lower end, the muffler was removed and the pipe slipped over the end of the exhaust. Though this make-shift change did not answer the purpose of a muffler, it was efficient in the prevention of gassing. Eventually, when the tractors of the entire battalion had their mufflers removed and the pipe substituted, no further cases of gassing of drivers occurred.

Monday, September 20th, saw the battalion on the road to Brodhead, Kentucky, with an interval of five minutes between the Supply Column and the leading battery and the same interval between batteries. This march was made with less road troubles than any march which had preceded it.

The road was rough in spots and grades up to about twelve per cent. were encountered. Though in general the thirty mile stretch was in better condition than we had found on our first two marches. Camp was made at Brodhead on the Fair Grounds. The battalion being in camp at 3.45 P.M. The camp site at this town was one of the best that the Battalion had during the entire march.

The march from Brodhead, Kentucky, to Livingston was a short



PHOTOGRAPH No. 1.—TRACTORS PULLING TRUCKS OVER VERY STEEP GRADE, ASCENT OF GAULEY OR WILDCAT MOUNTAIN, KY., "SCYLLA."

PHOTOGRAPH No. 2.—TRACTOR COLUMN CUTTING THROUGH FIELDS TO AVOID QUICKSAND. "CHARYBDIS."

one—eighteen miles. It was considered advisable for the battalion to reach the camp at Livingston at an early hour, in order that preparations could be completed before dark for the next day's march over Gauley, or Wildcat Mountain. This march was expected to be one of the most difficult of the entire trip. Reports had been received both from local inhabitants and as a result of a road reconnaissance made prior to the departure from Camp Knox, that the road over the mountain was narrow, very rough and in places exceedingly steep and dangerous. A number of people who had been over the road had stated that trucks would not be able to negotiate the grades—and the entire battalion knew that it was a question whether or not we could carry out our mission and reach East Bernstadt, fourteen miles away from Livingston, over this route, which was the only one at all passable for motor vehicles.

It was found that this stretch of road presented all types of obstacles which would ordinarily be used in a short test of the efficiency of a motor car. First came a stretch of sandy reddish loam, filled with boulders and rock ledges. A bridge with a weak flooring and somewhat uncertain supports required the vehicles to pass over it one at a time. This was followed by about a quarter of a mile of so-called road up a boulder-strewn creek bed.

A two hundred yard stretch of level, sandy road allowed the Supply Column to close up and halt. The tractors were unlimbered from the carriages and executed what was called "tractors pass trucks"—a movement which was necessary on a number of occasions when the Supply Column got into difficulties. The movement consisted of the tractors forming in the Supply Column, one tractor in front of each wheeled vehicle, being attached thereto by a tow chain.

The ascent of the mountain then began. The west side of the mountain presented a grade up to about twenty-five per cent, of some three hundred yards—followed by about one hundred yards of a grade of forty to forty-five per cent. The road was rocky and rough, and though most of the trucks required little assistance from the tractors, their motors proving of sufficient power to carry them up the grade, a number would have failed to reach the summit had they not had the steadying influence of the tractors.

The descent of the mountain was not as difficult as the ascent. The wheeled vehicles went down without the assistance of the tractors—braking with their engines—the ignition turned off—in addition to their brakes.

Hardly had this Scylla[2] been overcome—the battalion was over the mountain by 10.00 A.M.—then a Charybdis[3] in the shape of a

[2] See Photograph No. 1.
[3] See Photograph No. 2.

fifty-yard strip of quicksand made bad going for the wheeled vehicles. Tractors were again called into use. However, the road became so bad that the last battery in the tractor column was forced to make a detour through a soft meadow, where several trailers sank to their bodies.

The Supply Column had moved on, but soon struck a narrow muddy road, which caused more trouble—tractors were again necessary. Fortunately this bad stretch was a short one and all went well until the road ran up on a new fill on a mountain side, where six trucks sank deep into the soft earth and had to wait until the Tractor Column came up.

A ford, followed by a four-mile stretch of rough, though fairly level road, led into East Bernstadt.

Troubles, both mechanical and road, had been of great frequency. The rocky condition of the first part of the road was responsible for sheering off armor bolts; broken gas-lines and track links, and had caused several tanks to leak on the tractors.

A reconnaissance car had rushed the ford, gotten into deep water and cracked a cylinder block, and one F.W.D. truck had burned out its bearings.

The officers—there were but two per battery—and a few experienced mechanics had been hard at work since 4.45 A.M.—and when the majority of the vehicles reached camp at 6.45 P.M. it was decided to lay over a day for repairs.

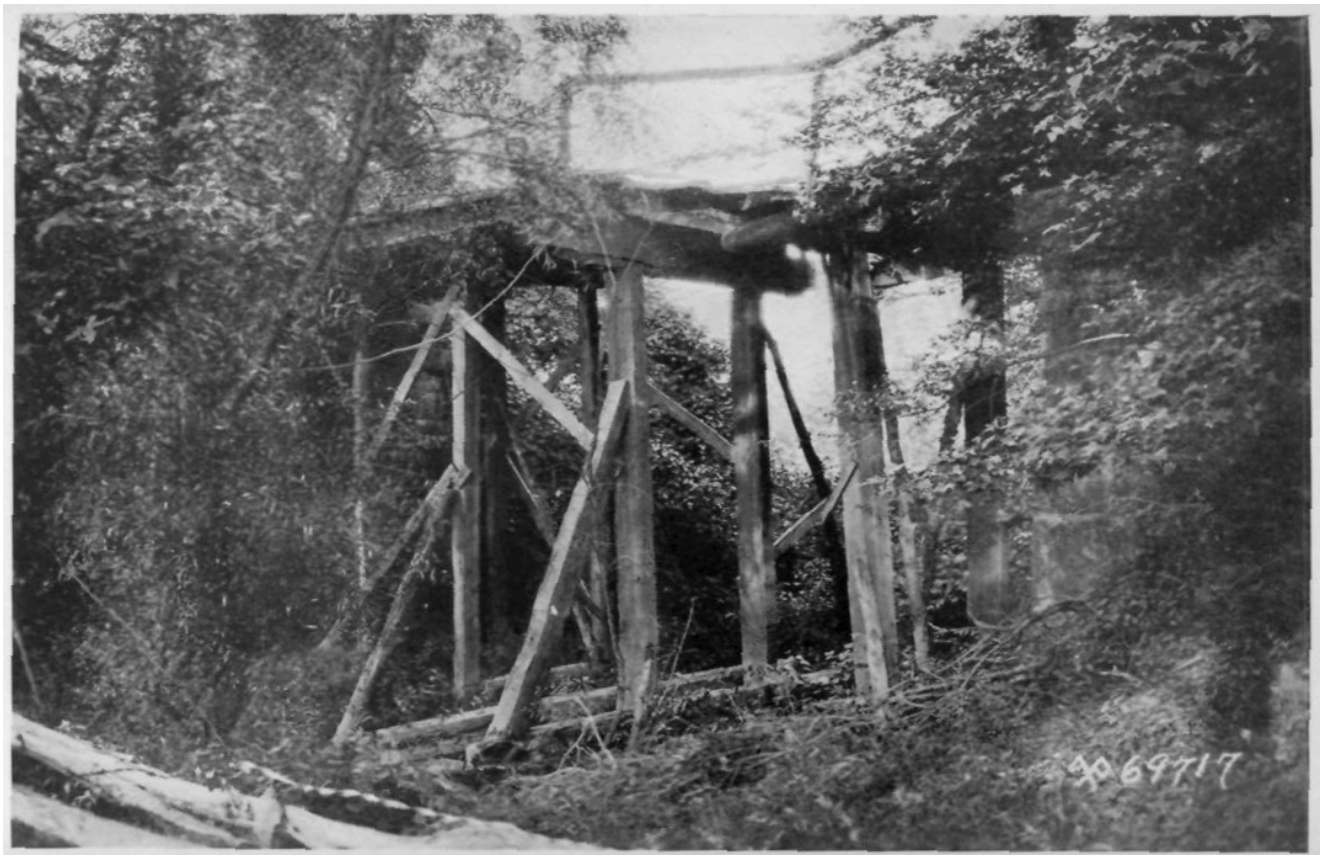
It rained during the night of September 23rd and for about two hours during the early morning of the 24th. This turned the already rough road from East Bernstadt to London, Kentucky—the next town—into a sea of mud. Five trucks slipped off the road within a mile of camp and delayed the column for about three-quarters of an hour.[4]

After negotiating the first stretch of bad road all went well until a weak, wooden bridge was reached. The Supply Column passed safely across, as did all of the tractors of the leading battery except the last. It broke the bridge at its far end, though fortunately made the solid ground without mishap.[5] A detour, which delayed the column over an hour had to be made—and camp was not reached by the Tractor Column until 3.00 P.M. The Supply Column had made the twenty-one miles by 12.30 P.M., arriving at Corbin, less one truck which was left at Bernstadt having its bearings renewed, and did not rejoin the column until the next morning.

Corbin to Jellico, Tennessee, proved easy going until the column reached a point about five miles from the latter town, where a three

[4] See Photograph No. 3.
[5] See Photograph No. 4.

PHOTOGRAPH No. 3.—TRUCKS STALLED FOR LACK OF CHAINS. VERY SLIPPERY CLAY ROAD. QUITE HIGHLY CROWNED.



PHOTOGRAPH No. 4.—HIGH BRIDGE BROKEN BY 5-TON TRACTOR. (TIMBERS ROTTED OUT.)

mile detour proved to be a veritable Waterloo[6] for the Supply Column. The road was nothing more than a mountain trail which became exceedingly slippery from a heavy rain which began to fall just as the leading trucks entered the detour. The road was so narrow that in many places it was impossible for the tractors to work their way past the column in order that they could render assistance to trucks which had gotten into difficulties.

Nightfall found the entire battalion, less three reconnaissance cars and one F.W.D. truck still on the detour. In the dark little could be accomplished, and it was decided to bivouac on the road and move into Jellico the next morning—September 26th.[7]

A tractor had turned over on September 25th and one man was badly bruised, though not seriously injured. It was impossible for him to jump clear of the tractor when it slipped from the road, a demonstration of the danger of present type of tractor top.

The supports of the tractor tops had already required considerable attention—a great many of them having sheared off as a result of vibration. The top was found to be entirely too heavy for the supports to withstand the strains to which they were subjected when travel was over rough country. The supports either broke, or sheared off the bolts which attached them to the body of the tractor. Welding the broken supports had been unsuccessful, as they soon broke at other points. At Jellico permission was granted to one of the batteries, in which a great deal of trouble with the tops had occurred, to ship them to Camp Benning.

When the accident occurred to the tractor in which the man was hurt, one of the personnel trailers was pulled from the road, upset, and broke a wheel bearing. Bearings from the machine gun trailer, rolling kitchen and three-hundred gallon tank trailer, were found unsuitable as a substitute. Local accessory dealers had nothing that would fit and the trailer had to be shipped by rail. The necessity for "one-type" wheels and bearings for all trailers was here clearly demonstrated.

The Headquarters tractor had leaky pistons, and an all night job was necessary to make repairs.

Armor bolts had sheared off and the number of broken gas-lines and leaking tanks had increased.

The nine-inch track shoes on tractors for which the eleven-inch shoe could not be obtained were showing signs of giving out. The under surfaces became concaved and cracks appeared at the link lugs.

The pounding of the main gas tanks on the wooden supports separated

[6] See Photograph No. 5.
[7] See Photograph No. 6.

them at the rolled flanges and though the cracks were soldered this was found to be impracticable, as they soon leaked at the points where they had been soldered. Later on, at Dalton, Georgia (October 4th), new wooden supports were installed, but in spite of this the tanks continued to give trouble during the entire march.

The door shield hinges on a number of tractors had been strained, due to the door being folded back on the top armor while the tractor was running. Though the door shields are arranged to allow the tractor to be run with them closed, heating of the engine is more liable to occur when this is done than when they are open and the need of a fastening on the top plate was seen.

The next march, to LaFollette, Tennessee, was made on September 28th. The diary of the march shows: Two and one-half miles of good, rock surfaced road, with grades up to about twelve per cent., followed by nine miles of narrow, rough and rocky mountain road (we were now in the Cumberland Mountains) with many steep grades, estimated up to about twenty per cent.[8]

After passing over this stretch, the road dropped into a valley, where it ran over a soft fill of reddish loam, which had become most undesirable for motor traffic, as a result of a hard rain which had fallen during the night of September 27-28th.[9] The trucks reached this stretch before noon, and it was well after 3 o'clock in the afternoon before the tractors succeeded in dragging them through the worst holes and had returned and pulled their own carriages to the hard road beyond. Here the road was rough and narrow with many grades.

Darkness fell soon after the Supply Column and the two leading batteries reached camp, while the last vehicles of the rear battery did not arrive until early morning.

About six miles from LaFollette a F.W.D. truck slipped from the road and rolled down the mountain side to a point where it was stopped by trees, about eighty feet below the road. It was towing a motor-cycle which also went over with the truck.

Though two men were on the truck and two on the motor-cycle all four succeeded in jumping clear when the vehicles left the road.

The motor-cycle was wrecked beyond repair; the truck was not irreparably damaged, though the injuries to it were of a nature which could not be repaired without shop facilities. It was towed to Fort Oglethorpe, Georgia, where it was shipped by rail.

Soon after the truck fell from the road one of the tractors of Battery "A" burned. Due to a broken emergency tank and failure of the vacuum feed system to function it had become necessary to

[8] See Photograph No. 7.
[9] See Photograph No. 8.

PHOTOGRAPH No. 5.—HEAVY GOING—SOUGH END OF DETOUR NEAR JELLICO, TENNESSEE.

PHOTOGRAPH No. 6.—MUDDY ROAD IN TENNESSEE.

place one of the main tanks on the top of the armor, connecting the 3-way valve to it in order to feed gasoline to the carburetor. The tractor had been driven some ten miles in this way when it caught fire and was damaged to such an extent that it had to be shipped from LaFollette to Camp Benning.

Battery "A" was left to camp at LaFollette on September 29th, in order to pull the truck which had gone over the mountain side back on the road and to ship the tractor which had burned. The battalion marched that day to Clinton, Tennessee, where a day's lay-over was to be made.

The Supply Column made the twenty-eight miles in five hours, the Tractor Column in seven hours and thirty-five minutes.

On this march one of the tractors of Battery "B" burnt out three main bearings, as a result of the failure of the oil leads to function properly. The work required to repair the damage which was done was of sufficient extent to make it necessary to ship the tractor.

The battalion was now getting out of the mountainous country, though numerous grades were still being encountered and the rough, rock-surfaced road continued to produce effect upon the fuel system and caused broken truck rollers, track links, etc.

Several stretches of soft loam road on this march would have caused exceedingly bad going for the trucks during wet weather and were even difficult for them with the weather favorable.

Battery "A" joined from LaFollette on September 30th, and the entire battalion marched to Harriman (30 miles) on October 1st.

The country was rolling and the rock-surfaced road in fair condition.

On this march Battery "A" again got into difficulties and a number of its tractors had not reached camp by 6.30 A.M. on October 2nd. The battery was left in camp at Harriman while the rest of the battalion marched to Spring City (25.4 miles) where it was to remain over Sunday. Battery "A" left Harriman at 10.30 A.M., October 2nd, and joined at Spring City that evening.

The march from Spring City to Sale Creek was made on October 4th without any occurrence worthy of note. The Supply Column covered the 24.6 miles at a rate of four and two-tenths miles per hour.

From Sale Creek to Chattanooga the road was in excellent condition, with the exception of a four-mile detour over a rough, unsurfaced country road. The Supply Column arrived in camp at 10.30 A.M.; the Tractor Column at 2.30 P.M.—Distance 28.4 miles.

The camp at Chattanooga was at the base of Signal Mountain, four miles north of the city. Here a one day's lay-over was again made to allow time for repairs to be made.

On October 7th the longest march of the trip was made—from

Chattanooga, Tennessee, to Dalton, Georgia, a distance of 37.3 miles.

Twelve miles of the road was asphalt, or cement, then came about thirteen miles of good macadam road; the remainder being rough, dirt country road. The country was rolling, but no difficult grades were encountered. However, by this time the tractors were giving a great deal of trouble, particularly the gas-lines, tracks, tanks and radiators, and after the first eighteen miles had been passed the "lame-ducks" which fell out from the batteries became more and more numerous.

The supply of spare parts, such as track links, track roller bearings, gas-lines and radiator sections had been exhausted, and the make-shift methods were found to be far from satisfactory. Main gas tanks which had been soldered were continually springing leaks, as the solder would crack from the vibration and pounding of the tank on its support.

By this period of the march the use of oil lamps on the tractors had to a large degree been done away with. Tractors which were brought into camp at night were usually convoyed by motor-cycles.

The upper bolt which secures the oil lamp brackets to the armor of the tractor was responsible for many leaks in radiator sections—the vibration of the armor causing it to chafe a hole in the side of the radiator. Other radiator troubles were caused through the construction of the upper and lower headers of the radiator to receive the overflow pipe. This construction weakened the headers and caused several to crack at these points.

The inaccessibility of the engine of the tractor added greatly to the troubles experienced. Repairs which could otherwise have been made in a few minutes were as a result of this condition, the cause of much lost time and labor.

Between Dalton, Georgia, and Calhoun, Georgia—the battalion made this march on October 8th, the road was rock surfaced, though rough. About five miles from the latter town one of the Liberty Tank Trucks, which was with the Supply Column, broke through a bridge—necessitating a seven mile detour for the Tractor Column over a narrow and exceedingly rough country road.

Battery "A" again had a great deal of tractor trouble on this march, and at 6.30 A.M., October 9th, but five tractors of the twelve still remaining in that battery had reached camp. A day's lay-over was to be made at Cartersville, Georgia, the next halt. The battalion less Battery "A" moved there on October 9th—Battery "A" being ordered to join the following day.

The Artillery Truck was left at Calhoun, to be available for repairs on the tractors of Battery "A."

The battery left Calhoun on October 10th—all tractors reaching

PHOTOGRAPH No. 7.—IN THE CUMBERLAND MOUNTAINS.

PHOTOGRAPH No. 8.—HEAVY GOING—NEW FILL OF WET CLAY.

Cartersville about noon on October 11th—where orders were received for it to remain for overhauling its matériel and giving demonstrations at the County Fair, which was taking place at Cartersville at this time.

The battalion—less Battery "A"—marched to Marietta, Georgia, on October 11th—21.5 miles—and to Lakewood Park (Atlanta), on October 13th—25.8 miles—where it remained until October 26, overhauling matériel at Lakewood Park and in the M.T.C. shops at Camp Jesup, and giving demonstrations at the Southeastern Fair which was then taking place.

Battery "A" joined from Cartersville on October 25th and marched with the battalion to McCollum, Georgia—26.7 miles—the following day.

The tractors had now become so worn from the rough country that had been traversed that the overhauling which they had received did not produce the results expected. One of the tractors burnt out its connecting rod bearings within a short distance of camp and was returned to Camp Jesup for shipment by rail, and later on during the march, at Greenville, Georgia, more trouble was experienced.

The battalion marched from McCollum to Luthersville on October 27th—21.7 miles—over a rough, rock surfaced road—which had about seven miles of good concrete road near the town of Newnan. By this time the gas-lines were almost entirely replaced by rubber tubing, the gas tanks had been as thoroughly repaired as conditions would permit, and all defective track shoes which could be replaced by the limited supply available at Camp Jesup had been changed.

Battery A had completely overhauled at Cartersville and had replaced all broken and badly worn parts to the extent that an incomplete supply of spare parts allowed.

A twenty-six mile march, from Luthersville, Georgia, to Chipley, Georgia, was made on October 28th.

Three tractors from Battery A became unserviceable on this march—one from a blown out crank case and two from burnt out bearings. One tractor of Battery B also had its bearings burnt out.

The road was in fair condition, through rolling country, and the breaking down of so many tractors was—taking into consideration the fact that they had been recently overhauled—a clear indication that the tractors had become so badly worn that the installation of more spare parts than had been available—and the complete overhauling in properly appointed shops—was necessary.

On October 29th, the column marched from Chipley, Georgia, to Columbus, Georgia (35.5 miles), and the following day completed the last ten miles of the march into Camp Benning.

FUEL CONSUMPTION

The record of fuel consumption for the march indicated that a total of 44,457 gallons of gasoline, 1358 gallons of transmission oil, 4175 pounds of cup grease and 3055½ gallons of lubricating oil was consumed during the entire period that the battalion was en route.

In making an analysis to determine the fuel consumption per mile, it was found that during the first 232 miles the 88 motor vehicles of the battalion consumed an average of 62.8 gallons of gasoline per mile. During the next 100 miles 86 vehicles (2 tractors had been shipped) used an average of 62.7 gallons of gasoline per mile. The next 123 miles the remaining 85 vehicles (one tractor had been lost) 61.2 gallons of gasoline were used.

The transmission oil consumed per mile averaged 2.6 gallons, while 5.5 gallons of engine oil were used.

CONCLUSIONS

It is believed that at least forty per cent. of the tractor troubles were caused by the inexperience of the personnel. The average experience of the tractor drivers was not over two months, and they knew too little of the adjustments and repairs that every driver should be able to do on the road without the assistance of any of the battery mechanics.

The mechanics themselves, though they were at work continuously from the time the battalion left Camp Knox until it reached Camp Benning, were with a very few exceptions too inexperienced to make any but minor repairs to the tractors. The mechanics who were competent to handle the more complicated repairs and make the difficult adjustments were swamped with work, and though the officers did the work of mechanics during the entire march, it was frequently necessary for both the mechanics and officers to work all night on the road, or in camp, in order to keep the motor matériel in running condition.

The tractor drivers and assistant tractor drivers should be thoroughly instructed in carburetor adjustment, clutch adjustment, and should be so familiar with the sound of their motors, when running properly, that they can at once detect the slightest knock in their engine, or discover immediately when the tractor is losing power. If the trouble is one that they cannot handle themselves it should be turned over to the battery mechanics—who will, on long marches, be able to properly handle only the more difficult work.

On the march of this battalion—especially that part of it when there were but two officers per battery—both the officers and mechanics were so occupied in working on the tractors that required immediate attention that they were not able to properly perform, in

addition, the repairs and adjustments which could have been made by experienced drivers. The drivers though anxious to keep their tractors in shape, were too inexperienced to do the work themselves, and many of the repairs and replacements made at the longer halts would have been avoided had the drivers been more thoroughly instructed.

The fuel system of the present five-ton tractor proved to be unsatisfactory. The gas-lines could not stand the vibration, the tanks—both main and emergency—gave a great deal of trouble, the gas-line connections frequently leaked and the 3-way valve was found to be a constant source of trouble.

The position of the emergency gas tank directly over the magneto was found to be dangerous, for when it leaked gasoline it was liable to fall on the magneto and cause a fire.

The mufflers were soon done away with, as their location was such that the exhaust fumes were carried back in the driver's face, causing asphyxiation.

The heavy armor was responsible for a great deal of trouble. It sheared off bolts, broke radiator sections, made the engine inaccessible, and the weight that it added to the tractor was greatly responsible for the breaking of many rollers and roller bearings.

The tractor tools might be improved upon—many of them were broken or became so badly twisted that they were unserviceable.

The trucks and other motor vehicles stood the test exceptionally well, as did the artillery matériel proper. The "Indian" motorcycles were practically worn out when they arrived at Benning—though it must be admitted that they stood the test better than had been expected.

Above all it was shown that an attempt should be made to standardize as far as practicable all parts which are required on motor matériel, in order that they may be purchased locally when the supply with an organization becomes exhausted.

The tractor in its present state of development is not perfect—by a large margin—for use on such a march as taken by this battalion; but it is believed that many of the defects discovered during the march can, and will, be corrected—and the tractors which will soon be issued to motorized organizations will be far superior to the model which was used on this march.

ARTILLERY AND INFANTRY

BY MAJOR WILLIAM E. BURR, FIELD ARTILLERY, U.S. ARMY

THERE seems to be a total lack of effort to benefit from the lessons of the war with respect to the dependence of artillery and infantry upon each other. The experience we gained appears to be going to waste.

The importance of this matter can hardly be overestimated. Artillery exists, primarily, for the support of the infantry. Its most important duties are bound up inseparably with that arm.

Examine the present situation. We are teaching the artillery officer his artillery duties, and the infantry officer the duties of his arm, but are we teaching the relationship between the two? Are we putting into practice what must be admitted to be theoretically correct? Are not the two arms proceeding along absolutely independent lines? To resort to a simile, a football team is usually successful because it is trained and practiced together. A coach does not train his backs independently from his linesmen. The Great War proved, as any war will, that an army, after all, is fundamentally a great team, whose different arms must play together. Why, then, allow two of its most important members to practice apart?

The object sought is the support of the infantry. In this discussion we will take it for granted that every officer knows the theory and practice of his own arm. Assuming such, "The Principles of Infantry Support," that is, the principles which provide for the essembling of the artillery and infantry as a team, and their continuation as such, can be enumerated as follows:

1. The comprehension, by artillery, of infantry organization, tactics and missions.

2. The comprehension, by the infantry, of the power and limitations of artillery.

The coördination of the two arms.

We shall now examine the necessity for these principles. Can an artillery commander, acting, concertedly or independently, with an infantry unit, render the maximum support if he is ignorant of the composition of the infantry company, battalion or regiment; if he does not understand the methods by which infantry attacks; or, finally, if he does not know what are infantry missions, and how they are gained? Likewise, the infantry officer, to achieve his object most efficiently, must understand the capabilities of the artillery supporting him. Its mobility, maximum ranges, rates of fire, kinds of ammunition and many other like subjects, are all matters of vital

importance to him. The artillery is the most powerful weapon of the infantry. Ignorance of its ability, as well as its limitations, would seem to be criminal carelessness.

The first two principles depend upon the third for their practical effectiveness. The coördination of this mutual knowledge and ability forms the keystone for the whole structure. Artillery and infantry can be coördinated without proper training, as they have been in the past, but unless this coördination is intelligent, waste of troops will occur. It is evident that, in this particular matter, without mutual understanding, no coördination can be intelligent.

However, principles are worth nothing unless they can be applied. It is the practice of the above principles that concerns the artillery and the infantry. To insure and provide for such, the policy of combined training must be adopted. Through no argument can it be deduced that satisfactory results might be achieved in the classroom. The contact between the two arms must be made and maintained.

Adopting this as our prime assumption for the practice of "The Principles of Infantry Support," we secure therefrom, first, a mechanical perfection of operation; second, an increase of morale and esprit in each arm, and third, a relationship between the two arms which service for a common purpose alone brings. These last two results born from the first, becomes eventually the most important.

Combined training means more than combined organization. We have the latter, to some extent, in our present divisions, but we are not securing combined training. It is necessary that the instruction of the artillery and infantry be fitted in with each other. Ideas and officers must be exchanged, theories discussed and weapons explained. This can be accomplished by the maintenance of our present divisional organization, and by the training of such organizations as divisions by frequent divisional exercises.

For the comprehension by the artillery of infantry organization, tactics and missions, it becomes necessary that every artillery officer, after receiving the fundamentals of his own arm, serve with an infantry company, battalion and regiment. There he would learn not only the infantry organization, but the practical use of that organization as applied to infantry tactics. For example, he would learn how an attack formation is made, the division into waves and reserves, the speed with which an attack can be made, the depth of penetration possible, etc. Following this would come the specific understanding of infantry missions, such as the attack of machine-gun nests, frontal attacks, flanking operations, the theory of infiltration, and many other definite infantry tasks. Their proper solution requires the correct application of the principles of organization and tactics.

It can not be denied that the average artillery officer of today not only does not possess this necessary training or knowledge, but fails even to see the necessity for acquiring it. Imagine a situation where, for instance, such an officer was compelled to support, directly, a typical infantry operation, such as a forced crossing of a river. Doubtless a creditable operation could be carried through, if sufficient time was available for lengthy discussions and planning. However, war waits for no one. Again, consider the pursuit of a retreating enemy. Would the average artillery battalion commander of today know how to support an infantry advance guard? Would not his difficulties arise from the fact that, taking for granted his liaison was good, he would be ignorant of the conduct of an advance guard? And yet, in France, this specific type of operation appeared without warning, and our artillery battalion commanders were forced to learn their rôles in action. That they succeeded at all is noteworthy, but such a system of imparting knowledge can hardly be called efficient.

The above examples are typical, and taken from the recent war. They could be repeated endlessly. If we would endeavor, to use a trite old phrase, to profit from our past experiences, our problems both present and future would be simpler. It will not be long before the present generation of officers, the one which should have learned its lesson, will be gone and we shall be forced to resort again to theory or, what is worse, blank indifference. A remarkable opportunity is offered now to any capable military critic who will point out in a constructive manner our errors, and methods by which to avoid them in the future. It is the writer's endeavor to impress upon the reader one particular error that we are falling into, and to present one remedy therefor.

Let us turn now to the "Practice" of the second principle, that is, the comprehension by the infantry of the power and limitations of artillery. Remember that it is assumed that every officer is familiar with the attributes of his own arm. For this reason we are omitting the subject of the artillery education of the artillery officer.

But the necessity for the comprehension of such things by infantry officers is not understood thoroughly at present. The infantry, however, is somewhat in advance of the artillery. The infantry school at Benning is teaching the junior infantry officer many things about artillery that he should know. But the units handled are small, nothing larger than a battalion of artillery, and our operations and problems in the future will be undoubtedly of larger scope. Furthermore our infantry field officers and regimental, brigade and division commanders are being sadly neglected. The junior infantry officer should be detailed to serve with artillery batteries, battalions

and regiments during a period of combined training. The first principle that should be inculcated is that there are limits to the fire of artillery. He should be instructed painstakingly in the methods of conducting fire, both direct and indirect. There are yet infantry officers of high rank in the service who do not understand that indirect fire is as efficient as direct. Infantry commanders have been known to order well masked batteries into direct fire positions, in order, as they thought, to secure better results on the target. Do the young officers now joining the infantry appreciate that there is something further required to destroy a target besides putting the shell in the breech and firing the gun? Can they be expected to assimilate them out of the thin air?

The principles of the selection and occupation of artillery positions should be known and appreciated. The system of artillery communications should be dwelt upon. The maximum and minimum ranges must be understood. Too often has an officer failed to understand why a target within the maximum range can not be reached. The duties and limits of the different calibres must be mastered. A 155-mm. howitzer is not the most effective sniping weapon.

Other subjects, essentially artillery, such as the vulnerability of artillery on the march, in the open, or while assaulted; the respective values of shell, shrapnel, gas and smoke ammunition; the endurance and rates of fire of field artillery guns and the importance of ammunition supply, all of these must be made clear and a matter of common knowledge.

The junior infantry officer that is uninstructed in such things as these can hardly be blamed for failing to make the best use of any artillery that may happen to be at his disposal. A good artillery liaison officer might make up for such a deficiency, but conditions might prevent the detail of a good one; or again, even though having one, a bullet might remove him suddenly. Many situations can be called to mind where the lack of the above knowledge might double the casualties of a command. For instance, would an officer well informed on these subjects, expect one battery to protect a front of one thousand metres with a DENSE BARRAGE?

It goes without saying that the senior infantry officers should be familiar with the same subjects. At present, thanks to the war, many know and appreciate them, but no opportunity is being given them for brushing up occasionally. Time will dull even the most vivid experiences. And, for those senior officers who did not come in contact with these matters, absolutely nothing practical is being done. Here again, our divisional organization would furnish an invaluable practical school if administration were subordinated to combat training.

It is admitted that many of these strictly artillery matters might be taught in the classroom, but it is not believed that their importance and practical value could be brough home to the infantry officer unless he serves with artillery units in combined training, where he could see, appreciate and undergo the demands made upon artillery by infantry in action. Of course, the ideal system, arranged for efficiency alone, would be to give such instruction during real campaigns. But, instruction wars are hardly permissible at present.

By practicing our first two principles, we prepare ourselves for the practice of the third, namely, "The Coördination of the Two Arms." Like the members of a football team, having perfected ourselves in the playing of our own positions, we are now ready to bend our energies to the acquisition of some teamwork. A good team never consists of members who can not play their own positions. Also, it must be something more than a collection of individual stars.

With the knowledge gained by service in both arms, all that is necessary now for the infantry and artillery is to practice teamwork. For this the one solution is combined training. Football teams are not turned out by correspondence schools. It is as foolish to imagine that artillery and infantry can be coördinated by general orders and instruction pamphlets.

The fundamental theory of this teamwork includes, first, an appreciation and understanding of the duties of the team as a whole; second, a spirit of coöperation, and third, an ability to put this spirit of coöperation into practical results. Much theory can be taught, but unless this fundamental theory becomes a matter of instinct the results will be meagre.

The practical results to be sought may be divided into the following.

1. The proper distribution and education of the liaison personnel.
2. Unity of preparation and execution of orders.
3. Mutual confidence.

If these three results can be attained, with respect to the coördination of the two arms our major difficulties in the future will be technical and not fundamental.

Taking them up somewhat in detail, the liaison question will be touched upon first. It may be compared to the nerve system of the human body. Suppose the hand touches a hot stove. The nerves affected signal the brain and the brain causes the proper muscles to remove the hand from danger. In the same manner, an infantry command is attacked. The artillery liaison system signals to the proper artillery headquarters, and the available artillery gives the necessary relief. If the nerves, brain or other affected parts of the

body are deceased or otherwise disabled, the part touching the stove will undoubtedly suffer more severely. And so, if the liaison system does not function properly, through lack of training, efficiency, or through other causes, just so much the more will the infantry suffer.

The key to the whole system is the artillery officer acting as liaison officer with the infantry. He must be thoroughly trained in the execution of his duty. He is responsible for the proper emergency support of the infantry with which he is detailed, for the transmission of artillery information to the infantry and vice versa, and, finally, in a large measure for the maintenance of mutual esteem and esprit between the two arms. The teamwork, which is developed by combined teaching, can never be secured by the separate theoretical training of the two arms. A liaison officer to know his business must practice it. A liaison system to function efficiently when needed must be put in working order and kept going. As a rule, theoretical systems never prove a success when applied to actual warfare. Ability to meet situations with prompt solutions is the requirement sought. Such a requirement is the foundation of the liaison system, and particularly of the liaison officer. Such ability is at its maximum efficiency when the constant opportunity to practice same is afforded.

The last and most important point regarding liaison, with respect to the coördination of the two arms, is the esprit developed. Infantry units become accustomed to their own artillery and vice versa. The officers of the two arms know each other, they understand each other's methods, and they put a feeling of personal relationship to each other into their combined duties, which to troops thrown together for the first time is entirely lacking. From such things springs that indefinable something called esprit. Infantry units were known during the war to insist upon the support of their own divisional artillery alone, and to regard the support of other artillery as of dubious value. With such esprit as this within a division there is no limit to the fighting value of that division. Esprit can not be produced by orders or theoretical training. Association in the face of difficulties, hardships and dangers brings it. To achieve it in peace time, we must have combined training.

A matter such as unity in the preparation and execution of orders seems too important to ever be neglected. In reality with respect to artillery and infantry, total ignorance of such a principle, as a rule, was shown by many commanders upon their initiation on the front. Division and other infantry commanders, at the beginning, were unacquainted with the results attainable by artillery, the time required to secure its support, and the limits to which it could be driven. Artillery commanders were ignorant of the methods of coördinating

their commands for infantry support. They did not realize, or know how to deliver for the benefit of the infantry, the power that they controlled. Frontal attacks were delivered by infantry in the open and were practically unsupported by artillery. The losses were resultingly severe, the reason being that the commander ordering the attack did not know how to coördinate his infantry and artillery.

What we must have is an exchange of ideas and information between the artillery and infantry before an operation is ordered. If time prevents such, then the commander issuing operation orders must fall back upon the knowledge gained by the application of our first two principles. Successful modern fighting is anything but haphazard. The plans for the artillery support of an operation can not be worked out independently from the infantry plan. The two must fit exactly with each other, the time element alone requiring coördination. As for the unity of the execution of orders, certainly, if we are taught the necessity of unity in preparation, we shall not disregard the principle of unity when it comes to their execution.

Experience taught these things to many of us, but it was a costly lesson. Every division that served on the front learned its own lesson. It is believed that in the event of another war, we will save many lives if we practice a little now.

Mutual confidence, to put it simply, is only another name for esprit. As we have pointed out, it comes from common association in times of stress. Too often in France our infantry and artillery abused each other for various reasons. Short firing, lack of information, poor coöperation, indefinite orders, these were the type of complaints. They all came, more or less, from one source, lack of confidence in each other. Different arms of the service, unaccustomed to serving with each other, are prone to blame each other if combined actions go wrong. On the other hand, for instance, assaulting infantry will advance with more firmness and hold with more strength when counter-attacked, if they have absolute confidence in their artillery. Likewise, the artillery will push up more closely and quickly, if it feels confident of its infantry's protection and success. But if we isolate the artillery from the infantry, exclusiveness instead of confidence is developed.

The practical solution of this problem rests within our divisions. Sufficient terrain, men and time are necessary. The exchange of officers between the two arms would be simple, and would entail no expense. The elements of the division being constantly together, the field manœuvres of the combined arms would inculcate, in addition to the required mechanical perfection, that feeling of teamwork and mutual confidence which has been shown to be of such importance.

It is a sad commentary that often our divisions, now, and while training for service in France, were handled solely as administrative units. Furthermore the terrain available at present to some divisions is not of sufficient size. However, this obstacle can be met very easily by putting the divisions on the march. It is doubted whether many divisions could conduct even a proper divisional march at present.

But we need a change of principle more than anything else. Let us make administration secondary to fighting ability. Let us require the different parts of the division to function together as in combat. Let us not place ourselves in the position of the famous chief of the Quartermaster Corps who complained that the Spanish War threw his corps into complete confusion just as he was getting it going nicely. Now that we have finally achieved divisional organization logic dictates that we make some use of it.

Before concluding let us consolidate the ideas that have been discussed.

1. The general principle of combined training must be adopted.
2. This broad general principle must be expanded in three directions:
   a. The instruction of the infantry in the power and limitations of the artillery.
   b. The comprehension by the artillery of infantry organization, tactics and missions.
   c. The coördination of the two arms.

It is understood and regretted that conditions in the army at present forbid the proper exploitation of these ideas. What we must do is to spread the gospel, as it were and to make the best of what we have. The infantry school has made a start, but it is believed that the school idea is fundamentally wrong. The soul of the idea is the esprit between the two arms. The association of units and individuals is the only thing which will produce it.

However, until conditions arrive which will provide the constant opportunity for this association, it is thought that there should be an exchange of junior and senior officers in the field training period. Let us neglect the specializing of the individual arms a bit, and make a common effort to get the team together.

Specifically, for the artillery, let us send regularly our officers to the infantry for the manœuvre period: the juniors to learn the problems and fighting methods of the lesser infantry units, and the seniors to learn the same of the larger units. Let us ask the infantry to reciprocate in like manner. Let us miss no opportunity of associating and manœuvring our units with the infantry in field problems of all descriptions. Let us divert some of the money poured into experimentation

towards the proper use of what we have. Let us adopt this principle of combined training and thus prove our reason to exist.

The war enlightened many of us, but the method of enligthenment was too often by the useless sacrifice of life. A general would find a battery on the march and order it to fire a barrage of five thousand rounds to protect his front. Infantry would attack through their own barrage, or not know how to follow it. Artillery would fire into the infanry, as a result of poor liaison or misinformation. Advances would be unsupported by artillery due to insufficient time allowed the artillery for preparation. Attacks would be ordered when it would be physically impossible for the artillery to reach the positions assigned.

These errors are not offered in a spirit of criticism, but only to indicate a reason for adopting a new course in the future. They were not the only errors committed. Each arm made mistakes due to technical inefficiency or other reasons. But the types of errors indicated above were due primarily to lack of combined training. Experience in war eliminated them. Why not practice now and have that much eliminated before the next emergency arrives. And if through the force of circumstances, we are not able to train ourselves as experience proves that we should, let us at least make the effort, adopt the principle and set our feet in the right direction.

DEFENSIVE EMPLOYMENT OF THE FRENCH ARTILLERY IN 1918

The Artillery of the 21st Corps in the Battle of the 15th of July

BY J. GOUBARD, CHEF D'ESCADRON D'ARTILLERIE

TRANSLATED FROM AN ARTICLE IN THE REVUE D'ARTILLERIE OF AUGUST, 1921, BY CAPTAIN PAUL C. HARPER, 18th F. A.

OUR modern doctrine of the employment of artillery in the defensive was born at Verdun.

Until 1916 the French artillery had been able to test its defensive methods only in battles where the number of guns used by the enemy was much smaller than that which he put into action at Verdun. On the contrary, from February to July of 1916, we found ourselves at grips with a mass of artillery so numerous and powerful that our artillery had great difficulty in accomplishing its mission. After overcoming these difficulties, however, the experience at Verdun was so instructive that we were able to formulate with precision a doctrine which was modified but very little till the end of the war. The information gained at such a cost was compiled in the Instructions issued by the Commanding General of the central group of armies May 27, 1916, under the title: "Employment of Artillery in the Defensive."

This document prescribed two methods of action for the artillery during the periods of combat:

Barrage fire, still considered well adapted for stopping hostile attack.

But above all the Offensive counter-preparation which, by breaking up the attack before it could get under way, became the most important method.

It was by following these principles that the French artillery developed its action in the course of the defensive operations of 1916 and 1917. It is these principles that are found at the base of the doctrine for the employment of artillery in the Instructions of December 20, 1917, on the defensive action of large units. It is these principles which, with some minor changes, were followed in the great battles of the spring of 1918. The fact that adhering to them almost literally finally enabled us to gain an unquestioned victory on the defensive justifies their use beyond question.

No one denies that the numerical superiority of the Germans and the secrecy with which they prepared their operations were large

factors in their successes of March and May, 1918. The extent of this success is surprising, nevertheless, in the face of an artillery which, having become the most important weapon in the modern defensive battle, was using methods especially adapted to the conditions of the struggle.

It is also possible that one additional reason for our reverses was the lack of harmony which existed early in 1918 between the mission assigned to the artillery and the manner in which the defense of the front was handled.

The judicious use of the artillery on the defensive calls for the existence of a deep zone of terrain situated on this side of the enemy front line and in front of the mass of our artillery. Although barrage fire is not entirely condemned it is incontestable that it has failed every time when, in an important action, it has been executed on a rigid line. Experience has proved that, however great its power, the artillery is never certain of stopping the enemy on a particular line. It is only by successively decimating the attacking troops by a series of bounds of fire that the artillery can hope to halt the attack. Moreover it is prescribed that the artillery be in readiness to put its fire back in order to cover the ground where the enemy will have come into the open.

But has the artillery the margin necessary for this effect? Without doubt the Instructions of December 20, 1917, prescribe that the high command defines the position on which resistance is to be offered, but it also adds that in the presence of a very powerful attack the high command may decide to accept battle only on the second position. Does not such precision influence a commander to consider this last solution as an exceptional extreme? We must admit, moreover, that at the time this rule was in force the French army considered only very reluctantly the eventuality of abandoning the front line, and that, for many officers, the holding of this position constituted a doctrine almost as firm as that of the national frontier.

There is therefore a contradiction—not in the letter of the instructions of the high command, but in the customs and practice of the battlefield—between the method of action prescribed for the artillery and the controlling idea of the defensive battle.

It was necessary to go through the first two great defensive battles of 1918 to convince everybody, and particularly the subordinate commanders, of the inefficiency of such methods. When, under weight of a powerful attack, the first position is almost fatally submerged, however great the density of its occupation, would it not be better to evacuate it in the first place, as soon as the imminence of the attack is determined, and establish the resistance on a position which

has every chance of remaining intact up to the moment that the enemy infantry is in position to attack it?

It is this point that was clarified so thoroughly in the instructions which G. H. Q. issued to the armies in June, 1918, and as a result there was no further doubt as to the manner in which to conduct a defensive battle. These instructions amplified those of December 20, 1917, by specifiying the conditions of the deployment, the echeloning and the concealment of the distribution of the artillery.

THE BATTLE OF JULY 15, 1918, IN THE CHAMPAGNE

From these two points of view: the form of the battle, the action of the artillery, the instructions of G. H. Q. were applied in spirit and in letter by the commanding general of the Fourth Army when he learned at the

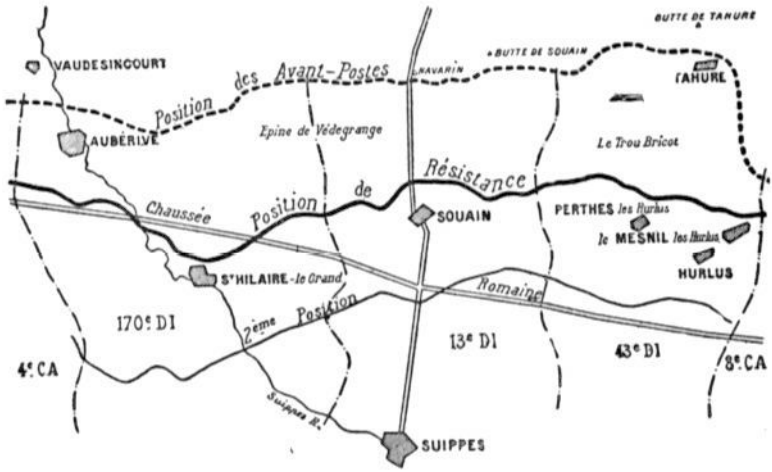


Fig. *a*. — Dispositif du 21e C. A. (Échelle : 1/2000000e environ.)

beginning of July of the German attack, the brunt of which he was to bear.

The decision of the commanding general of the army to almost entirely evacuate the ground to a depth of several kilometres has already been quoted many times as an example. The chief advantage of this decision, which was the principal cause of our victory of July 15, was that the dispositions were so made as to permit the artillery to exploit in full its qualities of manœuvre. The sudden appearance of our artillery reinforcements and the methodical execution of our successive systems of fire were the essential causes of our success. The object of the present study is to show how the handling of the artillery was planned and executed in one of the corps of the Fourth Army.

Situation.—The Twenty-first Corps had held, since the 21st of

June, the front of twenty kilometres between Suippes-d'Auberive and the Butte de Mesnil (Fig. a). The enemy was extraordinarily quiet. The three German divisions, 228th, 30th and 7th Reserve, of von Einem's army, which faced the 21st Corps, made no raids; the enemy aviation was almost entirely inactive. Our aerial photographs showed, however, quite important preparations in the region of Tahure and the Butte de Mesnil after June 29; suspicious camouflage and numerous gun emplacements near the front lines. On the 2nd of July positive information was received that the attack would take place between the 6th and the 9th, but its extent was not exactly known. The 21st Corps then received reinforcements, the American 42nd Division, then the 46th Division (French) and a number of batteries.

Occupation of the Terrain.—The general commanding the Fourth Army decided to take as a position of resistance the intermediate position, situated at a distance of three to four kilometres from the front lines. This position was to be occupied by almost all of his troops. In front in the first position, which had become the line of advance posts, there was only a company and a half per regimental sub-sector, as follows: one-half company in the parallel of redoubts—the platoons of this half company detaching combat groups in the support parallel who were to furnish look-outs whose duty was to report when the enemy had crossed our front line; when this mission of observation was accomplished these combat groups could fall back on the parallel of redoubts; one company in the centres of resistance situated between the position of resistance and the first position—this company was to establish a relay of signals and to form a wedge to break up the assault waves, making them lose their rolling barrage and herding them into lanes swept by our artillery. The elements in the parallel of redoubts and the centres of resistance were to hold their ground and resist to the end. Behind the position of resistance the 42nd American Division and the 46th Division were established on the second position, which constituted the reserve position.

Placing of the Artillery.—The artillery was deeply echeloned. All the batteries, except a few foot batteries which were not mobile, were brought back behind the position of resistance. Even an important part of the reinforcing artillery was placed at the disposal of the corps only with the reservation that it should be placed so as to take part under satisfactory conditions in the defense of the second position. As a result this artillery, at least the field pieces, could not participate in the counter-preparation, but it could contribute fully to the defense of the position of resistance.

The greatest precautions were taken to conceal from the enemy

this reinforcement; occupation at night, camouflage before any work began, no circulation during the day around the positions. None of the reinforcing batteries were allowed to open fire before the general attack; but their fire was prepared topographically and ballistically with the greatest care; most of them were installed in the open fields in emplacements which had simply been staked out, a few only taking possession of unfinished emplacements which had never been occupied. Finally, the batteries obliged to execute the daily firing were ordered to do so from emplacements other than their combat emplacements.

The greatest attention was paid to the choice of munitions (shells and fuses) to be consumed during the different phases of the battle. The supply delivered to the pieces amounted to four days of fire. On this basis the batteries were to consume two days and a half or three days of fire in the course of the battle. The high command counted on this much, and the extra day was a precautionary supply to be ready in case of a renewal of the attack.

Allotment of Artillery.—The artillery at the disposal of the 21st Corps composed the following total:

Field artillery:
18 battalions of 75s (of which 4 were American).
Heavy short artillery:
21 batteries of 155 C. S. (of which 6 were American);
1 battalion of 8^{po};
1 battalion of 220 T. R.
Heavy long artillery:
2 batteries of 95s;
8 batteries of 120s;
9 batteries of 155 L;
5 battalions of 105s;
2 battalions of 155 G. P. F.
High power heavy artillery:
1 battery of 190s (American);
1 battery of 320s placed by the army at the disposal of the 21st Corps.
Trench artillery:
2 batteries of 58s (one French and one American).

Finally, during the night of the 14th-15th the 219 regiment of artillery portée took up positions in the sectors of the 13th and 170th Divisions. The corps then had a total of about 500 pieces, for the most part long or at least of long range.

Assignment of the Artillery.—This artillery was assigned as follows. Divisional artillery—All the field artillery and short heavy artillery was attached to the divisions; each of the divisions on the

right received an extra battalion of heavy guns, 220 T. R. or 8^{po}, to sweep the broken and wooded ground forming the divide between the streams that flow toward the Aisne and those that empty into the Suippes.

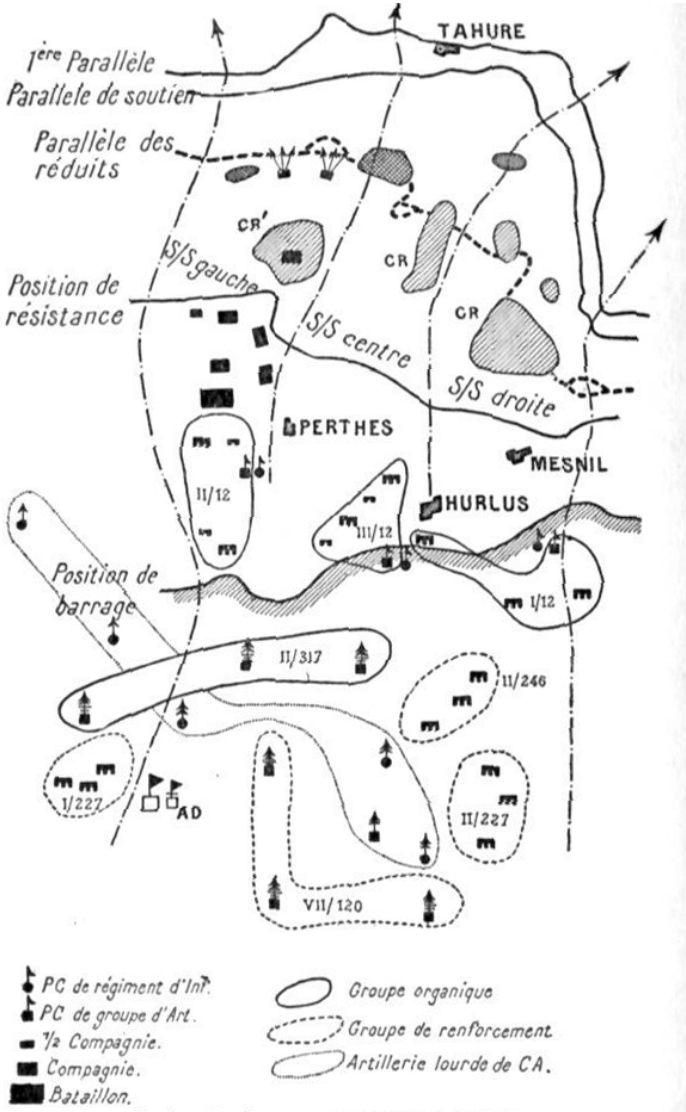


Fig. *b*. — Système defensif de la 43e D. I. française.

The sector of the 43rd Division was divided into three sub-sectors, each occupied by a regiment of infantry. Before the reinforcement

each regiment was supported by a battalion of 75s, the posts of command of the regiment and supporting battalion being together.

The artillery of the reinforcing division being charged above all with the defense of the reserve position and being also able to assist in the defense of the position of resistance, the reinforcing battalions were placed so as to operate each in a sub-sector; they were put under command of the corresponding battalions in the 43rd Division, regardless of the seniority of the respective battalion commanders. The regiment in support of each regiment of infantry was thus made up of two battalions of 75s under the orders of a chef d'escardon well acquainted with the infantry resulting in the best conditions for liaison between the two arms. In the same way the reinforcing battalion of 155 C. S. was placed under the orders of the battalion belonging to the 43rd Division. The combination made a regiment which was directly under the division commander and whose zone of action was the whole divisional sector.

Corps artillery.—The corps heavy artillery comprised three subgroupings designated divisional because they were directed to operate primarily in the zone of a division with which they had direct liaison. In this way each division commander had at his disposal a first reserve of powerful guns which he was authorized to put into action directly if need arose. The sub-groupings were made as follows:

East grouping:	Central grouping	West grouping:
2 batteries of 120s;	2 batteries of 95s;	3 batteries of 120s;
4 batteries of 155 L.	3 batteries of 120s;	2 batteries of 155 L.
	3 batteries of 155 L,	

A fourth sub-grouping, called long range and made up of all the modern matériel (105 and 155 G. P. F.), which could cover the whole zone of action of the corps, was at the disposal of the corps artillery commander. This permitted him to put down powerful and rapid concentrations of fire on points where the necessity for it should become known and also to sweep the rear areas.

Action of the Artillery before the Battle.—At the beginning of July the corps artillery information service decided from interpretation of aerial photographs that neither the enemy artillery nor the stocks of munitions were in position so the enemy was not yet ready. But on the 12th of July ascertaining that the last touches were being put to the preparations, the imminence of the attack was announced. This series of reports permitted the French artillery to change gradually its routine of fire, which increased day by day, although the re-enforcing batteries did not fire. The firing was along the following lines:

Interdiction.—This was very active at night and in weather not permitting aerial observation, and covered roads and all the approaches to the first position. The ordinary expenditure of ammunition was used, a third of a day of fire for the 75s, a half day for the long heavy artillery.

Destruction.—All new works revealed by the photographs were taken under fire; batteries, ammunition dumps and matériel depots; from the 7th to the 15th of July the explosions of a dozen dumps were observed every day.

Gassing.—Certain camps, zones and sensitive points within the limit of effectiveness of the available special shells were gassed.

Systems of Fire Planned for the Battle.—On the 14th of July about nine o'clock it was learned from prisoners taken in a raid by the 4th Corps that the enemy was massing for the attack, and that the fire of preparation would begin that very night at ten minutes after twelve.

Therefore, at eleven o'clock our artillery with all available pieces opened interdiction fire from the nearest target to the furthest, starting on the hostile first position. But this fire did not last very long, only till the enemy started his preparation fire.

The system of fire adopted for receiving the attack was dictated by the following considerations:

1. Experience in former battles showed that the enemy organized his approach so as to be massed in position at the time his preparation opened, practically as close as our barbed wire entanglements which he even started to cut;

2. Our very great inferiority in artillery did not permit us to enter a duel with the enemy's very numerous artillery (more than 2000 pieces); it was more worth while to bend all our efforts to destroy the active element of the assault, the infantry;

3. The abandoning of our first lines and our voluntary withdrawal to the intermediate position procured us a field of fire three kilometres in depth in which the enemy would have to advance unprotected in a deep formation. It was there, in the actual course of his advance, that it would be possible to destroy him. But in order to do this it was necessary to give up entirely a barrage prepared in advance on a determined line of resistance. It was necessary to substitute deep zone fire directed against the moving mass represented by the enemy's deployment and regulated afterward according to the progress of his advance. This fire was put down at the request of the signals marking this advance sent up by the observers in the first position and the centres of resistance.

Action of the Artillery During the Enemy's Preparation.—The German preparation began very violently at ten minutes past twelve,

but ten minutes later the French counter-preparation came down. It covered the strip of terrain in which it was supposed the enemy had completed the concentration of his assault troops, and it extended to a depth of 1000 to 1200 metres to take in a line that was thick with enemy batteries. As the front was so wide and our batteries, so few, the counter-preparation, to obtain mass effects, was fired in the form of concentrations in each division of an average length of thirty minutes put down successively in front of each regimental

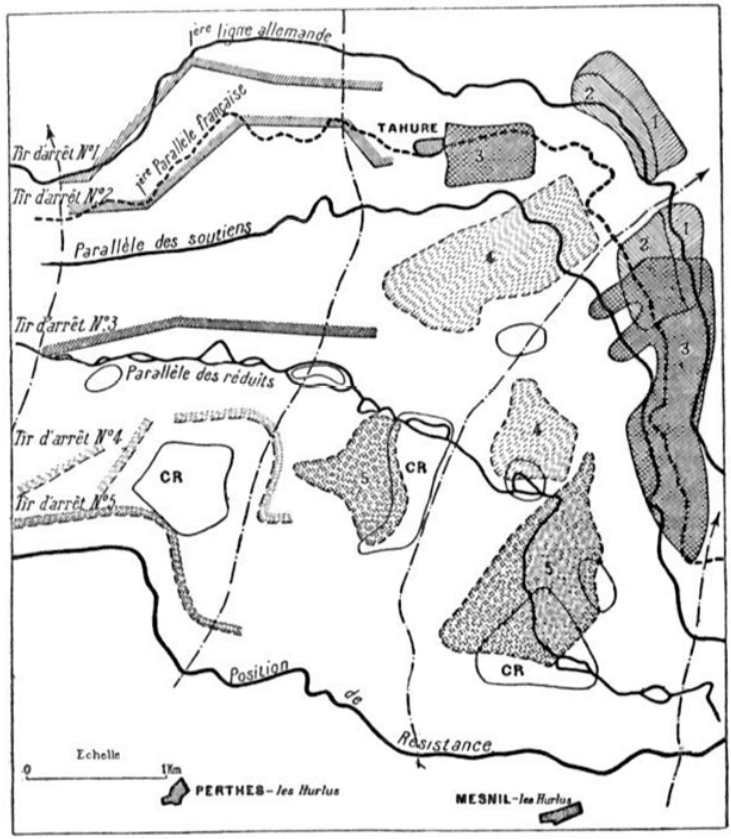


Fig. c. — Système de feux défensifs à l'intérieur de la position de couverture de la 43?? D. I.

sub-sector. All the pieces in the division took part in these concentrations, and in addition the corresponding grouping of long heavy artillery.

Action of the Artillery During the Attack.—The attack started about four o'clock, but some minutes before this our fire Disposition No. 1 was laid down. The successive systems of fire were prearranged to follow five dispositions. Each disposition, corresponding to a situation determined by the assailant, comprised:

A barrage fire executed by the field artillery; this fire was composed of a barrage properly speaking and of a raking fire reaching to a depth of about 600 metres to the rear.

A concentration fire by the heavy short artillery executed in each divisional zone by successive sections.

All this fire was done with shrapnel or time shell or instantaneous fuses.

Disposition No. 1 had its short limit on the enemy front line. It was prearranged—and the infantry elements in front were informed—that its duration was to be only ten minutes, at the end of which it passed automatically to

Disposition No. 2, whose short limit was 200 metres in front of our support parallel. Then our barrage came closer to our support parallel when the enemy's accompanying barrage made its first bound.

Disposition No. 3 had its short limit 200 metres in front of the parallel of redoubts.

Disposition No. 4 covered the centres of resistance occupied by the detached companies. Box barrages were formed around the centres of resistance and the lanes which separated them were swept with raking fire.

Disposition No. 5 had its short limit 200 metres in front of the position of resistance. The centres of resistance were spared as long as they held out, and after they had fallen they too were taken under fire.

The changes to the various dispositions were called for by rockets, different for each disposition. Besides this the infantry confirmed the requests in each phase of the combat by all other means at their disposal; telephone, wireless, ground telegraph, optical telegraph.

The systems of fire functioned as had been expected. Soon broken up by our barrage the assaulting waves were obliged to advance through the boyaux. About six o'clock Disposition No. 4 was put down; about six thirty Disposition No. 5 in front of the position of resistance. At nine o'clock it was established that the position of resistance was intact on the whole except at Perthes where enemy elements managed to infiltrate by the boyaux. Cut off by box barrages they were soon driven out or taken by a counter-attack. By noon the position of resistance was intact everywhere.

From information gained from prisoners it was learned that the six crack divisions which had made the attack had suffered losses of about fifty per cent., while the three support divisions held in the rear lost from twenty to thirty per cent. As a result the German attack was not renewed.

Results of the Enemy's Fire.—Not counting the advance detachments the sacrifice of which had been determined on beforehand, the infantry losses of the 21st Corps were insignificant. At the same

time the reinforcing batteries which were installed on absolutely new ground were untouched. On the contrary those which occupied positions on which work had been begun were the object of systematic fire, although they had never fired from emplacements. Finally, the old batteries whose emplacements were known to the enemy and which could not be kept silent before the attack were subjected to a very heavy fire. It was in this way that the 12th Regiment in eight hours lost nine guns by the enemy's fire, or 25 per cent. of its matériel.

CONCLUSION

Thus it was that the battle ended in a complete victory for us. There is no doubt that the artillery played the principal role. Its action was coördinated in so judicious a manner that we can consider it still as a model not to be imitated in detail, because the manœuvre which succeeded in 1918 might be frustrated by the enemy another time, but to be seriously studied. If the artillery obtained so great a success it seems that it should be attributed to:

The care with which the reinforcing units prepared their entry into action;

The precautions taken to conceal the batteries;

Establishing a very close liaison with the infantry;

The judicious organization of the command;

Finally, the remarkable flexibility of fire of the different groupings.

But there is another lesson to be learned from this historic example. It was because we won the defensive battle of the 15th of July that we were able to take the offensive and win the great battle that ended on the 11th of November, 1918. It is not unreasonable to imagine that similar circumstances will occur some day, and that, attacked again, we shall have to fight at the beginning of a war one or more defensive battles from which we must emerge victors before we can pass to the offensive. But we have shown that the defensive victory of July 15 necessitated the employment of large numbers of artillery (25 pieces to the kilometre), many more than we used in a number of offensive actions during the last two months of the war. It is this density, then, that we must be able to put on the line a very few days after mobilization and perhaps over an extended front. In consequence the artillery must be given in peace time the organization and effectiveness which it needs, in order to be sure that it will be able to play the important rôle which the high command will impose on it from the very outbreak of a new war.

At a moment when the laws for organizing the army are being formulated too much emphasis cannot be placed on this necessity so vital for our country.

OBJECTS SOUGHT IN SCHOOL INSTRUCTION AND FUTURE STUDY BY GRADUATES

(Extract from address delivered on June 28, 1921, to the graduates of The General Service Schools, by Colonel H. A. Drum, Infantry, Commandant.)

IN the preparation of the courses and text-books and in the method of imparting instruction, we have not sought to cover completely and in every detail all subjects and considerations which are necessary for the efficiency of commanders of a modern army. In all professions of civil life, after completion of a collegiate course, there is required a university training extending from three to four years. At the General Service Schools, the training of officers in courses far more comprehensive than those undertaken in a four-year curriculum of any university is limited to one and two years.

Few outside of the military profession realize the broad and detailed scope of the knowledge and training required of the modern military leader to cover the general and detailed information that an officer should possess of all professions and business activities. The work at the General Service Schools has been arranged with two viewpoints:

First.—To give a sound course by teaching the basic principles and illustrating their application, and

Second.—To open to the officer a field for future work; that is, to place before him an accurate picture of the scope of his profession and what it entails, and then to place before him the correct lines for future study.

Every graduate should keep in mind that the military profession demands constant study and research. Every new invention and new industry, every new twist to civilization, every new change in the geography of the world, and every new sociological influence have direct bearing on the development of the military profession. It is incumbent upon every graduate of these schools to continue the work started here. His success at these schools has added a double burden, that of teaching the subordinate while at the same time persevering to improve his own professional efficiency.

There is a tendency in the military profession, as well as in many others, to feel that the habit of study should pass with graduation from schools or on entry into the service. We find that the average young officer, upon being commissioned, feels that his mental

development and training is complete and that all schooling is over. We hear at times such expressions as "Must I spend my life studying?" "Who is going to do the soldiering if all are going to schools?" It is gratifying to observe in graduates from these schools a new intellectual "lease on life," coupled with a rejuvenated mentality and a desire for further knowledge.

A feeling that education ends with graduation from schools is one of the greatest weaknesses of the military service. Success results not from what one is taught; but, in the main, from what one teaches oneself. There is a necessity, particularly in the military profession, for a constant mental vigor, which should be nourished by daily exercise and development. The future immediately ahead of us (a small regular army scattered into small garrisons) makes these remarks especially pertinent, as serious efforts will be necessary to promote and maintain an up-to-date and mentally active corps of officers. "The moment a man begins to think he knows enough, and loses the first sharp craving to learn, a definite something in him has died, and his intellectual finish is not far off."

A NEW EPOCH FOR THE REGULAR ARMY

The regular army of the United States has just entered into a new epoch. This new epoch springs from, and will be surrounded by, two main influences.

The first influence relates to the theory that war is a thing of the past, *i.e.*, can be made impossible in the future. Such an influence should not be allowed to pass unchallenged, as the consequences thereof may be vital to the life of a nation. Before accepting or denouncing such theory, the life of man and the basic principles governing the same should be investigated and analyzed. One should question this theory with the following in mind:

1. Has it any practical application?
2. Does it neglect the true and established human and racial characteristics of man?
3. Does it ignore the real foundation upon which nations are created and exist, *i.e.,* community of interests and welfare, and agricultural, industrial and economic interests assured by commerce and trade?
4. Has it set aside world history, which is pregnant with lessons pointing to the rise and fall of races due to an ascendency or a decline in moral qualities?
5. Has this theory such a blinding influence that it will cause our people to disregard the position of America as a world power and the necessity for adequate relative preparedness?

6. Finally, to accept this theory, must not one assume human and racial natures to have so changed that national interests can be absorbed and replaced by complete international comity? Only when this state of affairs exists, will war be avoidable by such a great nation as America, whose very existence depends more and more on its commerce and trade.

However, we may expect this thory to lead to many situations and experiments such as disarmament, disregard of adequate relative preparedness, and, as a consequence, a weakening of moral forces. We must be alive to such conditions, sift the good from the bad thereof, and be prepared to perform our duty to the nation under whatever circumstances we may find ourselves. So long as men and races retain a mentality, a soul, two mighty arms and two muscled legs, they can and will make war in defense of what they conceive to be justice, liberty and their own interest and welfare.

We—who know the causes of war and the evils and benefits of war, who fear and despise war, and, in every way possible endeavor to avoid war—must recognize the good and the evil as well as the practical and theoretical consequences of such an influence. We should prepare ourselves as experts on such questions and, on proper occasion, advise and place a correct and sane view of such matters before our fellow-citizens, who are the final judges of the nation's course of action. This entails, on our part, study and research and ready knowledge of human nature and of world history. As the exponents of relative preparedness, we must be prepared to expound in an intelligent manner and convincingly the real basic facts associated with this vital national question.

As to the second influence—The World War has taught that wars in the future will be national in every sense of the word. Whereas, in the past nations based their defense on permanent military forces maintained in peace in immediate readiness for war, it is now realized that war between first-class powers will demand the entire man-power, finance, agricultural, industrial, and transportation strength of a nation. In minor wars only will permanent military forces suffice. These conclusions should result in our maintaining in peace a regular army for a two-fold purpose: First, for minor wars, and, second, as a school by which the citizens of the country are prepared for defense of the nation.

Whether we adopt universal service or not, this second function is the important mission of the regular army of the future. One does not have to examine closely the reorganization Act of June 4, 1920, to see such a trend in Congressional action. The provisions relating to the National Guard, the Organized Reserve, Citizens' Military Training Camps, and the extensive establishment of units

of the Reserve Officers' Training Corps convince one of the soundness of these conclusions.

This new epoch, into which the regular army has just entered, requires your thoughtful and earnest consideration. It means a marked change in your military life, added burdens and a professional viewpoint quite distinct from that held by the regular army before the World War.

Whereas, in the past we were absorbed in maintaining at a high state of efficiency the standing army, to-day and in the future our mission in life and our duty to the nation will involve many additional tasks which may be summarized as:

(*a*) We must become experts on the causes and results of war, and their relation to the present world position of America. Such expert knowledge is necessary to represent intelligently and sanely, on proper occasion, the national danger inherent in relative unpreparedness, *i.e.*, in rendering the nation defenseless.

(*b*) We must prepare ourselves to be the military leaders of the large national armies which will be required in the wars of the future. We should not content ourselves with knowledge of the duties and functions of the rank and position we hold in peace. In war, every efficient permanent officer will be called upon to perform the functions of grades three or four times higher than his peace rank. In addition, his tasks will not be limited to purely military work. Many of us will have to direct the operations of railroads, steamship lines, finance, food supplies, etc. In fact, we must gain an insight into the business methods peculiar to our people.

(*c*) We must take over in peace the national training of the youth and young men of the country. By national training, I do not mean military training solely; I include citizenship training and the upbuilding of the moral qualities of the youth, which, in the final analysis, are the backbone of national defense.

Briefly, then, this new order of things calls on the military man in America to cast aside the cloak of seclusiveness forced on him in the past and to become a part and parcel of the daily life of his fellow-countrymen. He must become a member of the local community, be intimate and in harmony with local interests, and be recognized therein as the expert on all national questions relating to citizenship, to the training and education of the youth and to the measures necessary for the defense of the nation. This change in our military life must be realized and accepted by our older officers and they, in turn, must train and bring up the younger officers in accordance with this new order of things.

APPRECIATION

In closing it is desired to congratulate all on the work of the year. It is not an easy decision for officers averaging forty-five years of age to accept the competition and test associated with these schools. However, a willingness to do so and to assume the responsibility and hard work involved in this decision, place you among the leading progressive officers of the army and upon whom the future success of the army depends.

One who, of his own accord, seeks the knowledge and instruction imparted at these schools, clearly demonstrates that his mentality is active and not atrophied; that he retains "the first sharp craving to learn" and, instead of having reached an "intellectual finish," seeks a further intellectual development and advancement. These qualities have been and will be recognized by higher authority.

SOME IMPORTANT AND TIMELY PROBLEMS FOR THE FIELD ARTILLERYMAN

BY LIEUTENANT-COLONEL CHARLES M. BUNDEL, FIELD ARTILLERY, U.S. ARMY

THAT the field artillery must strive for perfection in drill, training, mobility and the technic of fire, is self-evident.

To approach or achieve this perfection requires hard, unremitting study and work. The problems connected therewith are for the artillerymen to solve. To work out and solve them may be considered as his NORMAL MISSION. The Army at large is very deeply concerned in his success in solving them promptly and efficiently; in carrying out his normal mission.

But there are other problems of even surpassing importance to the Army in general, in which the artilleryman is greatly concerned; problems which, in the maze of work and tribulations, may be and often are, overlooked.

In the main, these problems all bear upon one subject: How best to fit the artillery into the general scheme of combat: How to handle it in a given situation so that it can best accomplish its fundamental task—that of aiding the infantry to close with its opponent in the shortest possible time and with a minimum of losses. This may be called the artilleryman's MAIN MISSION.

It is a fundamental principle of warfare that before a decision can be reached on the battlefield, the infantry must close with the hostile infantry and fight it out. Sometimes the opposing infantries will not come into actual physical contact, as one side will give way before that occurs, but the threat must be there, the infantry must be able to close with its opponent. Every auxiliary designed, every new method of warfare adopted, every effort made on and behind the battle area, is for that one purpose alone. If the infantry cannot close with the hostile infantry we can never reach a favorable decision.

For this reason the plans for using the infantry are decided upon first, the plans of all auxiliaries are secondary thereto and are based upon the infantry plan.

Thus, in the final analysis, the most important problem for the artilleryman is, "how best to serve the infantry." His problems of organization, training and technic, while of vital importance, are, in reality subordinate to the main issue. The infantry, which delivers the actual blow that spells success or failure, is not so much concerned in how the artillery goes about accomplishing its task (carrying out its normal mission), as it is in knowing that the artillery

appreciates its task and can accomplish them promptly, efficiently and in accordance with the infantry's wishes.

A 75-mm. gun with a great range and a minimum of dispersion is of little value to the infantry if the man behind that gun does not know how to give the greatest assistance to the infantry in a given situation. The finest and most perfectly organized and technically trained artillery regiment fails in its main mission if its commander does not appreciate fully the simple, basic fact that he is there to assist the infantry, or if he is not able to make the best and soundest tactical use of his regiment and to give the greatest possible support to the infantry in every situation.

The real solutions to these problems, this main mission of the artilleryman, are not found in any text-book or article on the subject. Text-books and articles are written to bring out and illustrate definite tactical principles; that is, the soundest and best methods of handling the problems of a given situation; but no article or book can cover all the situations that may arise, and, what is appropriate for one situation will not necessarily apply to any other. The actual problems arise only in war, but we cannot wait for war to begin or to develop our training. There will be no time then for training, and the cost of an education on the battlefield is too great.

But as our artilleryman must know in advance of war how best to serve the infantry, we must accept as methods of training, the best substitutes for war. These are *properly directed* study, and the solution of definite and *appropriate* tactical problems.

In all this work of preparation, the great underlying idea must be teamwork, the fitting of the artillery into the general scheme of combat so that it can best serve the infantry. This means that the needs of the infantry must be uppermost in the mind at all times.

To make an intelligent study of these problems we must first determine, to the best of our ability, what the character of the future combat will be, and, having made the best possible estimate of this, to determine what the infantry will probably demand from its most powerful friend to assist in overcoming the difficulties that will confront it.

A study based upon a sketchy or incorrect idea of what will confront us in the future, is labor and time thrown away. It will not only mean a waste of time and labor, but it may, and probably will, constitute a grave menace to the success of our army.

A study based upon an incorrect or mistaken idea of what the infantry will want in the battle of the future, is also a waste of time and labor. It may practically be regarded as an established fact, that that which the infantry demands in action, is what it will get if it is humanly possible to give it. The infantry bears the brunt of the battle, it is the arm that advances to meet the enemy hand-to-hand

and to strike the blow that decides the action. Hence when it calls upon its supporting artillery it is but simple reason and justice that it should get what it has asked for. The desires of the artilleryman must be subordinated. He must cast aside his own inclinations and give his best in support of the main issue; the advancement of the infantry without loss of time and with the minimum of casualties. He must keep his main mission constantly before him at all times.

THE COMBAT OF THE FUTURE

The writer does not put himself forward as a prophet, nor yet as a seer into the unknown. What the nature of the future battle will be cannot be definitely foretold, but, nevertheless, a study of our past experiences and of our present means of warfare may permit us to make a sound and intelligent prediction as to what will probably occur.

(a) To begin with, the wars of the future will be fought by nations in arms. Each belligerent will bend every effort to raise, train and put into the field a larger and better trained force than his opponent. This means a struggle between immense armies. If the war happens to be with a smaller or weaker nation the problems involved will be relatively simple and easy of solution. With immense armies engaged we will find our great fighting unit, the division, acting as part of a corps in almost every case. This means that it will operate in a relatively restricted area, with its flanks protected by adjoining divisions.

(b) The World War taught us the fallacy of launching attacks with "limited objectives," except in very special cases. By an attack with "limited objectives" is meant one in which the infantry, assisted by powerful artillery support, drives forward to a given objective, which is seized, organized and held until the great mass of artillery can be brought up and the process repeated. Such attacks were frequently employed during certain stages of the World War, but all, with a few special exceptions, had one great fault. The enemy, warned by the artillery preparation, knew that an attack in force was impending and, knowing this, made his preparations. Once the attacking force halted upon its objective the enemy was given his great opportunity, and he was not slow to take full advantage of it. The attackers were immediately smothered by intensive artillery fire and struck by heavy infantry counter-attacks, and were either driven back or suffered terrific casualties. The halt on the first objective gave the enemy just the chance he wanted, the chance to launch counter-attacks in force.

As the result of this experience we will see, as we saw during the final stages of the World War, the infantry driven forward with

all its strength and to its maximum, with no stop as long as it can possibly advance. When units are worn out in the struggle they will be properly replaced and the hammering attack continued until a decision had been reached.

(c) In the World War artillery was used to an extent never before dreamed of. Attacks were frequently launched in which each division engaged was supported by double or triple the normal amount of artillery. That this will occur in the future is hardly probable. The local conditions of the World War, the long stabilized situation, unlimited manufacturing facilities, remarkable road and railroad nets and short lines of communications made such things possible and inevitable, but it is very doubtful if the future war will see any such fortunate combination of circumstances. It appears much more probable that the division will fight supported by its own artillery alone. The corps and army artillery, if available, will be allotted to divisions along the front in proportion to the task demanded of them.

(d) It appears that the battle of the future will partake more of the character of trench warfare than in the past. By this it is not meant that the enemy will have elaborately entrenched positions one behind the other covering a depth of from ten to twenty or thirty miles. There will be no time for this, but he will organize his position in great depth in another way.

From the standpoint of the infantry, and this is, of course, the basis of action of the division, probably the most important and far-reaching development of the World War, is the machine gun. We can locate the enemy's artillery, to a considerable extent at least, by the means we have; we can see his tank, his airplane or we can photograph his defenses, but his machine gun is hardest of all to locate, and for that reason to overcome. By observation alone it is practically impossible to locate a concealed machine gun, except in stabilized situations, where this may be done by continuous observation, assisted by aerial photographs.

(e) With our large, complex organizations the necessity for teamwork, for constant and effective control of all units all through an engagement, is of far greater importance than ever before. The increased effectiveness of the opponent's auxiliaries, especially his artillery, makes effective communications on the battlefield much more difficult than in the past. Hence he will see an increase in the importance of communication and at the same time an increase in the difficulties of maintaining that communication.

(f) As the future action of our infantry will be in the nature of long, hammering drives in order that the enemy shall be given no breathing spell in which to prepare and launch concerted counter-attacks, we will see our brigades and regiments deployed in great depth in the ordinary case. For an attack in which the whole power

of the division is to be used (and this will probably be the usual case) the minimum of depth of deployment might be considered as that of a regiment. That is, if all four infantry regiments are deployed in line, unless something in the situation calls for less depth, each regiment will probably attack in a column of battalions. Other situations may see each brigade formed in a column of regiments, or with as many as six battalions in depth.

By these statements it is not desired to convey the impression that infantry regiments will never attack except in column of battalions. This does not occur in every case; for example, in a holding attack all three battalions may be placed in line. Generally speaking, however, the future combat will see our infantry units disposed in greater depth than in the past.

To sum up, the outstanding features of future combat seem to be about as follows:

(a) The division will habitually act as part of a corps, hence in restricted zone of action with its flanks protected.
(b) In an attack the infantry will be driven forward without stop to its maximum limit, hence there will be no attacks with "limited objectives," except in very special cases.
(c) The division will be supported by its own artillery alone, except when part of the corps or army artillery has been allotted to work in its zone of action.
(d) The enemy will organize the ground to a great depth, principally by concealed machine guns.
(e) Effective communications throughout the command will be of greatly increased importance, and there will be increased difficulties in maintaining these communications.
(f) The infantry units will be deployed in greater depth than in the past.
(g) Practically all troop movements in rear of the advanced line will be made at night to avoid hostile observation.

If these premises are correct let us see how they affect the artilleryman, what problems they present to him, what demands he may expect from the infantry.

Several of these conditions are closely related and will be considered together.

(a) The division will habitually act as part of a corps, hence in a restricted area with its flanks protected.

(f) The infantry units will be deployed in greater depth than in the past.

As the division will habitually act as part of a corps and in a restricted zone, its attacks become practically frontal attacks in every

case, so far as the division is concerned as a whole; that is, there will be no envelopment in the true sense by the division. The division will push straight ahead in its zone of action with little or no manœuvring as a unit. If the brigades are placed side by side, and this will probably be the usual disposition, they also will be assigned zones of action and will, in the general case, push straight ahead within their zones. The defense of the enemy will consist of natural features strongly held, with the intervening ground covered by machine gun and other classes of fire. The actual manœuvring to overcome this resistance will take place in the smaller units, the regiments and battalions.

The work of the supporting artillery will also be confined to this zone of action, and to the front, except in special cases where it has the additional duty of assisting adjoining divisions. The initial artillery positions will, as a rule, be limited to this zone, and the artillery in its advance will seldom be permitted to leave the zone. Zones of limited widths will seldom contain more than one road, often none at all.

From this it appears that the artillery will be restricted in its selection of positions; that is, the positions selected will have to fit into the general scheme of action of the division, rather than fulfill the requirements of a good artillery position. In other words, the artilleryman will have to make the best of what is allotted to him.

With the artillery regiments attached to infantry brigades which are deployed on narrow fronts, with only one road available and possibly none at all, the problem of advancing the artillery as the action progresses will be a very serious one. The infantry will require increased support from its artillery, and the artillery will experience increased difficulties in getting forward so that it can give this support.

We may expect to find the division (in an offensive action) deployed on a front of from about 1800 to 3000 yards. These limits are, of course, very general ones; the actual width of the division zone depending upon the mission, the terrain and the hostile dispositions. For example, in a holding attack over favorable terrain a division may cover as much as 4000 yards or more. In attacking to penetrate a defensive zone (a series of elaborately entrenched positions, one behind the other) the division may be deployed on a front much narrower than 1800 yards.

If the division, in order to make its most powerful drive, is deployed with brigades abreast, each brigade in column of regiments, we may find a depth of deployment as great as five or even six battalions. This will mean that infantry troops will be distributed far back in the zone, even in rear of the initial artillery positions. These troops must advance as the attack progresses, and they must advance in a deployed formation to avoid unnecessary losses.

The fitting of the artillery into this scene will be a difficult problem. It must be so placed that it can carry out its main mission effectively, and still not interfere with or delay the advance of the rear infantry units.

The solution of these problems will call for careful thought and a good knowledge of the dispositions and actions of infantry in combat. If the artilleryman makes his plans to cover such contingencies and fails to consider the actions of the infantry, he may be forced to change his plans just at the moment when that is the most difficult.

(b) The infantry will drive forward to its maximum limit without stop as long as it can advance.

The infantry, once it is committed to the attack, will keep going without voluntary stop. As its advanced battalions are worn out they will be replaced by those in rear, with no halt in the action. The action will thus result in a continuous series of blows upon the enemy, a constant hammering that gives him no chance to strike back with deliberately and carefully prepared counter-offensives. The infantry will, of course, advance as rapidly as it can: often its only salvation will lie in a rapid advance. The advance will not be at a uniform rate; at times the whole line will be held up, at other times it will advance rapidly. The various parts of the line will not advance simultaneously: one part will be held up by a strong-point, while adjacent parts will forge ahead.

The infantry will call for the closest possible support from its artillery all during this advance. It must have this support or it will be unable to advance against the increased resistance. Once it has been definitely stopped it is immediately exposed to deliberate counter-attacks by the opponent.

When the infantry meets with opposition that it cannot overcome with its own weapons it will expect its supporting artillery to assist it promptly and intelligently. This means that the artillery must be close behind. To keep close behind the infantry in its rapid, erratic, alternating advance is a problem that is as difficult as it is important.

In the modern battle, with its hurricane of fire on the front lines and in rear of those lines, communications are prone to fail. If the artillery has not been advanced rapidly and promptly behind the infantry, it may find itself unable to give the desired support, unable to carry out its main mission. An artillery unit several miles to the rear of the assaulting battalions, will experience great difficulty in bringing to bear the close, accurate and immediate fire demanded by those battalions, even if its communications are intact. A well supplied artillery unit even farther to the front, is of little value to the infantry if its communications are interrupted.

Therefore, in the future battle, we may expect to see the infantry

making greater demands upon its supporting artillery, a greater necessity for keeping the artillery advanced closely behind the infantry, and greater difficulties in making this advance.

The artillery will have need for all its mobility, and the artilleryman will have good use for all his tactical skill in solving these problems.

(c) The division will be supported by its own artillery alone.

It will probably be the exceptional case where the division will receive support from other light guns than its own, because of the impracticability of supplying great masses of artillery, the great difficulties, in the average country, of getting up sufficient ammunition, and the lack of roads and railroads. With our division attacking on a front of from one to two miles and supported by its own artillery alone, the character of the artillery support at once becomes apparent. The use of the barrage will be restricted to special cases, and the rolling barrage will find little application. In the initial stages of the attack the artillery will act as a unit, but as the attack progresses the artillery units will be attached to the direct support of infantry units.

Once the infantry attack has gotten well under way the infantry units in the assaulting line will begin to uncover their own immediate problems and will call for special and close support from the artillery units attached to them. The real work of the artilleryman begins then, all his work heretofore has been preparatory and comparatively simple of execution. With the infantry pushing farther and farther to the front and making increased demands upon him, his task will not be a light one.

He must answer the infantry's calls promptly and effectively, and he must advance his guns so that support can be given promptly and effectively.

In open warfare situations (these only are being considered in this article) the rate of advance of infantry in action cannot be foretold. No man can say that the infantry (unless following a barrage in a special case) can advance the first mile or two at an average rate of 100 yards in four minutes or in eight minutes. The rate of advance depends entirely upon the success of the infantry in overcoming the resistance it meets with, and this resistance cannot be definitely foreseen. There will be no elaborately prepared tables showing in great detail just where the assaulting lines and the artillery fire will be at specified minutes. About the best that the artilleryman can hope for in these circumstances, is to learn from the local infantry commander that he hopes to reach a certain point about a certain time; but even this cannot be depended upon. A few extra hostile machine guns may entirely upset the whole infantry plan.

The problem is one that calls for hard thinking upon the part of the artilleryman, for the closest possible coöperation with the infantry

unit to which he is attached, and a good working knowledge of the tactics and of the powers and limitations of infantry.

(e) Effective communications throughout the command will be of increased importance, and there will be increased difficulties in maintaining these communications.

The necessity for effective communications is so vital that all must combine in a concerted effort to achieve this. If a commander is not constantly in touch with all of his units the engagement quickly degenerates into local fights without coöperation, and he is losing that priceless thing, teamwork, the concerted action of the whole.

The infantry will be expected to do their part in maintaining communication, but they are not super-men, and the artilleryman must be prepared to do his part if the occasion demands it.

The question of communication also has some bearing on the tactical use that will be made of the increased range of the new field gun. This increased range will permit of placing the gun farther to the rear, which in turn means better and more accurate service of the piece, an earlier entry into the action and a decrease in the difficulties of supplying ammunition. On the other hand, there is the increased importance of communication and the increased difficulties in maintaining the same.

The problem is one for the artilleryman to solve.

(g) Practically all troop movements will be made at night.

This will apply to both the artillery and the infantry, hence the night before an attack is to be launched (open warfare situations only are considered) will see masses of infantry and artillery moving forward in the dark and in a restricted zone. The chances for confusion and delay are great, but the movement must be made. It will call for troops carefully trained in this respect and for carefully and intelligently prepared plans.

(d) The opponent will organize the ground to a great depth, principally by the use of concealed machine guns.

The characteristics of the machine gun are: its smallness, mobility, immense fire power, great range of action, and the ease with which it may be concealed. These combined make it the most difficult obstacle to overcome in modern warfare. A rock, a bush, may conceal a weapon capable of firing four hundred odd bullets a minute with deadly accuracy; a fire sufficient to hold up a battalion of infantry or more.

The extreme importance of this weapon, especially in the defense, is evidenced by its adoption in great numbers in all armies.

An opponent forced to assume the defensive will immediately utilize this powerful weapon to the fullest extent. The placing of the machine guns of a division, echeloned in depth and in concealed positions,

is a matter of a few hours. In an attack against an enemy in position, even though he has held that position but a few hours, the attackers will be compelled to force their way through the position itself (held by infantry and machine guns) and then through a terrain of considerable depth defended by machine guns concealed in every available spot.

The most effective weapon against the machine gun is the light tank, which is able to search out and crush the individual gun or nests of guns. But the tank has its limitations. It is easily put out of action by a direct hit from an anti-tank gun, and it cannot negotiate certain kinds of terrain. A high, sharp bank of a stream, or a field of tree stumps may effectually block the tanks.

The infantry howitzer is an effective weapon against machine guns, but in view of the limited number of these howitzers in a division, the immense number of hostile machine guns, and the great difficulty of overcoming even a single, well placed machine gun, the problem has not yet been satisfactorily solved. The infantry must have further help and that help, manifestly, must come from its artillery. If the machine gun can be located, the problem is simple. A single 75 within effective range can easily put it out of action in a short time. But if the machine gun has not been located, and this will be the usual case, the problem becomes a very serious one.

The importance of this problem is so great that it may be well to assume a simple situation and attempt to follow through the conditions that will probably develop.

Let us assume that our division, as part of a corps, has been given the mission of penetrating a hostile position for the purpose of flanking an enemy strong-point held in front of one of the adjacent divisions. According to the situation this strong-point must be reduced to permit the corps to advance. To reduce this strong-point our division must make its penetration and then drive against the flank or rear of the strong-point.

Let us further assume that our division has penetrated to a point from which it can strike at the flank or rear of the strong-point, that the operation, so far, has gone smoothly, and that part of the supporting artillery has been pushed up close behind the infantry. The division starts its movement against the strong-point and immediately its assault battalions are smothered by fire from concealed machine guns. The enemy has, of course, appreciated the possibility of just such action on our part and has disposed his machine guns in depth to meet the move we are making. Our assault battalions are reformed, the attack is renewed and is again stopped. Our tanks go out one by one by the fire of the enemy's anti-tank guns. The division has been stopped by machine-gun fire, and because it cannot advance the attack of the whole corps is held up. Something must be done.

It is the duty of the infantry to send word to the artillery regarding the targets upon which it wishes fire placed, but in this assumed situation (it is one that occurred frequently in the Meuse-Argonne fighting) the targets cannot be located. Our artillery cannot remain idle because of lack of information regarding targets, nor can it cover the whole terrain in a vain effort to reach the hostile machine guns.

It appears that this is one of the very live problems for the artilleryman, especially the junior.

It might be argued that locating these machine guns is a function of the brigade staff. So it is, if there is time for that. But in a continuous attack in an open warfare situation, where the hostile dispositions may change from hour to hour, there is little opportunity for determining possible machine gun locations.

It might also be argued that the advanced infantry, knowing the technic of machine-gun fire, should readily locate these guns by a process of elimination. So they should, but will they be apt to in the excitement and chaos of battle? Is it reasonable to expect men on the front line, crushed and battered into the earth by every known means of warfare, to sit down, map in hand, and figure the probable location of the guns that are smothering them with fire?

It seems, rather, that this is a duty that will fall to the junior artilleryman, whether he wants it or not. If he has a definite knowledge of machine-gun tactics and technic, the problem can be solved and the situation saved by him.

It has been claimed that a great part of our casualties in the Meuse-Argonne offensive might have been avoided had our junior artillerymen possessed a good working knowledge of German machine-gun tactics. The writer is not prepared to substantiate this claim, but he has met many officers, artillerymen among them, who are firmly convinced that this is so.

Overcoming machine-gun resistance in the future battle will also affect the artillery in another way. It will mean that the artillery must be prepared to accompany the infantry, physically as well as with fire. This will probably take the form of an increase in the use of accompanying guns.

It is realized by all that one of the great advantages of artillery is found in its unity of action. It is also realized that the fire unit should not be split if it is possible to avoid it. But if the infantry must have a large number of guns physically accompanying it to enable it to overcome machine-gun resistance, is there any good reason to believe that the infantry will not get what it wants, despite the desire of the artilleryman to keep his battery intact? Can we reasonably expect a division commander, seeing his infantry cut to pieces by machine-gun fire because it lacks sufficient accompanying artillery, respect the desires of the artilleryman to keep his unit intact? Rather

will we see the division commander unhesitatingly order batteries broken up, once he is convinced that his infantry needs more accompanying guns.

This is a condition that the artilleryman must meet, and be prepared to meet.

If our deductions are correct, it appears that the most pressing problems of the artilleryman, based upon what will happen in the future combat and upon what the infantry will demand are these:

1. Keeping his guns close in rear of the rapidly advancing infantry.
2. Getting his guns forward rapidly in a difficult, restricted area.
3. Advancing his guns rapidly and continuously in order to keep up with the long, steady advance of the infantry, and to meet their increased demands upon him.
4. Locating and silencing concealed hostile machine guns that are preventing the advance of the infantry.
5. Supplying many accompanying guns if the situation calls for that.
6. Keeping open his communications with the advanced infantry.
7. Moving to and occupying positions at night and in a restricted and congested area.

Some of these are old problems, and some of them seem to be at variance with our past teachings, but they all appear to be live, important ones which the artilleryman must solve satisfactorily if he wishes to properly carry out his MAIN MISSION.

ERRATUM

In the article entitled "The Principles of Bilateral Observation" bottom of page 370, July-August 1921 FIELD ARTILLERY JOURNAL, the following error appears:

Substituting for—cosα, its value found in (5). we have

$$F = \frac{\omega_1 + \omega_2}{2} \quad \frac{R}{\sin i/1000} = \frac{\omega_1 + \omega_2}{2} \bullet \frac{R}{i} \qquad (11)$$

This should read as follows:

Substituting for–cosα, its value found in (6), we have

$$F = \frac{\omega_1 + \omega_2}{2} \bullet \frac{R}{1000.\sin i} = \frac{\omega_1 + \omega_2}{2} \bullet \frac{R}{i} \qquad (11)$$

CURRENT FIELD ARTILLERY NOTES

A Field Artillery Observation Post in France

EDITOR'S NOTE:—*To many of our readers the frontispiece of this issue of the* JOURNAL *is a familiar picture. As Signal Corps Photograph No. 24863 it has been widely reproduced, and with reason, as it is an excellent portrayal of conditions as they existed in the field, but, as far as we know, without any information as to who were the occupants, on what part of the battle front it was taken or during what operations it functioned.*

Inquiries failed to obtain the desired information until one day in conversation with Lieut. Col. J. W. Kilbreth, Field Artillery, who, during the World War as Brigadier General commanded the 55th Field Artillery Brigade, the fact was brought out that the photograph in question was one of an observation post established by that brigade.

Lieut. Colonel Kilbreth kindly offered to write to one of the officers shown in the photograph for an account of its establishment and operation.

The offer was gladly accepted and an account, by Lieutenant S. G. Anspach, Jr., 115th Field Artillery,[1] *the officer shown in the photograph at the B. C. Telescope follows:*

"The observation post was established on the edge of the town of Montfaucon, Department of the Meuse, France, September 28th, and vacated October 8, 1918.

"It was operated under the 37th and 32nd Divisions A. E. F., by members of the 55th Field Artillery Brigade Headquarters, and the 115th Regiment of Field Artillery U. S. Army. The personnel consisted of two officers, two noncommissioned officers and six privates.

"Its mission was general observation for the brigade, and fire control for the 155-mm. howitzers.

"The equipment consisted of maps, plotting board, B. C. telescope, 30 power monocular telescope and field glasses.

"The communications were four aerial telephone lines going to the rear by different routes as follows: One to the advanced battalion of howitzers, one to the Regimental Command Post and two to Brigade Headquarters. Runners were also used."

Lieutenant Anspach has this to say of their food supply: "Food

[1] Lieutenants Lovejoy and Anspach, were respectively Assistant Operations Officer, and Information Officer, of the 55th F.A. Brigade, at the time of the Armistice.—EDITOR.

was necessarily rather limited and we lived on 'Corned Willie' most of the time. One day they sent us some fat meat, a can of beans and some bread. I fried the bacon then fried the bread in the bacon grease and finally dumped the beans in what was left of the fat. We ate the best meal of our lives. Not a scrap of anything was wasted." Of the water supply he says: "The greatest inconvenience was the lack of water. We sent to the bottom of the hill for it, and then had to boil it quite a while to free it from a slight amount of mustard gas that had been absorbed from shell fire I suppose.

"We slept in a deep dugout about one hundred yards from the O. P. Neither of us had any bedding, but an officer belonging to the corps artillery managed to get his bedding up to the front and very kindly shared it with us. I might add that we did not get much sleep."

As to weather conditions he says: "The weather conditions were not at all favorable for observation. It was cool at night, hot during the day and always damp. We could see nothing from dawn until about eleven o'clock on account of the heavy blanket of mist always covering the country. We were so high that most of the time we were above this blanket of fog."

Under the heading of "General Notes" Lieutenant Anspach says: "Our communications were the greatest source of worry. Repair gangs, operating from both ends, could not keep over two lines in working order, and once the entire system was out of commission for twenty-four hours. The principal cause was shell fire. The telephone men did excellent work through all this time, working night and day. On one occasion we had just begun to register when all our lines were cut, but as it was caused by shell fire near the O. P. we were quickly in communication again.

"Two French observers established an O. P. in the church steeple three hundred yards to our rear, and the second day they were both killed by shell fire. Just across the road from us was the house where the Crown Prince erected his famous periscope to view the Battle of Verdun. I refer to Signal Corps Photo 24863. This building was not fired on a single time while I was there, and the Corps Artillery used it safely for an O. P. Our wall was considered a good registration point by the Germans, for they frequently used it as such. They evidently did not suspect our presence, for we never suffered a real shelling. The road leading to the rear passed very close to the O. P., and was often used by trucks and wounded. Whenever any of them started up the hill we knew that we would get a few shells, but as most of them went wide no damage was done. They drove us into our little dugout only three times, and the closest they ever came to us was three yards. We were covered with dirt and badly scared but not hurt in the least.

"The only firing we were able to do was on fleeing targets at a

range just within the limit. The time of flight as I remember it was 47 seconds. Here is the method we used:

"The guns (eight of them) were registered on a sharp curve in a road that came over a hill and disappeared in a deep ravine. The curve was about 500 yards from the top of the hill, and a heavy wood cut off the view of the road for a slight distance. As a target appeared we estimated the speed and fired the guns accordingly. The guns were always loaded and laid on this point unless they were engaged in some special mission. After about three days the Germans quit using this road. I suppose we had scared them off, but the damage we did was not great. Only three or four motor convoys, a few horse drawn vehicles and three companies of infantry were our only targets. We only obtained a few direct hits for the targets displayed great reserve speed after fire was opened and were quickly gone. It was most fun firing on the infantry, they would scatter like partridges at the first salvo.

"The only enemy artillery we detected in action was to the east, out of our territory entirely, and a lot came from east of the Meuse. The Germans as a rule made excellent use of the many deep ravines and kept their movements well hidden, much to our disappointment. I must confess that we did not keep under cover as much as we should, and the enemy was always ready to fire on the slightest provocation. The walking wounded suffered most. Poor devils, they always took the most visible route to the rear, and many never reached there for that reason. I saw a number killed when it was impossible to warn them of their danger. The town of Montfaucon was under almost constant fire, but as we were on the extreme edge I think we suffered as little as anyone. I remember a Colonel of the Corps Artillery who slept in a little summer house right in the middle of the town and was not hurt. The officer whose bedding I shared was on his staff, so I had full details and considered him an exceedingly brave if not a wise man.

"As to the details of our work, we would take turns observing and plotting. The best observer I ever knew was a man about fifty who was a professor of mathematics in a university somewhere in Wisconsin, I met him the day I opened the O. P. He was only a sergeant, but he could take a pair of field glasses and a map and tell you more in five minutes than you could find out in a day.

"I remember very well just when the picture was taken, for at that time there were spies on the mountain, and we had been rather closely questioned by some officers who were sent to investigate. Therefore I made the photographer show his credentials before telling him who we were. At the time the picture was taken we were trying to establish a point for registration, and we were having a hard job, I am using the instrument and Lovejoy is plotting the

point. I quote below a paragraph from the letter I received from the Signal Corps when they sent me a copy of the picture.

"'24863 Lieut. S. G. Anspach, One Hundred and Fifteenth Field Artillery, Fifty-fifth Brigade, Thirtieth Division,[2] taking observation. Under him is Lieut. J. S. Lovejoy, One Hundred and Fifteenth Field Artillery, Fifty-fifth Brigade, Thirtieth Division, getting messages and returning them to headquarters. This is the highest altitude in this section. Montfaucon, Department of Meuse, October 2, 1918.'

"You will notice that he assigns Lovejoy to the regiment and me to the brigade. The reverse is correct. The exact location is the last house, on the road leading towards the enemy, on the right hand side. This road runs through the village along the crest of the hill."

Italian Light Field Artillery Matériel

SERVICE REPORT

1. THE following report is submitted to comply with the desire of the Chief of Field Artillery for certain information, as contained in Proposed Standing Instructions for Military Attachés.

2. The tendency in design of new field artillery is to obtain increased power. The present amount of mobility, although considered satisfactory, should not, according to the best Italian thought, be reduced. It is considered possible to add power and muzzle velocity without making any changes in the gun or its carriage by improvements of ammunition. It is considered very necessary to make exhaustive studies and experiments on the designs and materials used in projectiles, as well as to obtain propelling charges whose progressive burning will be such an improvement over the burning of charges heretofore used that the thickness of the walls of projectiles can be diminished and the maximum pressure within the gun attained without unnecessary shock. As to weight of light field artillery, it is considered necessary to have the guns and caissons readily pulled by two pairs of horses; three pairs are considered preferable and are provided, but it is felt that in time of war much of the pulling will have to be done by four horses instead of six. For this reason, the present weights behind the team should not be increased in order to get more power and weight of matériel.

3. Italian field artillerymen are absolutely convinced that the field piece must have a very wide traverse and high elevation. These qualities are not only desirable but are considered essential. It must be remembered, however, that Italian warfare in the past has been

[2] The 55th F.A. Brigade was assigned to the 30th Division but never served with it.—EDITOR.

to a great extent in the mountains and, as her new frontiers are all high in the air, it is felt that future battles will also be on mountainous terrain. It is stated that one of the chief advantages of high elevation is that batteries can occupy positions which under other circumstances could not be fired from. It was found that frequently the most desirable positions to fire from were on slopes which declined steeply towards the enemy. If the guns were not provided with split trails the spades would be so high that the gun could not shoot anywhere but straight down the slope, to say nothing of clearing the covering crests.

4. A wide traverse is considered essential for both open and trench warfare. In the first case it facilitates prompt opening of fire upon targets of short duration; in the second case, it allows the piece to take part in barrages in different sectors without undue effort and loss of time.

5. It is interesting to note the enthusiasm of all Italian artillerists for the Deport type light field piece. Since Italy fought the war with the split trail this is considered important. Italian artillerymen invariably state that if they had been equipped with French 75's or other non-split trail light gun they would have been badly handicapped.

6. It is anticipated that the field gun will be used against airplanes. This, however, will be exceptional. Regulations for firing field guns against airplanes were worked upon before the war but never well tried out. Probably some time in the future a board will work upon this use of light field guns with a view to determining the best methods of firing against airplanes in case of necessity.

7. The calibre howitzer to be used as companion piece of the light field gun is 100-mm.: its name is 100/17 Model 1914 howitzer. It is considered an excellent piece of artillery. It has a top carriage traverse of ± 50 mills; the shield overlaps the wheels. The gun proper weighs 386 kg. It has four kinds of ammunition:

i. Model 1914 shell; weight 16.5 kg; loaded with picric acid, trotyl, or compressed toluolammonal. It is provided with a fuse with or without delay;
ii. Model 1915 shell; weight 13.5 kg; loaded with trotyl or compressed toluolammonal; double effect fuse;
iii. Model 1914 combination shrapnel and shell with iron or lead bullets; bursting charge, trotyl or black powder. Special model 1914 fuse, for universal ammunition; weight 11½ and 13½ kg.
iv. Shrapnel, Model 1914, with iron or lead bullets and a rear charge of black powder of .125 grams; double effect fuse; weight 11½ or 13½ kg.

8. This howitzer has been adopted recently and each regiment of divisional artillery is provided with one group of batteries equipped with the 100 mm., Model 1914 howitzer. The outstanding reason why this model was chosen is the fact that it cost the Government nothing, for they were all captured from the Austrians. The Italians know, also, that it is a very effective weapon, for they were under its fire throughout a great part of the war. Some modifications, it is understood, have been made before issuing the howitzer to the regiments. These will be reported upon as soon as learned.

Ordnance Notes*

4.7-INCH GUN—155-MM. HOWITZER MOTOR CARRIAGE, MODEL 1922

THE design of a motor carriage upon which will be mounted interchangeably either the 4.7-inch gun or the 155-mm. howitzer is nearing completion in the Ordnance Office. The design studies and general drawings are being made in this office and detail drawings will be made at Rock Island Arsenal where the pilot carriage is to be constructed. It is expected that this motor carriage will be ready for test the early part of the summer, 1922.

Two preliminary designs of this motor carriage have previously been made, one by the Ordnance Office and one by the Holt Manufacturing Company, Stockton, California; both having been larger than the present design. It has been decided to reduce the size and weight as much as possible, consistent with good design.

The gun, howitzer and the recuperator are used without any change from the field carriages. A new top carriage and traversing mechanism has been developed. The frame is a built up box construction, including at the rear end a steel casting in which is carried the transmission and the gun pintle, and to which are fastened the outriggers, the track driving sprockets, and the rear spring shafts which support the frame upon the trucks. The front of the frame is supported upon the trucks through an equalizer which eliminates weaving strains due to traveling over uneven ground.

The motor carriage will be propelled by a Sterling, four-cylinder, 5¾-inch bore, 6¾-inch stroke, dual-Valve-in-Head engine with all cylinders inclined at 45 degrees, developing 150 H.P. at 1500 R.P.M. The lubrication is by pressure pump from an oil tank located outside the engine crank case. Cooling is by means of a Modine Radiator with fan and water pump circulation. Ignition is by means of a K.W. magneto with impulse starter. A Northeast Electric Starting system is provided.

The transmission has three speeds forward and one reverse. Steering is by means of a steering clutch and brake for each track drive. Both steering clutches and master clutch are of the disc type (metal to Raybestos) and are held in engagement by spring pressure.

* Reprint from *Army Ordnance* November-December, 1921.

The controls consist of a steering column, upon which is mounted the gas and spark levers, a foot pedal brake, a clutch pedal, a hand brake lever and a foot accelerator. Such controls as starting, ignition, choke, etc., are mounted on the dash at the back of the engine hood.

A single truck frame is used with a constant spring pressure applied to the front track sprocket for the purpose of keeping the track always at the proper tension.

The track construction has not been definitely decided. The Ordnance Department is in touch with experts of the Goodyear Rubber Company who are collaborating in the problem of silencing and reducing shock on the track.

This motor carriage will have a maximum speed of twenty miles per hour at 1800 R.P.M. of the engine.

Total weight of Motor Carriage (estimated)	20,000 lbs.
Total length of Howitzer	150 inches
Weight of Howitzer	4,265 lbs.
Maximum overall length of vehicle	165 inches
Maximum overall height of vehicle	73 inches
Maximum overall width of vehicle	91 inches
Height of trunnions above the ground	56½ inches
Centre to centre of tracks	78 inches
Width of tracks	13 inches
Length of track in contact with ground—	
a. Minimum contact on hard surface	70 inches
b. Contact length (3-inch depression)	115 inches
App. ground pressure (on hard ground)	11.8 lbs. per sq. in.
App. ground pressure (3-inch depression)	7 lbs. per sq. in.

Road speed at normal motor speed (R.P.M. = 1500)

Low speed = 2.5	High speed = 16.5
Intermediate = 7	Reverse speed = 2.8

Maximum Traverse, degrees, 15 right; 15 left.

Maximum elevation, 60 degrees.

Horsepower per gross ton of weight ..... 15 H.P. per ton

SERVICE TEST OF DIVISIONAL MOTOR CARRIAGES

Shipment has recently been made from the Aberdeen Proving Ground, Maryland, to Fort Sill, Okla., of pilots of two types of new divisional motor carriages for service testing by the Field Artillery Board. These divisional motor carriages mount interchangeably either the 75-mm. gun or the 105-mm. howitzer of the new long-range types recommended by the Westervelt Board. Both types of divisional motor carriages were designed for sustained running speeds of from twelve to fifteen miles per hour on the road, with a maximum for use in case of emergency of thirty miles per hour on good roads. In order to effect as much economy as possible in the development of these motor carriages, guns, howitzers, recuperators and mounts as used on the regular field carriages have been utilized without modification.

The question of an armor plate shield for the protection of the cannoneers of the Divisional motor carriage against front, flanking and

overhead fire with the carriage in either the firing or the traveling position has received a great deal of thought and consideration. As yet no solution which is considered entirely satisfactory has been arrived at. An armor plate shield to satisfactorily protect the cannoneers under the various conditions becomes quite heavy and there is some question as to whether or not it would be needed at all times. A detachable, collapsible shield has been manufactured for the motor carriage Model 1920 (Holt type) and shipped to Fort Sill, Okla., where it will be tested by the Field Artillery Board in connection with the test of the carriage.

Two pilots of each of these two new types of Divisional motor carriages were manufactured. One pilot of each type will be tested under direction of the Chief of Field Artillery and the other by the Ordnance Department at the Aberdeen Proving Ground, Maryland. This arrangement affords the opportunity for a very complete and comprehensive test of the present stage of development of the Divisional Motor Carriage as both types will undergo a test of an engineering nature at the Aberdeen Proving Ground and an actual service test by the Field Artillery where not only weaknesses or shortcomings due to design will be developed but also the advantages and disadvantages of various design features from the viewpoint of troops utilizing the matériel in service.

The 75-mm. gun—105-mm. howitzer motor carriage Model 1920 built at the Stockton, California, plant of the Holt Manufacturing Company follows the general lines of design of the conventional "Holt Caterpillar" type of a track-laying vehicle and in addition embodies various new features necessary to insure a long life of the vehicle with the high speeds required of divisional motor carriages. The entire vehicle is thoroughly spring supported, but in order to further eliminate shock and vibration and reduce noise as much as possible rubber has been used on the drive sprockets, front idlers, track supporting rollers, the forward truck wheel and on the track shoes themselves. The application of rubber to these various parts has accomplished the desired results and has been installed without special difficulty except in the rubber pads on the track shoes. On the track shoes, the quality of rubber as well as the design of the rubber pad requires further experimentation and this problem is being considered by the Ordnance Department with one of the leading rubber companies of the country. This motor carriage complete weighs a little over 13,000 pounds.

The 75-mm. gun—105-mm. howitzer motor carriage Model 1921 embodies the Christie patented feature of a combined wheel and track laying vehicle and was built by Mr. Walter Christie at the Front Drive Motor Company, Hoboken, N. J. This motor carriage normally operates breech forward both when running on the rubber-tired wheels or when manœuvring off the roads with the tracks around the wheels. It can, however, be operated muzzle forward, although when operating on the tracks it should run only short distances muzzle forward as in this case the slack of the track is on the ground side which is not the best operation for a track-laying vehicle. The total weight of motor carriage is a little over 18,000 pounds.

This motor carriage is spring supported at the breech end only, but considerable cushioning effect is had from the rubber-tired wheels over which the track passes when the carriage operates as a track-laying vehicle. When running on the road the tracks are removed and the motor carriage operates as a rubber-tired truck. Special Overman rubber tires are used on this vehicle.

CONFERENCE ON MOTOR EQUIPMENT DESIGN

Mr. Pliny E. Holt, of Stockton, Cal., Vice-President, in charge of engineering of the Holt Manufacturing Company, recently visited the Ordnance Office, Washington, D. C., and attended the meeting of the Army Ordnance Association at the Aberdeen Proving Ground, Maryland, on October 7, 1921. The Holt Manufacturing Company is coöperating very closely with the Ordnance Department in the development of "Caterpillar" vehicles for army equipment. In conference with Mr. Holt, the latest developments and features of design of this class of vehicle, both for commercial and military uses, were discussed. Such personal contact and detailed discussion of related problems foster a close relationship between the Ordnance Department and Industry of the country and insures that commercial progress and development are incorporated in army equipment.

105-MM. HOWITZER CARRIAGE M 1921 E

A carriage for the 105-mm. Howitzer, Model of 1920 M2-E, has recently been completed at this Arsenal.* It is known as the 105-mm. Howitzer Carriage, Model of 1921E, and is a companion carriage for 75-mm. Gun Carriage, Model of 1921E.

The new carriage is lighter than the howitzer carriage of 1920, but uses a projectile having the same weight and muzzle velocity as the 1920 carriage. This increases the ratio of projectile energy to weight of howitzer and carriage 24 per cent., which is desirable.

A preliminary proof-firing program has been completed in order to adjust the recoil mechanism and parts of the carriage. The first shot indicated that the length of recoil was too great and the counter recoil was too slow. The length of recoil was shortened by changing the lift of the throttling valve and the time of counter-recoil changed by enlarging the orifice of the buffer valve.

A point of interest in this recoil mechanism is the aluminum regulator body which has always heretofore been made of high-grade steel. Difficulty was encountered in obtaining a piece of aluminum which was sufficiently dense and free of blow holes. An Ami forging was obtained of the Aluminum Manufacturers, Inc., which in every way met the requirements. It was easily machined to the high finish and narrow limits required by this piece. The use of aluminum reduced the weight of the piece to one-third that of a similar steel piece.

The use of this metal to replace steel for such parts of the recoil mechanism as glands, followers, stuffing boxes and piston bodies is being considered.

* Rock Island Arsenal.

Two types of equilibrators are furnished with this carriage. One of them is the ordinary spring equilibrator which employs helical springs to overcome the preponderance of the howitzer. The other is a pneumatic equilibrator which employs compressed air. The preliminary tests made at this Arsenal were not extensive enough to determine the merits of each type. The spring equilibrator gave the lightest hand wheel pull. It is thought that by adjusting the pressure in the pneumatic type the pull could have been made the same.

STATUS OF TRACK-LAYING VEHICLE DESIGN

Development of motor vehicles of the track-laying type by the Ordnance Department dates back only to March 2, 1916, when a Board of Officers met at Fort Sill, Oklahoma, and made definite recommendations for the production of track-laying or caterpillar vehicles for artillery purposes. Commercial tractors slightly modified by the Ordnance Department were procured and turned over to a battery of field artillery. The performance of these vehicles furnished the War Department with basic information for the vehicles that were to be developed from then on and up to the present time. The first production tractors built under Ordnance specifications were ordered in the fall of 1917 and were known as the Five- and Ten-ton Artillery Tractors, Model 1917. These tractors, which were armored against shrapnel fire and had a speed of from five to eight miles per hour, were used throughout the World War with satisfaction.

Modern warfare requires speed. The five-ton and ten-ton types traveled at a greater speed than most automotive engineers believed possible prior to their development, but they do not travel fast enough. Twelve to fifteen miles per hour is the speed required for artillery tractors of the immediate future. This means resilient or rubber cored track rollers and springing the vehicle similar to commercial truck practice or developing convertible vehicles which can be changed from track-laying to conventional wheeled vehicles in a very short period of time. Experimental vehicles of the latter type have been built and test runs made with a certain degree of satisfaction.

It is the belief of the Ordnance Department that, with rubber cored track rollers, the vehicle being properly sprung, and with an improved type of track, vehicles can be produced which can run on tracks at a speed from fifteen to eighteen miles per hour either on or off the road and have sufficient life to warrant their production. Rubber-cored track rollers have been developed that will stand up, relieve metal fatigue and reduce common tractor shocks to a minimum. Track development is progressing rapidly and it is hoped that in the near future tracks will be produced which will have a life of approximately 2000 miles or better. Already light vehicles of from 200 to 2000 pounds have been constructed and carried on an improved type of track that has been satisfactory to the Department. Design is now under way of a similar track for vehicles up to fifteen tons in weight and it is believed that it will be as satisfactory on the heavy as on the light vehicles already tested.

Although speed is the prime factor to govern future development

there are numerous other obstacles that must be considered. Weight is almost as important as speed and must be held down to correspond with the total load prescribed for the prime mover. Vehicles must be more stable than any vehicles produced up to the present time. This means a wide, low vehicle and as long as practicable without affecting its turning. The width of the vehicle is governed by the tread of the vehicle that is to be towed as the towed load should always track with the prime mover. The height should be reduced to a minimum but under all present designs wherein commercial motors are used the height is entirely governed by the motor height plus the ground clearance desired.

Considerable difficulty was encountered with the first vehicles produced, due to the fact that they could not cross streams which a horse could readily ford. This difficulty has now been overcome as shown by various tests that the Ordnance Department has run on the waterproofing of motors. It has proven to be practicable to waterproof commercial motors to the extent that small streams can now be forded without the slightest injury to the motors. With the adaptation of rubber-cored rollers and modern tracks the vehicles are as silent as the average commercial vehicle and it is hoped that, with other refinements now under study by the Department, tractors will be produced that will be silent in the future. 119

The Ordnance Department has been handicapped in the development of artillery tractors as there is little commercial value for the vehicles developed other than for artillery purposes. The natural trend of commercial organizations is to produce rigid construction, slow-moving vehicles to travel not over four to five miles per hour. Vehicles having a speed of even five miles per hour are in the minority, being used principally in the old fields and lumber camps. The average commercial tractor used for farm purposes has a speed of but three miles an hour or less.

The United States Field Artillery Association

Annual Meeting

PURSUANT to the call of the Executive Council, the regular annual meeting of the Association was held at the Army and Navy Club in Washington, at 4.30 P.M., December 17, 1921. The President, Major-General William J. Snow, being absent from the city, the chair was occupied by the Vice-president, Colonel George Le R. Irwin. A quorum for the transaction of business was present in person and by written proxy.

The minutes of the last annual meeting, as published in THE FIELD ARTILLERY JOURNAL, were approved.

The Secretary-Editor and Treasurer presented his annual report, as follows:

The business of the Association during its last fiscal year suffered somewhat from the depression general throughout the country, particularly in advertising patronage and in such growth in membership as might otherwise have been expected; but there was an increase of something like three hundred in the membership, and the books of the Association at the close of the fiscal year, November 30, 1921, showed that the business yielded some net profit, and considerably more than was made during the preceding fiscal year. There was no decrease in the prices necessary to pay for the materials and labor used in the manufacture of THE FIELD ARTILLERY JOURNAL; but considerable economies were effected in other ways, prominent among which was a change made in the style of THE JOURNAL by printing it in smaller type, thus reducing the size of the magazine without making any reduction in the amount of material published. There was a decrease in the income of the Association, but it was more than offset by the decrease effected by the management in the expenditures. Without counting the funds on hand at the beginning of the year, the total of the receipts of the Association was $10,838.59, and to this should be added the amounts due the Association but not collected up to the date of closing the books for the year, totalling $704.27, making the total of the business $11,542.86. The expenditures were $9,267.55, which amount is $2,275.31 less than the income, the latter amount therefore representing the profit for the year. The receipts and expenditures for the year are shown in detail in the following table:

Receipts

Balance on hand December 1, 1920	$1,046.48		
Securities on deposit	15,000.00		
		$16,046.48	
Subscriptions to THE FIELD ARTILLERY JOURNAL	$6,497.85		
Advertisements	3,605.66		
Interest on securities and deposits	564.16		
Sales of books	163.77		
Miscellaneous receipts	7.15		
		10,838.59	
			$26,885.07

Expenditures

Publishing THE FIELD ARTILLERY JOURNAL	$7,064.55		
Miscellaneous printing	202.02		
Postage	236.35		
Personal services	840.00		
Office supplies and stationery	178.54		
Refunds	10.25		
Bad checks (all redeemed)	5.70		
Books	91.56		
Telephone	8.57		
Prize essay competition, 1921 prizes	250.00		
Articles and translations	67.00		
Office rent	87.50		
Miscellaneous expenses	225.51		
		$9,267.55	
Securities		15,000.00	
Balance on hand November 30, 1921		2,617.52	
			$26,885.07

The cordial support accorded the management in the way of membership dues and subscriptions to THE FIELD ARTILLERY JOURNAL, and the many words of encouragement received, are much appreciated. There are still a number of officers of Field Artillery of the Regular Army and a very large number in the Reserve Corps and National Guard who do not belong to the Association; but it is expected that during the present fiscal year, with better times and a more settled condition of business throughout the country, the management will be able to very considerably extend the circulation and influence of THE FIELD ARTILLERY JOURNAL.

A. F. CASSELS,
Lieut.-Col., U. S. Army, Retired,
Secretary.

A committee, composed of Major E. P. King and Captain T. W. Wrenn, was appointed to audit the Treasurer's financial statement. The committee reported that the financial statement was found to be correct, and on motion the report was accepted.

The election of members of the Executive Council, which followed, resulted in the election of Major-General W. J. Snow, Colonel Andrew Moses, Colonel Oliver L. Spaulding, Jr., Lieutenant-Colonel Augustine McIntyre, from the Regular Army; Brigadier-General DeWitt G. Weld, Colonel George E. Leach, from the National Guard; and Lieutenant-Colonel Leroy W. Herron, Lieutenant-Colonel Robert L. Bacon, from the Field Artillery section of the Officers' Reserve Corps.

The following resolution was adopted: That the thanks of the Association be extended to Lieutenant-Colonel Arthur F. Cassels, Secretary-Editor, and Mr. C. S. West, for the successful conduct of the business of the Association during the past year.

After discussion of the affairs of the Association and of THE FIELD ARTILLERY JOURNAL, the meeting adjourned.

BOOK NOTICES

BATTLEFIELDS OF THE WORLD WAR: WESTERN AND SOUTHERN FRONTS. A Study in Military Geography, with Plates. By Douglas Wilson Johnson, Professor of Physiography in Columbia University, formerly Major, Division of Military Intelligence, U. S. A. With a foreword by General Tasker H. Bliss, Member of the Inter-Allied Supreme War Council, New York Oxford University Press, American Branch: 35 West Thirty-second Street. London, Toronto, Melbourne, and Bombay. 1921. Price $7.00. Review later.

RESERVE OFFICERS' EXAMINER. Based on Paragraph 162, Special Regulations No. 43 War Department, 1921. Washington, D. C., United States Infantry Association, 1921.

MILITARY SKETCHING AND MAP READING, INCLUDING PANORAMIC SKETCHING AND AERIAL PHOTOGRAPHY. By Loren G. Grives, Major, Infantry. Fourth Edition Revised and Enlarged. Washington. United States Infantry Association, 1921.